# Policies Misalignment in Pakistan:

## Implications for Output Gaps, Neutral Rate of Interest, and Debt Dynamics


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**APPROVAL SHEET**

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## Declaration

I, Muhammad Shuaib Malik, pronounce that this write-up titled "Policies Misalignment in Pakistan: Implications for Output Gaps, Neutral Rate of Interest, and Debt Dynamics," is my undertaking. I have carried it out individually under the supervision and guidance of my supervisor. I further declare that this work has not been submitted to any institution for the award of a certificate, diploma, or degree. It is undertaken in partial fulfillment for the Doctor of Philosophy degree in Economics of the International Islamic University Islamabad.

Muhammad Shuaib Malik: _____ Date: _____

## Disclaimer

The views in this publication are exclusive of the author. The author does not accept any responsibility for the validity of the evidence presented or the costs resulting from its use by third parties.

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To Allah Almighty, Lord of the Universe, be all praise and honor. He, Who sent Prophet Muhammad (sallallahu alayhi wa sallam) as the most noble of Prophets and Messengers for our guidance; may peace and blessings be upon him, his family, and his Companions.

At age 54, it was a really long journey of hardships and disappointments managing official work family life, and studies. But my perseverance has paid off. I am so thankful to Almighty Allah SWT that I have reached this stage.

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## Dedication

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## Table of Contents

**Declaration** ... ii
**Disclaimer** ... iv
**Acknowledgment** ... v
**Dedication** ... vi
**List of Figures** ... ix
**List of Tables** ... x
**List of Abbreviations** ... xi
**Abstract** ... xii
**Chapter 1** ... 1
**Introduction** ... 1
**1.1. Background of the Study** ... 1
**1.2. Significance of the Study** ... 5
**1.3. Research gap** ... 7
**1.4. Research Objectives** ... 8
**1.5. Research Questions** ... 9
**1.6. Delimitation of Study** ... 11
**1.7. Plan of the Study** ... 12
**Chapter – 2** ... 13
**Literature Review** ... 13
**2.1. Theoretical Understanding of the Objectives of the Study** ... 14
**2.2. Literature related to Output Gap** ... 17
**2.3. Literature related to Neutral Interest Rate** ... 27
**2.4. Literature related to Public Debt** ... 32
**2.5. The Rationale for the Study from Existing Literature** ... 36
**Chapter 3** ... 39
**Economy of Pakistan –** ... 39
**Macroeconomic Imbalances, Output Gaps, the Neutral Rate of Interest and Debt Dynamics – Policy Misalignments** ... 39
**3.1. Theoretical Framework** ... 39
**3.2. Understanding Economy of Pakistan in the Context of Research Objectives** ... 40
**3.2.1. Macroeconomic Imbalances** ... 41
**3.2.2. Potential Output & Output Gap: Overall and Sectoral Disaggregation** ... 42
**3.2.3. The Neutral Rate of Interest in Pakistan** ... 47
**3.2.4. Debt Dynamics** ... 51
**Chapter – 4** ... 56
**Data & Methodology** ... 56
**4.1. Data Collection and Variables Selection** ... 56
**4.1.1. Potential Output & Output Gap: Overall Economy & Sectoral Disaggregation** ... 57
**4.1.2. The Neutral Rate of Interest in Pakistan** ... 60

**4.1.3. Debt Dynamics and Implications of Policy Misalignments** ..... 61
**4.1.4. Statistical Nature of Main Variables** ..... 62
**4.2. Methodology** ..... 63
**4.2.1. Potential Output & Output Gap: Overall Economy & Sectoral Disaggregates** ..... 63
**4.2.2. The Neutral Rate of Interest in Pakistan** ..... 70
**4.2.3. Debt Dynamics** ..... 78
**Chapter – 5** ..... 85
**5.1. Potential Output & Output Gap: Overall Economy & Sectoral Disaggregation** ..... 85
**5.2. The Neutral Rate of Interest in Pakistan** ..... 113
**5.3. Debt Dynamics and Implications of Policy Misalignments** ..... 120
**Chapter – 6** ..... 123
**Conclusions & Policy Recommendations** ..... 123
**6.1. Contributions to the Literature and the Policy Debate** ..... 123
**6.2. Main Results and Conclusions** ..... 124
**6.3. Policy Recommendations** ..... 126
**6.4. Contributions versus Limitations and Future Research** ..... 129
**References** ..... 130
**Appendix – A** ..... 136
**Building a Coherent and Detailed Pakistan National Accounts Databank** ..... 136
**Appendix – B** ..... 140
**The Economy of Pakistan – A Data-Based Description** ..... 140
**Appendix – C** ..... 148
**Variables – Description** ..... 148
**Appendix – D** ..... 157
**Rationale for Using ARDL** ..... 157
**Appendix – E** ..... 159
**Assessing Long-Run Relationship - Cointegration Analysis** ..... 159

## List of Figures

Fig – 3.1: Historical Growth Performance (Real GDP Growth %) ..... 41
Fig – 3.2: Growth Performance of GDP - Production Side ..... 43
Fig – 3.3: Trend Interest Rate and Inflation Rate ..... 49
Fig – 3.4: Trend Interest Rate and LSM Growth ..... 50
Fig – 3.5.a: Public Debt (Rs Billion) ..... 53
Fig – 3.5.b: Public Debt to GDP Ratio ..... 53
Fig – 5.1.1.a: Inverse ICOR Total of Economy ..... 89
Fig – 5.1.1.b.i: Inverse ICOR Agriculture ..... 91
Fig – 5.1.1.b.ii: Inverse ICOR Industry ..... 92
Fig – 5.1.1.b.iii: Inverse ICOR Services ..... 93
Fig – 5.1.2.a: Relationship of Potential Output with Actual Output ..... 94
Fig – 5.1.2.b.i: Relationship of Potential Output with Actual Output (Agriculture) ..... 96
Fig –5.1.2.b.ii: Relationship of Potential Output with Actual Output (Industry) ..... 98
Fig – 5.1.2.b.iii: Relationship of Potential Output with Actual Output (Services) ..... 99
Fig – 5.1.2.c: Aggregate and Sectoral Potential Outputs ..... 100
Fig – 5.1.3.a: Relationship between Output Gaps ..... 101
Fig – 5.1.3.b: Performance of Sectoral Output Gaps ..... 102
Fig – 5.1.4.a: Impact of Monetary Policy (Policy Rate) ..... 109
Fig – 5.1.4.b: Impact of Fiscal Policy (Primary Balance to GDP Ratio) ..... 111
Fig – 5.2. a: Observed versus equilibrium rate of interest ..... 115
Fig – 5.2. b: Observed minus equilibrium rate of interest ..... 115
Fig – 5.3: Relationship between Disequilibrium in Policy Rate & Trade Balance ..... 117

## List of Tables

Table – 2.1: Methods to estimate PO and OG with Short Description ..... 25
Table – 4.1: Variables Used in Analysis of Potential Output & Output Gap ..... 57
Table – 4.2: Variables Used in Analysis of Neutral Interest Rate ..... 60
Table – 4.3: Variables Used in Debt Analysis ..... 61
Table – 4.4: Statistical nature of main variables ..... 62
Table - 5.1.1.a: Estimated Result of Overall ARDL Equation ..... 87
Table – 5.1.1.b.i: Estimated Result of Agriculture ARDL Equation ..... 89
Table – 5.1.1.b.ii: Estimated Result of Agriculture ARDL Equation with Restriction ..... 90
Table – 5.1.1.b.iii: Estimated Result of Industry ARDL Equation ..... 91
Table – 5.1.1.b.iv: Estimated Result of Services ARDL Equation ..... 92
Table – 5.1.1.b.v: Relationship between Estimates ..... 93
Table – 5.1.2: Correlations between growth rates of potential GVA (t-stats in parentheses) ..... 100
Table – 5.1.3.a: Correlation Matrix (t-stats in parentheses) ..... 102
Table – 5.1.3.b: Correlation Matrix with lag in Agriculture (t-stats in parentheses) ..... 102
Table – 5.1.4.a: VAR Model to Estimate the Sectoral Effects of Economy-Wise Shocks ..... 104
Table – 5.1.4.b.i: VAR Model Estimating Sectoral Effects of A Monetary Policy Shock ..... 105
Table – 5.1.4.b.ii: VAR Model Estimating The Effects of A Monetary Policy Shock on Industry And Services (Excluding Agriculture) ..... 106
Table – 5.1.4.c: VAR Lag Order Selection Criteria ..... 107
Table – 5.1.4.d: VAR Model Estimating the Sectoral Effects of a Fiscal Policy Shock ..... 109
Table – 5.2.a: Equilibrium Interest Rate ..... 114
Table - 5.2.b: Partial Adjustment Mechanism ..... 116
Table - 5.3: ARDL equation explaining the major determinants of the change in the debt ratio ..... 120

## List of Abbreviations

| | |
|---|---|
| ARDL | Autoregressive Distributed Lag |
| ARIMA | Autoregressive Integrated Moving Average |
| BOP | Balance of Payments |
| DSA | Debt Sustainability Analysis |
| DSGE | Dynamic Stochastic General Equilibrium |
| ECB | European Central Bank |
| EFF | Extended Fund Facility |
| FPAS | Forecasting and Policy Analysis System |
| FRDLA | Fiscal Responsibility and Debt Limitation Act |
| GDP | Gross Domestic Product |
| GVA | Gross Value Addition |
| HP filter | Hodrick-Prescott (HP) filter |
| ICOR | Incremental Capital Output Ratio |
| IMF | International Monetary Fund |
| MMT | Modern Monetary Theory |
| OG | Output Gap |
| PO | Potential Output |
| SBA | Stand-By Arrangement |
| SBP | State Bank of Pakistan |

## Abstract

Stabilization-focused contemporary monetary policy reaction functions govern the short-term interest rates to address deviations of output from potential and inflation from target. These are used to achieve targets of both output and inflation. However, fiscal policy primarily concerns meeting budgetary targets and keeping public debt within sustainable boundaries. These policy frameworks aim to stabilize the economy in the short run and provide an enabling climate for long-term growth. However, sectoral output gaps and their policy implications receive little attention, particularly in Pakistan. Similarly, academic economic literature extensively discusses neutral interest rates, but Pakistan has yet to conduct any study on this topic. This study examines the sectoral output gap, neutral interest rate, and debt dynamics.

We hypothesize that monetary and fiscal policies that use the aggregate output gap as an indicator of economic activity may not work efficiently. The effects of the two policies may differ across different sectors of economic activity, making the aggregate output gap a poor policy indicator. The issue is crucial for a country like Pakistan, where the underdeveloped agriculture credit market means that changes in monetary and fiscal policy instruments may not have symmetrical effects on agriculture and other sectors of the economy.

This study employs a variety of methods to analyze its subjects. The share of gross fixed capital formation in gross value-added and inverse incremental capital-output ratios shows how much potential output growth and output gaps there are in the economy as a whole and different sectors. We used Structural Vector Autoregressive Models to estimate the effectiveness of fiscal and monetary policy in stabilizing the output gap, and we estimated impulse response functions to establish short- and long-term policy multipliers for Pakistan's economy by identifying appropriate restrictions. We computed the equilibrium interest rate using an autoregressive distributed lag framework. Finally, we calculate the debt equation within the ARDL framework for debt analysis. The thesis conducts an annual analysis covering the period from 1981 to 2022.

We find a significant relationship between each sector's potential gross value addition and the aggregate potential output growth. However, industry and services have a stronger relationship than agriculture. Surprisingly, the output gaps in agriculture do not correlate with those in industry and services. There is a significant connection between the output gaps in industry and services. Monetary policy has considerable influence on overall and industry and services output gaps, whereas fiscal policy has smaller effects on overall and all sectors' output gaps. When looking at the "Neutral Rate of Interest," it is clear that the policy rate has been fluctuating for a long time, either above or below the equilibrium level. The departure of the policy rate from equilibrium appears to harm the overall production gap, along with industry and services gaps. Furthermore, a positive correlation exists between the trade balance and the interest rate gap. Finally, in debt analysis, we find that the primary balance is the principal tool for managing the debt-to-GDP ratio. A primary balance surplus of 1 percentage point reduces the debt-to-GDP ratio by 1 percentage point of GDP. Under unchanged conditions, nominal GDP growth and debt costs have similar but opposite effects on the debt ratio. A 1% nominal GDP increase reduces the debt ratio by 0.51%. However, a one-percentage-point rise in debt costs raises the debt ratio by 0.54 percent. Interest rates on domestic and foreign debt, as well as exchange rates that convert foreign currency debt payments and the total amount of foreign currency debt into domestic currency, affect debt expenses. Thus, interest rate and exchange rate misalignments dramatically affect debt ratios.

This thesis suggests using sectoral output gaps as better indicators of economic activity and coupling monetary and fiscal policy decisions with sector-specific policy interventions. Policy mistakes cause boom-bust cycles, galloping inflation, and unstable debt dynamics. To sustainably boost economic growth, the country must rebalance its spending priorities, shifting from consumption-driven expenditures to strategic investments.


Keywords: Output Gap, Neutral Rate of Interest, Debt

JEL Classification : E12, E13, E31, E32, E43, H63

# Chapter 1

## Introduction

This study aims to investigate the misalignment in macroeconomic policies and its impact on macroeconomic instabilities in Pakistan. It focuses on the monetary and fiscal policies, which always relied on biassed aggregate parameter estimates. As a result, there was a squeeze on fiscal space and a significant debt burden. Macroeconomic instabilities occur whenever key macroeconomic indicators deviate substantially from their equilibrium paths. Usually, these deviations are addressed by implementing appropriate economic policies, notably tailored monetary and fiscal measures. The research aimed to identify and quantify deviations from equilibrium and the optimal policy responses, comparing them to policies put into practice. These lessons from the past can inform policymakers, helping them avoid repeat mistakes in the future.

### 1.1.Background of the Study

The output gap gained prominence in the 1960s as a crucial metric for assessing economic activity, when Keynesian theories held significant sway. Economists such as Okun and Heller were instrumental in formulating this concept. The contributions made by both Okun and Heller to the notion of the production gap were crucial in influencing policymakers during the 1960s. Okun's research mostly focused on quantitatively measuring the output gap, but Heller mainly focused on attaining full employment and eliminating the output gap. Heller emphasized on this notion which aided policymakers in comprehending its significance in achieving economic success[1].

During the monetarist era 1980s, central banks started to prioritize inflation targeting and monetary policy rules, leading to the increased importance of the output gap as a policy tool. Similarly, within the New Keynesian framework in the 1990s-2000s, the primary focus was on the output gap, highlighting the significance of aggregate demand and monetary policy in maintaining economic stability. During the 2008 Global Financial Crisis, policymakers relied on the output gap to inform their decision-making process. They used this measure to quantify the difference between actual and potential economic production, which helped them devise appropriate fiscal and monetary

[1] Heller, W., Gordon, K., Tobin, J., 1961. The American economy in 1961: problems and policies. In: January 1961 Economic Report of the President and the Economic Situation and Outlook, Hearings before the Joint Economic Committee, Congress of the United States, U.S. Government Printing Office, Washington, DC

policies in response to the crisis. Even after the 2008 financial crisis, the output gap has remained an important term in policymaking. Central banks and governments still rely on it to evaluate economic performance and make policy decisions.

The output gap continued to be the key priority in policy formulation. Output gaps serve as a crucial measure of market inefficiencies and the necessity for economic stabilization. Policy interventions are implemented to reduce the difference between actual and potential production, stimulate economic growth, and generate employment opportunities. Keynes placed significant emphasis on the significance of aggregate demand and government action to remedy gaps in production. He contended that government expenditure and fiscal policy may effectively mitigate production gaps in times of economic downturns. Similarly, both activists and monetarists take into account production gaps when making their policy suggestions. Activists promote the use of fiscal policy to eliminate output gaps, while monetarists propose that output gaps may also be addressed by interest rate changes using monetary policy. In addition, policy frameworks that are built on rules, such as Taylor's Rule, expressly include output gaps in their policy rules. Conversely, discretionary policy takes into account production gaps as one of several criteria when making policy decisions. Taylor's Rule utilizes the production gap, in addition to inflation, as its two primary factors to calculate the optimal interest rate setting.

Nevertheless, it is worth noting that the use of the Aggregate Output Gap in policymaking is associated with several drawbacks, such as simplicity, lack of granularity, and a uniform approach that may not be suitable for all situations. In addition, measures that rely simply on aggregate production gaps may not effectively tackle specific sectoral difficulties. The aggregate production gap might result in a standardized policy approach, disregarding the varying requirements of different sectors. Therefore, it is crucial to accurately assess the differences between actual and potential production levels in certain sectors. Policymakers may enhance economic results by analyzing sectoral production gaps and formulating more informed, effective, and targeted policies to tackle specific economic issues and opportunities. Therefore, the benefits of using the Sectoral Output Gap are:

1. Detailed analysis: Sectoral production gap offers precise information regarding individual industries or sectors.

2. Targeted policies: This allows policymakers to create policies that focus on certain sectors and may effectively address the unique issues faced by those sectors.
3. Optimal resource allocation: Facilitates the effective distribution of resources, prioritizing sectors that have the highest potential for growth.
4. Enhanced policy efficacy: The existence of a sectoral output gap results in policies that are more successful, since they are customized to address the individual demands of each sector.
5. Improved economic comprehension: Offers a more profound understanding of the structure and development of the economy.

Globally, central banks have utilized interest rates to manage fluctuations in the output gap. Interest rates play a crucial role in shaping various economic factors, including aggregate demand, productivity, the money multiplier effect, and inflation. Deviations from the neutral interest rate can significantly impact macroeconomic stability. This research proposes that relying solely on aggregate output gap measures for policymaking may neglect sectoral-level performance. Moreover, increasing interest rates beyond the neutral rate may exacerbate economic strain by increasing debt servicing costs, rather than achieving the intended corrective effects. Thus, resulting in the ballooning up of the public debt.

From an economic perspective, Pakistan has frequently experienced significant strain, characterized by low foreign reserves, a depreciating currency, high inflation, and unsustainable growth. Since independence, the economy of Pakistan has always been in vicissitudes situations. Occasionally, it happens that economic growth surpasses its potential. However, this high growth resulted in increased consumption which in turn influenced domestic prices, exchange rates, and foreign reserves. Thus, economic imbalances became so severe that International Monetary Fund (IMF) programs became the only viable choice. A combination of factors, including fiscal policies generating large deficits, lenient monetary policies, and the preservation of a strong exchange rate, have driven up spending and boosted economic growth in the short term. Analyzing the historical output growth in Pakistan, it is found that the components of growth from the production side are the services, agriculture, and industrial sectors.

The output growth especially in its initial years was heavily dependent on agriculture which is susceptible to the vagaries of nature Mohey-ud-Din & Siddiqui, (2016) found

that fluctuations in GDP are dependent on the performance of agriculture. Further, the direction and the size of the change in agriculture performance were augmented by the industrial sector, especially textiles being also dependent on agriculture. It was stated that the significant determinants of GDP fluctuations included aid dependence, trade openness, volatility in the price level, reliance on agriculture, and political stability. It was proposed that managing these determinants could help reduce the volatility in the GDP growth rate. For the last few decades, the services sector has emerged as the primary sector responsible for growth. However, the variations in the economic activities were compounded by inadequate attention to sectoral policy interventions and their timing as well as their differential impact. It has been found that along with effective implementation, a better research-based policy understanding of some fundamental constraints and the regional variations in factors such as the declining size and fragmentation of operated farms, rural poverty, and the levels of market development and institutions is essential (Malik, Sheikh, & Jilani, 2016). Broader more generalized policies have not and will not be effective.

As discussed earlier, the aggregate output gap is generally considered an indicator of inflationary pressure in the economy. It is considered an important link between the real side of the economy and prices. Thus, historically, whenever the overall output gap became positive, emergency measures were put into place to slow down the overheated economy. With slower growth, the resulting strains were on revenue collection, and then on keeping the budget deficit under control, and as a result, development expenditures would be reduced. However, misaligned policies to cool the economy not only contributed to an increase in the volatility and increasing size of the basic macroeconomic imbalances along with the ballooning of public debt (International Monetary Fund [IMF] Staff Report, 2023).

It is pertinent to mention that in economic literature little attention has been given to the sectoral output gap in the context of policy implications and no study is currently available for Pakistan. Likewise, neutral interest rates have gained popularity in recent economic literature but no research has been made for Pakistan. The concept of a neutral interest rate is mostly used/discussed in terms of the policy rate (modeled through a Taylor or other rule). It is a crucial benchmark for the central bank's interest rate setting. It is part of the new Keynesian approach in which long-term growth is based on neoclassical theories and short-term cycles (output gaps) occur because of the

Keynesian thesis that wages and prices are not completely flexible in the short run but take time to adjust due to contracts etc.[2]

This study, therefore, examined the misalignment in macroeconomic policies, particularly the monetary and fiscal policies, that have contributed to macroeconomic instabilities in Pakistan with a focus on the sectoral output gap, neutral rate of interest, and debt dynamics; three distinct but interrelated aspects of the complexity behind the historical inability to keep Pakistan on a steady stable path of growth.

### 1.2. Significance of the Study

The research is inspired by the need for a better analytical understanding of Pakistan's economy and the required policies for its optimal growth. Modern macroeconomic analysts agree that past fluctuations were not cyclical. Major seasonal variations like business cycles if predictable are easier to handle in the design of policy instruments. However, unpredictable disturbances cause the economy to fluctuate as the economic disruptions spread. The business cycle's proximity to an economy's long-term potential output is the focus of attention for economists and policymakers. They follow the GDP trajectory and depart from its potential. The output gap measures the difference between an economy's real and potential output. Potential production is an economy's maximal output at full capacity. Thus, policymakers, notably central bankers, prioritized predicting potential production and output gaps. In monetary policy analysis, the output gap shows how far the economy is from its greatest productive capacity. Due to its impact on inflation, the production gap can also inform policy decisions. An economy experiencing a positive production gap is characterized by excessive production, leading to inflationary pressures. A negative output gap is indicative of economic instability and serves to depress inflation. A positive output gap prompts central banks to increase interest rates to cool an expanding economy, while a negative output gap necessitates monetary stimulus. The neutral rate of interest becomes important here. The neutral rate of interest, also known as the natural rate, is the inflation-adjusted interest rate that supports full employment and maximum output while stabilizing inflation. It is mentionable that a sustainable fiscal policy allows fiscal deficits that do not lead to explosive debt dynamics.

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[2] Taylor, J. B. (1993). Discretion versus policy rules in practice. Carnegie-Rochester Conference Series on Public Policy, 39, 195-214.

The long-term growth trajectory of the economy is influenced by the supply side, within individual sectors, and in aggregate. Designing policies to address the aggregate output gap may lead to misleading outcomes. The sectoral analysis is preferable to an aggregate approach due to significant variations in sectoral behavior. Interdependencies exist among sectors. A portion of the agricultural output is allocated for final consumption, while another portion is utilized for intermediate consumption in the industrial sectors. Pakistan's industrial sector is based largely on agricultural output. Thus, not only sectoral relevant policies but also their timing and sequence need to be considered. Also, relying solely on demand-side policies, such as interest rate policy may not effectively achieve the intended objective. Demand management policies that are not properly aligned can lead to internal and external imbalances, contributing to economic instability characterized by boom-and-bust cycles, heightened uncertainty, and constrained investment decisions.

The country's output gap estimate allows it to identify cyclically neutral expenditures, revenues, and overall fiscal balances. They are therefore a vital analytical element in evaluating the fiscal stance at any moment in time. However, if the real interest rate beats the real growth rate, then for maintaining a stable Debt to GDP ratio, it is requisite that, the primary balance must be positive. In Pakistan, the rigid structure of the fiscal sector has undermined the government's ability to adapt to evolving circumstances. Additionally, the lack of coordination between fiscal and monetary policies has further contributed to this destabilization (Burki, 1996, Sherani, 2008). These observations show that at times, Pakistan has experienced policy conflicts. When inflation was excessive or the BOP was in unsustainable deficit, the SBP raised interest rates above their equilibrium level, thereby causing an excess burden on the financing cost of domestic debt. Since the law on the independence of the SBP, domestic debt needs to be financed at market rates. Strong increases in domestic interest payments reduce the room for the conduct of a real fiscal policy. The essential task of policymakers is to avoid as much as possible such disequilibria in the economy[3].

Historically, Pakistan has been plagued by frequent economic crises, forcing the country to seek financial assistance and expert economic guidance from the International Monetary Fund (IMF). Finding out why this has happened and how to

[3] Of course, unexpected and exogenous shocks occur, which require the input of policies to steer the economy back to its equilibrium path.

prevent it from happening again is, therefore, the main question. Effective answers to these problems based on macroeconomic analysis are required. From this perspective, the thesis's originality and significance come from its emphasis on differentiating between the sustainable route—the country's equilibrium path—and the unsustainable path—any departures from this path. The thesis achieves this goal by distinguishing between states of equilibrium and disequilibrium in three important areas of macroeconomics. Potential (long-term) economic growth and sector-level output gap variations are the subject of the first. The second one looks for interest rate deviations from equilibrium as well as the equilibrium rate itself. The third one investigates where the dynamics of the national debt came from and how to return them to a legally mandated and sustainable operational aim. Policy actions that are essential to maintain the economy as near to the equilibrium macroeconomic path are the central focus of this thesis after these equilibria and disequilibria have been identified. Historically, vicious macroeconomic cycles have been fueled by incorrect policy. Based on an analysis of Pakistan's accessible macroeconomic papers, this thesis takes a fresh tack in the country's policy discussion.

### 1.3. Research gap

Historically, it has been observed that high growth momentum always becomes unmanageable and does not remain sustainable in Pakistan (see Appendix B). Typical macro models focus on aggregate GDP. The estimation of the Output Gap through aggregate macro modeling remains inadequate mainly due to assumptions underlying macroeconomic aggregation of the variables and their implicit static interactions. Further, internal financing constraints significantly impact sustainable sectoral output creating gaps between potential and actual. The inability to precisely model the output gap and potential growth trajectories and generate viable predictions for policy has been a major policy and implementation bottleneck.

Inadequate technical integration of various policies and aggregative politically determined interventions not in line with existing economic realities add to the complexities of the policy misalignment. This study is devoted to providing an improved empirical econometric understanding of these gaps based on an in-depth disaggregated analysis of Pakistan’s economy.

Typical macro models are aggregate. The estimation of output through aggregate macro modeling remains inadequate mainly due to assumptions underlying macroeconomic

aggregation and their implicit static interactions. These create gaps between reality and the predictions which are the basis of policies. For example, the "Residual Growth or Solow Residual" to Dynamic Stochastic General Equilibrium (DSGE) models (Christiano, et.al., 2018) inspired by Lucas' Critique (Lucas, 1976) and the more recent Forecasting and Policy Analysis System (FPAS), are generally used to estimate aggregate output. Central banks then use these output predictions from these models to stimulate economic growth using interest rates as a major tool for determining the equilibrium supply of money for maintaining the price level (inflation), based on expectations; and, through the price level influence the desired rate of growth of the economy.

These gaps between actual and predicted potential output create pressures within the economy. Adjustments create pressures on internal and external financing. Not only, does monetary policy become inadequate but the financing of the Government budget deficit to address these gaps using non-monetary financing is also impacted by high-interest payments and the restricted fiscal space thus pushing the country into increasing debt. The external financing constraint also further impacts sustainable financing of the current account deficits in the BOP. These macroeconomic imbalances along with inadequate foreign reserves then push the country into IMF (International Monetary Fund) programs. As already mentioned, available research on Pakistan indicates there is a gap because the sectoral Potential Output has not been assessed, and the natural rate of interest has not been seen through the fiscal side. Thus, the implications for debt sustainability have not been estimated in this way. It is noted that fiscal policy becomes a problem if most of the revenue is spent on perpetual debt financing. Thus, there is a need for an accurate estimation of potential output for major sectors of the economy of Pakistan. Further, there is a need to estimate the natural rate of interest. For instance, if the State Bank is following an inflation-targeting policy, it may adversely affect the fiscal side.

### 1.4. Research Objectives

The precise estimation of the output gap becomes critical for keeping the Macroeconomic, Monetary, and Fiscal policies aligned with the objective of optimal growth. It is hypothesized that the aggregate levels at which this modeling and analysis are conducted mask vast disparities across sectors and sub-sectors and thus, one-size-fits-all policies are not able to have the desired results. The overall gap must be

estimated as the weighted sum of the sectoral gaps and the impacts of monetary and fiscal policies on the growth objectives. Further, there is an intense need to estimate the equilibrium interest rate, deviations from equilibrium, and policy implications. One of the implications is on debt. Therefore, it is necessary to examine the origins of government debt dynamics and determine how to restore them to a sustainable operational target as described by the Fiscal Responsibility & Debt Limitation Act. 2022.

The research objectives therefore are:

a) To estimate sector-wise output gaps and their implications for the overall macroeconomic output gap and demand management policies.
b) To analyze the effectiveness of monetary and fiscal policies on sectoral output gaps.
c) To estimate a "neutral rate of interest" and analyze its implications for key macroeconomic variables.
d) To identify misalignments in demand management policies and their implications for overall equilibrium.
e) To estimate the stance of fiscal policy that is compatible with a stable debt-to-GDP ratio and with the equilibrium paths of economic growth and the neutral interest rate.

### 1.5. Research Questions

The following research questions are addressed in this study:

Q-1: How to estimate the long-run equilibrium paths for economic activity and growth in Pakistan's main economic sectors? Do they significantly differ from each other? What is their degree of mutual correlation? How to estimate the corresponding deviations from these long-run equilibrium paths sector-wise? Do these cyclical conditions differ among sectors? To what extent is the effectiveness of monetary and fiscal policies different among these sectors?

Q-2: How to estimate the "Neutral Interest Rate" for Pakistan? What are the consequences for sectoral economic growth and public finances when the stance of monetary policy is unduly accommodative or restrictive?

Q-3: How to estimate the stance of fiscal policies that is compatible with a low and stable debt-to-GDP ratio (as prescribed by the Fiscal Responsibility & Debt Limitation

Act. 2022) and compatible with the equilibrium growth path and with the equilibrium interest rate?

It is important to decompose the path of economic production into two main components: the equilibrium/potential path of value-added creation at constant prices and temporary deviations of production from this long-run equilibrium path. In terms of economic policies, the issue of promoting growth potential should be addressed by structural policies, which are not tackled in this study. The issues of economic imbalances, measured by the deviation of current production from potential are addressed by demand management policies such as monetary and fiscal policy. Misalignment in demand policy further adds to the imbalances instead of resolving them. Therefore, the first research question is focused on how to measure imbalances for each of the main sectors of the Pakistan economy. This is analyzed empirically by developing a supply-side theory that is inspired by neoclassical supply-side economics. This theory is empirically estimated and used to provide a quantitative estimate of Pakistan's sectoral potential outputs and output gaps

Likewise, the neutral interest rate is the equilibrium interest rate that prevails when the economic activity and its growth rate are on the equilibrium growth path and inflation is on its target. This should be the benchmark for monetary policy.

Thus, the first research question addresses the need to estimate empirically the sectorial output gaps. The output gap is an important input in monetary policy. Together with the deviation of inflation from its target (inflation gap), the output gap is a main determinant in the monetary policy reaction function. The central bank sets its policy rate above or below the neutral/equilibrium rate following the inflation and output gaps. This requires an estimation of the neutral interest rate in order. Comparing the observed interest rate with the equilibrium allowed us to evaluate the stance of monetary policy. Then the question can be addressed as to whether that stance is appropriate for bringing the economy back into equilibrium. This study estimated the path of the neutral interest rate based on money demand/supply theory and the use of empirical estimation methods.

Overall economic equilibrium requires several key macroeconomic variables to be at or close to their equilibrium levels. This guarantees economic stability and therefore reduces uncertainty and motivates investments and sound and healthy long-run growth

prospects. The research presented here focuses on three fundamental interrelated economic fundamentals; economic growth and cycles, interest rates, and sustainable public debt. According to Blanchard (2023)[4], debt sustainability is a concept that is based on probabilities. The author's preliminary operational definition is as follows: debt is considered sustainable if the likelihood of a debt explosion occurring is low, with the specific meanings of "explosion" and "low" requiring clarification. Pakistan has established the Fiscal Responsibility law to prevent debt instability and unsustainability. The Fiscal Responsibility and Debt Limitation Act of 2005 was approved on June 13, 2005 amended in 2016[5] which mandates that the debt-to-GDP ratio should be reduced to 60%.

This research is based on addressing the three questions above and in the process, highlighting potential policy misalignments in Pakistan and their implications for output - gaps (and hence steady state optimal growth), neutral rate of interest, and debt dynamics.

### 1.6. Delimitation of Study

The empirical research has by necessity involved the use of unobservable variables such as potential aggregate and sectoral outputs in the determination of the output gaps, equilibrium interest rate, cyclically adjusted fiscal magnitudes, knowledge of the country's inflation target, and monetary policy reaction function and its parameters. As always, no single optimal methodology for such estimations is available. The methods used here were pragmatic and best suited to available data supported by relevant economic theory and up-to-date empirical techniques and testing.

In this way, it is expected that useful additions to the literature on Pakistan identified in the research questions were provided.

Earlier, in Pakistan, no official quarterly national accounts data existed. However, our analysis requires a much longer sample period to obtain reliable estimates and inferences from the data. In the absence of these, we used annual data and applied statistical distribution (interpolation) techniques to convert these to quarterly observations wherever required in the analysis. It should be mentioned beforehand that

[4] Blanchard (2023), Fiscal Policy Under Low Interest rates, MIT Press
[5] https://www.finance.gov.pk/frdla2005_amended_2016.pdf

this poses a limitation that would not exist if actual quarterly national accounts data were available over a sufficiently long observation period.

### 1.7. Plan of the Study

Following this introductory chapter, the Second Chapter covers the Literature Review. In this respect, it must be mentioned that no literature is currently available concerning the estimation of potential output and output gaps on a sectoral basis for Pakistan. Nor is there available literature on the equilibrium interest rates for Pakistan. Therefore, in the Literature Review, the concepts are discussed separately along with their respective implications.

Chapter Three is on Pakistan's Economy in the Context of the Macroeconomic Imbalances, Output gaps, Natural Rate of Interest, and Debt Dynamics and provides an overview of the economy of Pakistan in the context of growth performance, macroeconomic imbalances, policy responses, and outcomes. Chapter Four provides the Research Methodology used to achieve the objectives of the study, Data Collection, and Variables Selection. Chapter Five is about Results and Discussion and Chapter Six describes Conclusions and Policy Implications.

Thus, this study is divided into seven chapters and an Annexure containing five Appendices. The first Appendix is “Building A Coherent and Detailed Pakistan National Accounts Databank”, the second is “Economy of Pakistan – A Data Based Description,” the third is “Variables Description, and the fourth is “Rationale for Using ARDL.” While last Appendix is about “Assessing Long-Run Relationship - Cointegration Analysis.”

## Chapter – 2

### Literature Review

The typical objective of a literature review is to acquire a comprehensive understanding of the research and discussions about a specific topic or field of study. The present study examines the misalignment in macroeconomic policies that have resulted in macroeconomic instabilities in Pakistan. This study specifically examines the sectoral output gap, neutral rate of interest, and debt dynamics. The interconnection of these three aspects has posed challenges in sustaining a consistent growth trajectory throughout Pakistan's history. It is worth noting that literature is scarce in the context of the theme and main idea of the study. For instance, relatively little attention has been paid to the sectoral output gap. Though, there is a significant amount of literature on the aggregate output gap, with numerous studies conducted in the context of Pakistan as well. Similarly, the concept of a neutral rate of interest, also referred to as the natural rate of interest, is not a recent development. The term "natural interest" was introduced by Eugen von Böhm-Bawerk in his work Capital and Interest, which was initially published in the 1880s. However, it is worth noting that the concept itself was first developed by the Swedish economist Knut Wicksell[6]. In 1898, Wicksell published a study where he defined the natural rate of interest. According to him, this rate would lead an economy to aggregate price equilibrium if lending was conducted without considering money. According to Wicksell, the natural rate of interest is a specific interest rate on loans that does not affect commodity prices, neither increasing nor decreasing them. The exploration of the neutral rate of interest was not undertaken in Pakistan. Furthermore, the issue of debt dynamics due to the misalignment of macroeconomic policies has not been previously discussed.

As a result, the literature in this study will deviate from the norm. The literature review provides an in-depth analysis of the existing research on the aggregate output gap and its associated implications. Next, the discussion focuses on the literature regarding neutral rates of interest, followed by debt. The conclusion highlights the sectoral output gap, the neutral rate of interest, and debt dynamics, along with their interconnected aspects.

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[6] Wicksell, K. (1898/1936). Interest and prices. London: Royal Economic Society.

## 2.1. Theoretical Understanding of the Objectives of the Study

Historically, growth accounting is the empirical methodology used to show the breakdown of observed growth of GDP into components associated with changes in factor inputs and production technologies. Potential Output always remains the focus of policy discussions. The reason is that policymakers always look at the real output and output gap (deviation of real output from the potential output) to make effective monetary and fiscal policies to gauge the level of economic activity. In economic research, the potential output gains importance by being typically defined as the level of output consistent with no pressure for prices to rise or fall.

Thus, the output gap being the difference between potential output and actual output is a summary indicator of the relative demand and supply components of economic activity while Potential output (PO) is defined as the maximum output an economy could sustain without inflationary pressure. PO is the best composite indicator for measuring the aggregate supply side of an economy. It thus gained much importance in research (Denis, et.al., 2002). The potential output can be defined as a maximum level of output when there are no imbalances in the external, internal, and financial sectors of the economy (Ódor and Kucserová, 2014, Casey 2018). Consequently, the output gap is the difference between the actual and the potential output expressed as a percentage of gross domestic product (GDP). The output gap represents useful information for policymakers. Positive gaps occur when observed output is above potential; in other words when the degree of capacity utilization is unsustainable. This may not only cause undesirable inflation but also current account deficits that may put pressure on official reserves and/or on the exchange rate. Negative gaps occur when capacity is fundamentally underutilized. This will normally go along with high degrees of unemployment. Consequently, one objective of the stabilization policy is to minimize the output gap or the gap between actual and potential output. To effectively apply stabilization policy and determine when it should be implemented, precise measurements of potential output are required[7].

Potential output is a proxy for an economy's actual output that cannot be directly measured. Regrettably, despite extensive academic research, there is still no consensus on a universally accepted measure or definition of potential output. As a result,

[7] Jahan, S., & Mahmud, A. S. (2013). What is the output gap? IMF Finance & Development, 50(3).

policymakers are faced with some uncertainty regarding one of their main objectives. The measurement of potential output and output gap frequently involves decomposing observed GDP into a trend component and a cyclical component (Beveridge and Nelson, 1981; Blanchard and Quah, 1989; King, et.al 1991; Hodrick and Prescott, 1997). Potential output is considered as the trend or permanent component while the transitory or cyclical component is referred to as the output gap. The simplest and most widely used methods for estimating potential output and output gap rely on the application of univariate or multivariate filters (Hodrick-Prescott, 1997, Christiano and Fitzgerald, 2003, Band-Pass filters, 2022). The main problem with these filters is that they are not guided by economic theory.

Whenever the output gap is zero, production equals potential, the economy is on the equilibrium path. On this path, inflation equals the inflation target, nominal and real interest rates reflect their equilibrium values, fiscal policy is cyclically neutral, and current account and fiscal balances are sustainable. However, any shock whether on the production or expenditure side, thus causes deviations from the equilibrium path, leading to disequilibrium in macroeconomic variables like inflation, BOP, employment, growth, etc. Appropriate monetary and fiscal policies, supported by structural policies are thus required to limit these deviations both in magnitude and duration. In principle, monetary policy is focused on the reduction of the estimated economy-wide output gap. Instruments of monetary policy affect the output gap and inflation through different transmission channels, such as the interest rate, exchange rate, credit, asset prices, and expectations channels.

It is important to mention that the effectiveness of these transmission channels and hence of monetary policy increases with the degree of homogeneity of output gap fluctuations over the different economic sectors. As a result, various industries may experience varied transmission of monetary policy effects on the output gap. As a case in point, monetary policy may be less effective in controlling the output gap in the agricultural sector with its inadequate credit markets and traditional structure if the shock has mainly happened in this sector. Hence, information on the differential impact of shocks on potential output and output gaps in different sectors can be useful information for the central bank's monetary policy decision in the future.

Further, like other central banks, the State Bank of Pakistan also uses interest rates as a policy instrument to address the output gap. Thus, the understanding of the neutral

interest rate becomes important which is considered as equilibrium interest at which the economy is at full employment and stable inflation. It is the rate at which monetary policy has neither a contractionary nor an expansionary effect. However, if the central bank keeps a policy rate that deviates significantly from the neutral interest rate, it may have repercussions on the economy through the fiscal side. The adverse effect of raising interest rates is restricting fiscal constraints through high-interest payments, thus increasing the current expenditure side of the government, and squeezing fiscal constraints. According to the Staff Report prepared by the staff team of the IMF on July 3, 2019, the fiscal deficit for FY 2019 was expected to be Rs. 2.7 trillion billion (7.0 percent of GDP). However, for FY 2019, fiscal deficit was recorded historically high mounting to Rs.3.5 trillion (9.0 percent of GDP). One primary reason for this increase was a significant increase in interest/markup payments (Rs. 2.1 trillion). This happened because of a policy rate reversal by the State Bank of Pakistan (SBP). Thus, increasing the interest rate by a cumulative of 750 bps in FY 2019 (13.25 percent in July 2019). This was a step considered to correct the underline imbalances in the economy and an increase in future expectations about inflation. The high-interest rate, thus, not only adversely affects fiscal deficit through current expenditures but also becomes a cause of mounting ever-high public debt (Rs. 36.4 trillion, $216.4 billion; 87.2 % of GDP at the end of June 2020). According to the Fiscal Responsibility and Debt Limitation (FRDL) Act, the fiscal deficit must be falling.

In Pakistan, historically, it has been observed that high growth momentum always becomes unmanageable and does not remain sustainable for an extended period. However, severe macroeconomic imbalances happened in 2019 when both the fiscal deficit and the current account deficit ballooned to a critical level. These imbalances along with inadequate foreign reserves then let the country into the IMF (International Monetary Fund) program. On 3rd July 2019, Pakistan signed a 39-month Extended-Fund Facility (EFF) with the IMF which is the twenty-second in the history of Pakistan. The program aims to help the country in designing strategies that can reduce macroeconomic imbalances at domestic as well as external which are structural impediments in maintaining sustainable growth. However, whenever the IMF program starts, it requires a high-interest rate and massive depreciation adjustment followed by deep structural reforms based on the aggregate output gap situation. However, using the aggregate output gap for analyzing the economic situation and following the

requisite economic policies may further worsen the condition. Thus, this study focuses on analyzing the sectoral output gap, neutral rate of interest, and debt dynamics. The interactions of these areas have presented difficulties in maintaining a steady path of growth historically. However, there is a limited amount of literature available in the context of the topic and focus of the study.

Thus, in the next section, a comprehensive review of the output gap, neutral interest rates, and debt dynamics are discussed and finally, the conclusion focuses on three distinct but interrelated aspects of these three.

## 2.2. Literature related to Output Gap

In recent years, policymaking institutions especially central banks have placed greater importance on measures of potential output and the corresponding output gaps. These measures are considered in macroeconomic projections as well as in evaluating the monetary policy stance. Usually, potential output measures are typically been based on statistical filters or the estimation of the economy-wide production function. In the context of Pakistan, it should be mentioned that many data are lacking for macro-financial modeling. For example, available income accounts do not contain information on wages, disposable income, firm earnings, etc. National Accounts (NA) data are primarily accessible through the Gross Value-Added Approach. The Expense Approach calculates private consumption as a residual. The NA data is only available on an annual basis. The State Bank of Pakistan (SBP) uses an FPAS model (Ahmad et al., 2018). This model explains the production gap, inflation, the exchange rate, and the short-term interest rate. The main concern of these models is monetary policy. However, in these models, there is no direct relationship between the output gap and the production function and, by extension, the economy's supply side. Usually, the supply side of models is based on a production function methodology. This allows for estimating the output trend of the economy's potential output, which indicates the output gap when contrasted with the observed production.

### Potential Output & Output Gap: Short Overview of Techniques & Models for Estimation

The Output Gap (OG) is defined as the (percentage) deviation between the currently observed real output value from its potential level. When the OG is positive, it means that economic activity is higher than normal. A negative OG implies excess supply due to demand falling short of normal output potential. Whereas the current actual value

added is calculated and reported in the official national account statistics, the PO and the OG cannot be observed directly. And yet, these variables are essential inputs in analysis and policy formulation. The OG indicates the cyclical stance of the economy. As such, it is an essential piece of data for central banks to have when deciding on monetary policy because it reveals the current state of the business cycle.

PO and OG have to be estimated because they cannot be observed. Measuring PO and OG is not easy, and many alternative techniques and approaches exist. Each of these approaches has its advantages and disadvantages. Univariate and multivariate filters are designed to calculate the trend component of observed real GDP. The univariate filter method utilizes a single variable at a time, whereas the multivariate approach incorporates multiple variables. The trend component is supposed to represent PO. The remaining components then represent cyclical and irregular elements. They are relatively easy to calculate and have a straightforward interpretation. But they also suffer from several shortcomings:

- They do not rely on any economic theory and therefore the calculated trends are difficult to interpret and explain;
- Some of them (such as the HP, multivariate HP, and Baxter-King filters) are two-sided filters based on past and future observations. Therefore, they generally suffer from end-of-sample problems. Most of the time, this is remedied by adding actual GDP forecasts to the time series, but this does add another degree of uncertainty;
- They are less suited to treat structural breaks. The influence of such breaks on PO is spread over several periods instead of being allocated to the exact moment of their occurrence.

Another popular model for measuring PO and OG is the production function approach. This is now the preferred method in the European Union and in many other countries and central banks (D' Auria et al 2010). It explains observed output and PO based on the movements of factors of production (labor and capital) and technological progress. It is therefore based on supply-side theory, which allows the results to be interpreted. It allows so-called growth accounting which attributes observed and potential output growth to the growth rates of the arguments in the production function. But this also implies that a prior choice as to the exact nature of the production function must be made (mostly a Cobb-Douglas production function is the preferred choice because of

its simplicity). Furthermore, the calculation of the trend movements of the production factors may require the use of univariate trend extraction filters, such as the HP filter, which suffer from end-of-sample problems.

In the following section, the Univariate HP approach and the Production Approach for measuring the PO and OG are discussed in detail.

**1. Univariate HP Approach**

The HP filter results from the minimization loss function (see e.g., Almeida and Felix, 2006). This loss function represents a trade-off between minimizing the deviation of potential output from the observed output (criterion of goodness of fit) on the one hand and minimizing the variability of calculated potential output (criterion of smoothness) on the other hand. This trade-off requires an assumption on the trade-off parameter $\lambda$ .

$$\min_{Y_t^P} L = \sum_{t=1}^{S}\left(\ln Y_t - \ln Y_t^P\right)^2 + \lambda\sum_{t=2}^{S-1}\left(\Delta \ln Y_{t+1}^P - \Delta \ln Y_t^P\right)^2 \qquad (2.2.1)$$

The HP filter as a smoothing procedure to extract a variable trend from an observed series is very popular mainly because of its simplicity. Applied to log real GDP which generates a trend called potential GDP or PO being $Y^P$, and output gap i.e., the difference between Potential Output (PO) and Observed Output (Y). The resulting OG is a stationary series. But with these advantages also come some problems associated with this filter. The first one relates to the choice of the smoothing parameter $\lambda$ . There is no univocal choice of this parameter and actual practices widely differ. A very high value $\lambda$ lets the HP filter converge to a linear trend, implying that only demand shocks drive observed GDP, which is consistent with an extreme Keynesian model. A very low value $\lambda$ lets the filter converge to the observed series, implying that GDP is only driven by supply shocks, which would be consistent with an extreme Real Business Cycle Model. The mainstream macro models are currently of the neo-Keynesian types incorporating both supply and demand shocks, such that a moderate value $\lambda$ is warranted. In any case, the results can be tested for their sensitivity to the choice of this important parameter.

The second shortcoming is commonly known as the end-of-sample problem. The HP filter, obtained from the minimization of the loss function L, is a centered moving average. However, throughout the start and finish of the sample period (S is number of observations), no enough lags or leads are available. This implies that the HP estimate

for the most recent period suffers from a bias, overemphasizing the weights of the last observations. This is particularly unhelpful when policymakers need to estimate the most recent movements in the business cycle. This problem is frequently resolved by extending the available sample period with the best forecasts.

Finally, when applied to non-stationary series, it is sometimes reported that the HP filter may indicate spurious cycles, i.e. may produce a cyclical output gap even if there are no cycles present in the original data.

It is mentionable that the production function approach relies on economic theory rather than statistical assumptions about time series properties and the correlation between trends and cycles. The production function approach is centered on the supply side of an economy and offers the benefit of establishing a more direct connection to economic theory (Roeger, 2006). The production function approach with issues is discussed below:

## 2. The Production Function Approach: Theory and Measurement Issues

The Production Function (PF) approach focuses on the supply potential of the economy and is based on supply-side theory. It is therefore theory-based which allows economic interpretations of the estimated PO growth and the movements in the OG. On the other hand, being based on theory, it requires several theoretical assumptions to be made, apart from choices related to measures of variables and their trends.

One of the main assumptions relates to the exact form of the PF itself. In this respect, the literature as well as current practice in international and national institutions, reveals a preferred choice for the Cobb-Douglas function. One of its big advantages is its simplicity which seems to outweigh its simplifying assumptions related to the constant returns to scale and the assumed unitary factor price elasticity. The latter implies that the factor shares are stationary variables in the long run. The PF approach is presented in a fairly similar manner in most of the literature and can be summarized as follows.

Output Y (real value added) is produced by three main types of inputs: Total Factor Productivity (A), Labor (L), and Capital (K) as illustrated in eq. (2.2.2):

$$Y_t = A_t.L_t^{\alpha}.K_t^{1-\alpha} \qquad (2.2.2)$$

Where $\alpha$ and $(1-\alpha)$ represent the output elasticities of labor and capital. Under the assumptions of constant returns to scale and perfect competition, these can be estimated from the observed labor income share.

Labor input (L) is typically measured in terms of the number of hours worked (H). Capital input (K) relates to the physical stock of capital. Y and both L and K are in principle available or can be calculated from national accounts data. Under the mentioned assumptions, the parameter $\alpha$ can be estimated by the labor share in national income. A, on the other hand, is not observable but can be calculated as a residual from eq. (2.2.2). But this implies that the residual from eq. (2.2.2) may not only reflect technological developments but also all potential measurement errors related to the factor inputs L and K. For example, the number of hours worked may not always be correctly measured, and the capital stock is typically calculated based on observed investment expenditure time series according to certain assumptions. Furthermore, in the particular case of Pakistan, output has been subjected to numerous structural shocks and breaks due to changed external and internal political and economic conditions. These can be expected to be reflected in the total factor productivity term, A, as well.

Taking logs of (2.2.2) and differentiating over time, results in an equation that decomposes real economic growth according to its main contributing factors:

$$\Delta \ln Y_t = \Delta \ln A_t + \alpha \Delta \ln L_t + (1-\alpha)\Delta \ln K_t \qquad (2.2.3)$$

Eq. (2.2.3) is the basis for a familiar growth accounting exercise. Such an exercise explains observed economic growth in terms of the contribution of the expansion of capital (investments), the contribution of changes in employment, and technological and efficiency shocks. Observed output growth is explained in terms of observed inputs of labor, capital, and observed progress in efficiency.

When moving from actual to potential output, it is necessary to define potential factor use and potential efficiency gains.

**For the capital stock**, the usual practice is to assume that the (calculated) capital stock is fully utilized and therefore reflects its maximum potential output contribution (this assumption is related to the fact that the capital stock is generally calculated based on the permanent inventory model.

**For the potential labor input**, it requires an estimate of the normal maximum input of working hours into the production process. This estimate would depend on several characteristics and parameters in the labor market (e.g. Musso and Westerman, 2005). The number of hours can be modeled as follows. The starting point is the total population (P). But not everyone is of working age. Define the dependence ratio (dr) as the proportion of the number of people that are not of working age as a percentage of the working-age population (PWA):

$$dr = \frac{P - PWA}{PWA} \tag{2.2.4}$$

from which follows:

$$PWA = P\frac{1}{1+dr} \tag{2.2.5}$$

Within the population at working age, not everyone is necessarily looking for a job. The labor force (N) is the product of the participation rate (pr) and the PWA:

$$N = pr.PWA \tag{2.2.6}$$

The number of people employed (E) is then the labor force minus the unemployment number (U), or using the unemployment rate (ur):

$$E = N - U = N(1-ur) \tag{2.2.7}$$

Finally, the number of hours worked (H) is the product of the people employed and the average hours worked per person employed (h):

$$H = E.h \tag{2.2.8}$$

Combining these parameters into one expression shows that the number of hours worked at any given time is given as:

$$H = \frac{pr(1-ur)h}{1+dr}P \tag{2.2.9}$$

If labor input is measured in terms of the number of hours worked then:

$$L_t = H_t \tag{2.2.10}$$

The potential number of hours worked then requires the evaluation of the potential maximum values of these parameters. These potential values are mostly approximated by de-trending these variables using various techniques. In the EU method, which is

now recognized to be the official approach to analyzing PO and OG in the EU-member countries, the following procedures are being used (see D'Auria et al):

- The trend labor force is obtained by mechanically trending the participation rate, using a HP filter;
- Trend employment is obtained based on an estimation of the time-varying non-accelerating wage rate of unemployment (NAWRU);
- The trend of hours worked is obtained by multiplying the trend of employment with the trend of average hours worked per employed person.

**The trend in total factor productivity** refers to a 'normal' level of efficiency of factor inputs. It is also mostly obtained by de-trending A in eq. (2.2.2). In the EU method, trend efficiency is estimated using a bivariate Kalman filter (Planas et al, 2009) which exploits the link between the TFP cycle and the degree of capacity utilization in the economy (the latter is obtained from business cycle surveys).

**PO can now be expressed and measured as**:

$$PO_t = Y_t^P = A_t^P \left(H_t^P\right)^{\alpha} \left(K_t^P\right)^{1-\alpha} \tag{2.2.11}$$

Where superscript P refers to potential levels.

**Finally, the percentage OG can then be obtained as**:

$$OG_t = \frac{Y_t - Y_t^P}{Y_t^P} 100 \tag{2.2.12}$$

Thus, Potential Output is an unobserved variable typically equated to sustainable output. However, it is usually calculated from observed data like GDP. Potential Output definitions can be derived from either theoretical or empirical data relationships. However, a lack of consensus exists regarding the theoretical definition of potential output, posing a significant obstacle in its measurement. Kiley (2014) stresses the significance of conceptualizing various approaches to assessing results. Potential output is often defined by economists in terms of the output trend, which can be linear or quadratic. Analysts can now use univariate or multivariate econometric methodologies to measure prospective output with this concept, requiring just rudimentary theoretical frameworks. However, the success of these strategies is frequently predicated on unproven theoretical assumptions (Basu and Fernald, 2009).

One common definition of potential is the utmost possible output that could be obtained if all available resources were used to their fullest extent. It is still unclear whether these models are adequate for characterizing the economy considering recent structural changes. However, the calculated results depend critically on underlying theoretical assumptions.

Traditional statistical measures are found to be unreliable by Orphanides and van Norden (2002) for real-time estimation of the U.S. output gap. This is because of the large adjustments and the uncertainty surrounding the final sample. Despite shifts in productivity, Edge and Rudd (2016) found that estimates of the production gap became much more accurate in the late 1990s and early 2000s. Despite popular belief, the Great Recession did not cause the current condition of low productivity, as demonstrated by the research of Fernald (2014), who analyses the productivity slowdown over the 2000s and finds that losses in productivity existed before the Great Recession. The deceleration is consistent with a smaller output deficit and a lower long-term potential growth rate (estimated at around 2.1% by Fernald). These results contrast with those of the Congressional Budget Office (CBO).

Estimates of the output gap in the Euro Area (Marcellino and Musso 2011), are also questionable. They describe it as fluctuating parameters and unreliable models rather than changing data. One-step-ahead potential for the G-7 countries is forecasted by using an unobserved components (UC) filter; they find that correlated shocks are more helpful to the measuring of potential than structural disruptions (Dungey, Jacobs, and Tian, 2017). However, the Unobserved Components Method (UCM) is sometimes reported to be complex and difficult to operationalize in the framework of macroeconomic policy models (Kátay, Lisa and Matthieu, 2020)

Pakistan's economy has been subjected to many shocks in the past related to changes in the specific institutional and political environment. It is difficult, therefore, to interpret movements in PO and OG obtained by purely statistical methods. The PF method seems more suited in this respect because it allows the decomposition of both observed and potential growth into economically identifiable factors such as the use of labor, capital, technology, and exogenous structural shocks. For their 2017 study, Haq and Malik measured the Output Gap using data from 1960 to 2010 on Pakistan's labor force, real GDP, inflation, interest, gross fixed capital creation, unemployment, and real

GDP. According to the study's findings, the production gap estimations in final data differ from those in real-time data. Even though there were less data modifications than other adjustments, they were still considerable. Thus, the output gap that was estimated using the final or amended data does not accurately reflect the output gap that was accessible to policymakers when they made their choice.

It is mentionable that a considerable portion of the estimate of output is driven by HP filters, which have no theoretical underpinning. Further, the Output Gap is explained in terms of variables without any theoretical model behind it. Therefore, it is not possible to interpret the signs of these coefficients, whether these be negative or positive. Thus, the actual choice of the technique(s) to be used depends on the availability of data, the economy's structure, and the exercise's purpose. There is no unique topology to classify the main methods to model PO and OG. Based on a short literature review, the following is the summary and short description of methods to estimate PO and OG.

**Table – 2.1: Methods to estimate PO and OG with Short Description**

| **NON-BAYSEIAN TECHNIQUES:** Do not assign prior distributions to coefficients in the model | |
|---|---|
| **Univariate filters** | |
| Linear trend | PO is estimated as a linear time trend through observed real GDP |
| Split trend | Same as a linear trend but calculated during each business cycle period separately |
| Hodrick-Prescott (HP) | The trend component of real GDP is calculated as a trade-off between a good fit and the degree of smoothness of the trend series |
| Band-pass filters such as the Baxter-King and Christiano-Fitzgerald filters | Time series are transposed into the frequency domain. Business cycle fluctuations are supposed to correspond to a well-defined band of frequencies |
| Unobserved Components Method | Time series is decomposed into a permanent and a temporary component. It is modelled as an auto-regressive process for the temporary component and assumed that the permanent component follows a random walk. This structural time series model is estimated using the Kalman filter |
| **Multivariate filters** | |
| Hodrick-Prescott | More variables are included as compared to the univariate HP |
| Band-pass models | More variables are included as compared to the univariate band-pass filters |
| Unobserved Components Method | More variables are included as compared to the univariate Unobserved components models |
| **Structural methods** | |

| | |
|---|---|
| Structural Vector Autoregression | Imposes structural restrictions to a Vector Auto Regressive model to identify demand and supply shocks in the real GDP series |
| Production function approach | Uses a production function in terms of capital, labor, capital, and total factor productivity to analyze the supply side of the economy |
| **BAYESIAN MODELS:** Assign prior distributions to coefficients in the model | |
| The models used to determine PO and OG are DSGE and Bayesian estimated small-scale models. | |

Source: Brouwer Gordon de. (1998). Estimating Output Gaps, Research Discussion Paper 9809, Economic Research Department, Reserve Bank of Australia
EU Independent Fiscal Institutions, (2018). "A Practitioner's Guide to Potential Output and the Output Gap," Network's Output Gap Working Group, EU Independent Fiscal Institutions

Earlier, no proper intention has been made to estimate sectoral output gaps, especially in Pakistan. Peykov (2021) examined the relationship between the output gap of different sectors and the overall output gap in the Bulgarian economy. The HP filter procedure was utilized to assess the potential output of each sector. The results revealed distinct cyclical dynamics among sectors, suggesting that the structural changes in production are influenced not only by cyclical factors but also by fundamental factors. Due to the varying volatility of sectoral output gaps, shocks in one sector can significantly affect the rest of the economy through cross-sectoral dependencies.

For Pakistan, instead of sectoral output gaps, some studies in which sectoral Total Factor Productivity has been estimated. Chaudhry, (2009) estimated Total factor productivity (TFP) for Pakistan between 1985 and 2005 by using Cobb-Douglas and trans log production functions. This was done separately for the industrial and agriculture sectors and then for the entire economy. The research revealed that manufacturing productivity exhibited a yearly growth rate of 2.4%, primarily driven by capital investments, whereas agricultural productivity demonstrated a yearly growth rate of 1.75%, despite the constraints of the available data on agricultural output. Likewise, Ahmad and Ilyas (2011) found that the total factor productivity (TFP) in the services sector experienced an average annual growth rate of 0.91 percent from 1965 to 2010. The phenomenon has exhibited significant fluctuations throughout its history. Overall, it has contributed approximately 16% to the growth of value-added.

Sherbaz et al (2009) made a study on "Output Gap and its Determinants: Evidence from Pakistan (1964-05)". The analysis was based on the Cobb-Douglas production function with constant returns to scale in which three factors of production (total factor

productivity, labor, and capital) were used. However, potential total factor productivity was based on an HP filter defined as Potential L: PL=(1-Upot)LF, where Upot is an HP filter, LF is labor force, and output gap was defined as OG=100*(Q/Qpot-1). Further, the Output Gap was used as a function of growth in public investments, exports, imports, and higher education.

Thus, the research gap exists in estimating the sectoral output gap, especially in the context of Pakistan. Consequently, the study aims to estimate sectoral output gaps and analyze their potential impact.

### 2.3. Literature related to Neutral Interest Rate

The concept of monetary policy as distinct from administrative action was solidified when the Bank of England was founded in 1694. The bank was granted the authority to produce gold-backed notes. The objective of monetary policy was to maintain the stability of the currency, ensure that banknotes were equivalent in value to precious metals, and minimize the circulation of coins. Central banking systems were established by industrialized nations between 1870 and 1920, with the Federal Reserve being the final one to do so in 1913. At this point, the central bank had solidified its position as the "lender of last resort." Interest rates were gaining recognition for their significant impact on the overall economy. This increased awareness was fueled by a growing understanding of the marginal revolution in economics, which highlighted how people's decisions were influenced by changes in their economic trade-offs.

The connection between the money supply and the macroeconomy is a topic that monetarist economists have delved into extensively. One notable example is Milton Friedman, who advocated for the use of government budget deficits during recessions to be offset by money creation. This approach aimed to boost aggregate demand for production. Subsequently, he supported the idea of maintaining a steady and moderate increase in the money supply as the most effective approach to ensure low inflation and consistent economic growth. Nevertheless, the adoption of this approach by United States Federal Reserve Chairman Paul Volcker in October 1979 proved to be impracticable, primarily because of the unstable link between monetary aggregates and other macroeconomic factors. Over time, Milton Friedman came to acknowledge that

the direct manipulation of the money supply did not yield the desired outcomes as originally anticipated[8].

A significant shift in the search for simple monetary policy rules took place in the 1970s, following the appearance of new types of models. These stochastic, empirical models incorporated both rational expectations and sticky wages and prices. Previous so-called Real Business cycle models included rational expectations in a world of instantaneous market clearing, thereby excluding any role for monetary policy. Building on these rational expectations models with rigid wages and prices, policy rules research took off in the 1980s and was based on trying out different policy rules in different models and seeing how they affect some welfare criteria (for example the variability of output and inflation).

Using the rational expectations model for multi-country, Taylor (1979) simulated economic performance in the G-7 countries by applying different rules. He came up with the following simple rule:

$$R_t^{T93} = r_t^{LR} + \pi_t + 0.5(\pi_t - \pi^{LR}) + (\mu^{LR} - \mu_t) \qquad (2.3)$$

The actual nominal federal funds rate for the quarter is denoted by $R_t$, four-quarter price inflation for the quarter by $\pi_t$, *the* unemployment rate in the quarter by $u_t$, and the level of the neutral real federal funds rate in the longer run by $r^{LR}$. It is expected that on average, a neutral real federal funds rate be consistent with sustaining maximum employment and inflation. Further, $\mu^{LR}$ is the rate of unemployment in the long run. In fact, in Taylor (1993) not the unemployment gap was used, but the deviation of real GDP from target (which nowadays is measured by the output gap). The coefficient of the unemployment gap is 1, whereas, in Taylor's representation, the coefficient of the output gap is 0.5. According to Okun's law, the unemployment rate responds to the output gap with a coefficient equal to minus 0.5.

Taylor asserts that this rule tracks the observed federal funds rate remarkably well during the 1987-1992 period. However, Taylor and Williams (2011) noted the monetary mistakes of the Great Depression. The study found that this rule embodies two important characteristics. First, the interest rate reacts by more than one-for-one to

[8] Bamforth, S. (2021). Note on History of Monetary Policy. Global Journal of Commerce & Management Perspective, 10(5).

movements in the inflation rate (in other words if inflation is too high, the real interest rate should be increased and this has been termed the Taylor principle). Second, monetary policy leans against the wind (in other words, monetary policy responds to deviations of inflation from target and output from potential, to bring the economy back to equilibrium).

According to macroeconomic theory, there is a crucial real rate of interest that determines whether the monetary policy is inflationary or deflationary. For about ten years following the Great Financial Crisis, economists observed a connection between deflationary pressures and the challenges faced by central banks in achieving sufficiently low policy interest rates. This was particularly notable due to the long-term decline in market real rates of interest worldwide. On the other hand, some attribute the current worldwide increase in inflation to the delayed recognition by central banks of the necessity for sufficiently high real interest rates to effectively curb demand.

Wicksell (1898) is often referenced by economists for the observation that when a real central bank policy rate is lower than a benchmark real market rate of interest, it tends to lead to inflation. Conversely, when the central bank policy rate is set higher than the benchmark rate, it tends to result in deflation (Woodford 2003). However, the concept has a long history, dating back to Henry Thornton in the early 1800s. In his introduction to Thornton's 1802 classic, "An Enquiry into the Nature and Effects of the Paper Credit of Great Britain," Hayek (1939, p. 50) discussed the connection to Wicksell.

In recent years, monetary policymakers have increasingly relied on the natural rate framework to inform their interest rate decisions, driven by a commitment to achieving inflation targets. Research by Borio (2021) shows that central bankers' references to the natural or neutral interest rate surged in 2015, coinciding with the Federal Reserve's decision to raise interest rates following the Global Financial Crisis. This trend has continued, with a growing number of speeches mentioning this rate. Earlier research by Barsky, Justiniano, and Melosi (2014) found that aligning monetary policy with the natural real interest rate can significantly reduce output and employment gaps, while also decreasing inflation variability. These findings suggest that adopting such a policy could be beneficial in economies without nominal rigidities or price and wage markup shocks.

A study conducted by Ruch (2021) focused on 30 emerging markets and developing economies (EMDEs). The findings indicate a decline in the neutral real interest rates of inflation-targeting emerging markets and developing economies (EMDEs) in line with

the decrease in the neutral rate of the United States over the past two decades. In EMDEs, the neutral real interest rate experienced a significant decline, dropping from approximately 6% in 2000 to 2.2 percent in 2019. This exceeds the estimates made by Laubach and William (2003) for the US by 1.4 percentage points. A significant majority of emerging market and developing economies (EMDEs) are experiencing a decrease in their neutral real interest rates. Commodity exporters experienced a significantly larger decline in the neutral rate of interest compared to importers. In the past two decades, the impact of domestic and global factors on savings and investment has been limited. This is due to the decline in neutral real interest rates in EMDEs, which has gone beyond potential growth. In conclusion, the majority of emerging markets and developing economies (EMDEs) tend to implement countercyclical monetary policies, which involve managing the difference between real interest rates and the neutral rate. Central banks tend to adopt accommodative policies in periods of low inflation and weak demand. This was demonstrated during the 2009 global recession and its subsequent events. On the other hand, during the early 2000s, there was a notable increase in production, although it was necessary to keep inflation in check and maintain a restrictive policy with a real interest rate above the neutral level. Supply shocks can lead to a divergence in the movement of inflation and output, rendering the policy stance inappropriate.

For estimating neutral interest rates, a simple theoretical approach grounded in the Dynamic Stochastic General Equilibrium (DSGE) literature was applied in a period of balanced growth, (Gali, 2008; Perelli and Roache, 2014; Han, 2019).

The most appropriate method of deriving the equilibrium real interest rate is $rr^* = \sigma . g_y + \rho$ where $rr^*$ is the neutral (equilibrium) real risk-free rate of interest (policy rate), $\sigma$ is the degree of relative risk aversion, $g_y$ is the steady state (potential) per capita economic (consumption) growth rate, and $\rho$ is the households' discount rate (Gali, 2008). However, the parameters $\boldsymbol{\sigma}$ and $\boldsymbol{\rho}$ are deep parameters in the households' utility function, which are unknown.

In Pakistan, the discussion on the neutral interest rate has not been explored. The State Bank of Pakistan (SBP) has been instrumental in strengthening the nation's financial system since its establishment in 1948. The development of SBP as an institution has occurred gradually over time, with its monetary policy framework continuously adapting to address emerging trends. The SBP has implemented various monetary

policy regimes over the years, which have been tailored to suit the prevailing economic and financial conditions. Before 1972, the utilization of interest rate policy was infrequent, with a heavy reliance on direct instruments of credit controls, both qualitative and quantitative, for the implementation of monetary policy. In 1972, the implementation of direct credit control was expanded with the establishment of the National Credit Consultative Council (NCCC) and the nationalization of the banking system. The primary aim of this monetary and credit policy was to assist the priority sectors by facilitating access to affordable and subsidized credit. In the early 1990s, the process of financial liberalization began and a market-oriented monetary policy framework was introduced. The monetary aggregates targeting approach adopted by SBP in the 1990s involved the use of broad money supply (M2) growth as an intermediate aim and reserve money as an operational target. This rule remained popular until the late 2000s. During this time, monetary aggregates served as the primary reference point for monetary policy. The SBP shifted its approach to controlling inflation by adjusting short-term interest rates, as the connection between monetary aggregates and end targets became less significant. The policy rate changes of this regime are determined by macroeconomic conditions, with a specific focus on the near-term inflation trend with the inflation objective. Therefore, inflation and inflation forecasts play a crucial role in shaping Pakistan's monetary policy. In August 2009, the SBP introduced the Interest Rate Corridor (IRC), which had a 300-basis-point gap between the ceiling and floor rates. The IRC mechanism underwent improvements in response to changing market dynamics. In February 2013, the Corridor decreased to 250 bps. In May 2015, the Interest Rate Corridor (IRC) structure was revised to align with international standards. This involved including the SBP Policy Rate as a specific Target Rate to effectively communicate the central bank's monetary policy position. The IRC ceiling and floor were adjusted to be slightly above and below the policy rate, with a narrower width compared to before.

Hayat and Nadeem (2016) conducted an empirical analysis to investigate the effectiveness of monetary aggregates and short-term interest rates as monetary policy instruments in Pakistan. They also examined the impact of the State Bank of Pakistan's shift towards using short-term interest rates on their relative effectiveness in controlling inflation. By examining indicators of long-lasting shifts in the fundamental patterns of relevant variables, we have discovered that broad money consistently serves as an explanation for inflation across monetary, transitory, and interest rate regimes. While

the interest rate instrument has become less prominent during the transition to the interest rate regime, it appears to have a positive relationship with inflation, which is often referred to as the price puzzle. Therefore, it is advisable to not disregard the significance of money entirely when transitioning to a flexible inflation-targeting regime, as intended.

In a study conducted by Chughtai et al. (2015), the effects of key economic indicators, such as inflation rate, interest rate, and exchange rate, on the economic growth of Pakistan were analyzed by using secondary data from the years 1981 to 2013. It was found that the inflation rate and interest rate spread hurt Pakistan's economic growth, whereas the exchange rate positively and significantly impacts economic growth.

In the case of Pakistan, there is an inherent paradox. As monetary policy seems to rely on the interest rate instrument, an estimation of its neutral level is necessary. And yet, no such estimates are available, at least not in the available literature.

Thus, there is a research gap in estimating a neutral interest rate for Pakistan and finding the implications on the economy whenever the policy rate deviates from the neutral rate of interest. Therefore, in the present study, the research gap will be addressed by estimating a “neutral interest rate” and analyzing its implications for key macroeconomic variables.

### 2.4. Literature related to Public Debt

As per Webster's Dictionary, Public debt is the aggregate of all national, state, and local obligations; an indicator of the extent to which public expenditures are funded through borrowing rather than taxation. Before discussing the implications of rising debt, it is important to briefly address the recent confusion caused by a rudimentary understanding of Modern Monetary Theory (MMT). MMT advocates say a financially autonomous government that issues its credible fiat currency can spend unlimitedly until inflation increases. However, this is not the case. MMT proves a financially independent government can spend freely. It can create or borrow money to spend without previously getting funds. It is not the case that indirect restrictions do not exist. There are always limitations imposed by the economy. Reason being, money cannot flow into an economy from outside sources; if there is an ex-ante imbalance, some part of the economy will have to cut back on spending to make up for it. This can be done through either explicit or implicit transfers. Government spending without boosting supply produces an ex-ante supply-demand imbalance that must be addressed by

implicit or explicit transfers. Transfers must close the ex-ante demand-supply mismatch. regardless of money's credibility. The debt levels were already considerably higher before the initial implementation of COVID-19 lockdown measures. Before the COVID-19 pandemic, the real and nominal neutral interest rates steadily decreased for many years. The enduring trend can be attributed to a range of structural factors. These include sluggish economic growth and demographic changes, as highlighted by the IMF in 2023, as well as a global scarcity of safe assets, as discussed by Caballero et al. in 2017. Several of these factors are anticipated to continue operating in the future.

Some scholars, including Blanchard (2023) and Blanchard (2019), have posited that high levels of public debt may result in minimal fiscal and social consequences due to the negative differential between interest rates and growth. Our research aims to thoroughly examine the circumstances in which public debt incurs substantial costs, disregarding any potential beneficial applications of such debt. Resource scarcity and finite production capacity affect all sectors, including governmental activities. Thus, for debt sustainability, standard economic models assume the interest rate exceeds economic growth. If economic growth surpasses government borrowing costs, the government can roll over its debt and lower its debt-to-GDP ratio without raising taxes. Recently, economists have begun to question whether a positive interest-growth difference is sufficiently founded in experience and what the ramifications of relaxing such assumptions might be. Olivier Blanchard noted in his 2019 American Economic Association presidential address that the US government debt interest-growth difference has often been negative. Since the 2008 Global Financial Crisis (GFC), r – g differentials have remained negative in most advanced economies, even those with solid economic growth. Policymakers must weigh negative differentials against bigger public debts than before the global financial crisis.

Motivated by Blanchard's (2019) seminal work on r-g in the United States, a growing number of papers examine the behavior of r-g in various countries, where r is the real interest rate and g is the real growth rate. r-g, the gap between the real interest rate and the real economic growth rate, is highly volatile in the existing literature. Long-term expectations for r-g are negative, according to data from advanced economies (Barrett, 2018). While negative real interest rate episodes have been documented before (Reinhart and Sbrancia, 2015; Escolano, Shabunina, and Woo, 2017; Jordà, Knoll, Kuvshinov, Schularick, and Taylor, 2019; Mauro and Zhou, 2020; Mehrotra and

Sergeyev, 2019; Garn, Lester, Sims, and Wolff, 2019; Checherita-Westphal, 2019), they are by no means common. Previous research has shown that a higher amount of initial public debt is associated with a higher chance of r-g downside risk and a shorter length of negative r-g events.

The literature on debt analysis includes a multi-equilibria model that explores the possibility of adverse short-term shocks leading to negative long-term equilibria and self-fulfilling debt crises. This model has been discussed by various authors such as Calvo (1988), Cole and Kehoe (2000), Chamon (2007), Aguiar and Amador (2014), Aguiar, Amador, and Gopinath (2009), and Lorenzoni and Werning (2019). Further, an empirical study by Lian et al. (2020) shows that public debt can make the r-g dynamics more susceptible to shocks from the outside world. The results of this research add to the current empirical literature on how government debt affects economic growth and bond yields. They show how internal and international shocks affect the growth and borrowing costs of countries with high levels of public debt. Many researchers have come to the same conclusion, including Bohn (1998), Laubach (2009), Reinhart and Rogoff (2010), Panizza and Presbitero (2013), and Eberhardt and Presbitero (2015).

By the end of 2017, the IMF evaluated low-income countries in which 5 countries were already in debt default, 22 were at high risk thus needing concessional funding, 28 were at moderate risk while at low risk there were only 10 countries. Thus, analyses of debt crisis gain importance as the debt crisis in one country whether in the private sector or government, can frequently spread economic pain to other countries. Inefficient tax policies cause low government revenue collection which is intensified by weaknesses in the rule of law thus implying poor debt management. Furthermore, debts are not used as productive investments but used for consumption goods. Moreover, external shocks like falling commodity prices and natural disasters further intensify the problem. Poor Debt Management is also related to an ailing diversified export structure.

Alam and Fouzia (2013) analyzed panels of a group of six countries, Pakistan, India, Nepal, Sri Lanka, Indonesia, and Thailand being “Debt Trap Countries (DTC)” versus eight Malaysia, Bangladesh, Korea, Papua New Guinea, Philippines Fiji, Singapore, and Myanmar being “Non-Debt Trap Countries (NDTC)”. Findings showed external public debt, exchange rate depreciation, Current Account Deficit, and budget deficit are positively related. However, concerning Debt Trap Countries and Non-Debt Trap Countries, there is variation in the strength of the relationship. The strong coefficient

of external public debt, budget deficit, and exchange rate depreciation indicate explosive borrowing. Further, substantial utilization of foreign exchange with high demand for external public debt. However, a lower coefficient of Current Account Deficit indicates the deviation of borrowed funds towards the current account for Debt Trap Countries.

Ayen. Kose. et.al., (2021) in the World Bank Policy Research Paper observed a dramatic rise in debt in underdeveloped nations and emerging markets well before the epidemic hit. The global recession caused by the pandemic in 2020 has led to a significant rise in debt. Furthermore, it mentioned that global government debt has continued to rise even five years after previous global recessions. Based on the historical data and considering the substantial financing gaps and significant investment requirements in numerous countries. Debt resolution has become increasingly complex due to factors such as a fragmented creditor base, limited transparency in debt reporting, and the presence of government debt without collective action clauses.

In the case of Pakistan, Naeem (2011) observed that twin deficits caused the government to use public foreign and domestic debt to fund development. The study investigated public debt's effects on Pakistan's economic development and investment from 1972 to 2009. Autoregressive Distributed Lag (ARDL) was used to estimate the model since some variables are I (1) and others are I (0). It was found that public external debt negatively affects per capita GDP and investment, validating the "Debt Overhang effect". Further, it was also found that domestic debt hurts investment and per capita GDP. It appears to have discouraged private investment. Ejaz and Attiya (2013) conducted a comprehensive examination of debt sustainability in Pakistan's economy from 1971 to 2008. This study examined the debt sustainability of Pakistan's economy by analyzing the fiscal reaction function. The results indicated a positive correlation between the surplus-to-GDP ratio and the lag debt-to-GDP ratio. The low debt-to-GDP ratio suggests weak sustainability. The negative relationship between government spending innovations and consumption and output can be compared to Ricardian behavior. In the study, the researchers used Johansen cointegration to estimate the long-term relationship between the surplus-to-GDP ratio and the debt-to-GDP ratio. The purpose was to confirm the sustainability of this relationship. The results indicate the presence of a long-term association between these two series.

Wajid Islam. et.al., (2023) assessed Pakistan's public debt sustainability by employing the Debt Sustainability Analysis (DSA) framework and fiscal reaction function (FRF) from 1976 to 2021. According to the DSA findings, it is projected that by the year 2030, the public debt level, currently at 80%, can be reduced to the sustainable limit of 60% by implementing a 10% growth rate and maintaining a real interest rate below 10%. Moreover, the estimates of the Fiscal Responsibility Framework (FRF) do not provide any indication of debt sustainability. Additionally, the COVID-19 pandemic has a positive correlation with the primary balance primarily attributed to the decline in the primary balance from -3.5% in 2019 to -0.9% in 2020. This outcome was anticipated due to the significant amount of debt relief granted to Pakistan during this timeframe. The study's findings suggest that the country will struggle to manage its increasing debt if the current trend of rapid accumulation persists. Hence, it is imperative to maintain a strategy of ongoing coordination between fiscal and monetary policy to sustain robust growth momentum and ensure the sustainability of debt levels.

### 2.5. The Rationale for the Study from Existing Literature

From the understanding of the literature discussed, in general, and more specifically for Pakistan, there is a lack of understanding of the transmission of monetary policy on the sectoral level. Similarly, there is also a lack of understanding of the implications of interest rate policy on the public finances. Excessively high interest rates, together with the external financing constraint, hamper the financing of the Government budget deficit using non-monetary financing instruments. It will be impacted by high-interest payments and the restricted fiscal space will then push the country into increasing debt. One of the reasons could be the notion of the aggregate output gap used as a prominent measure of economic activity and thus has a significant role in both monetary and fiscal policy. We hypothesize that monetary and fiscal policies while using the aggregate output gap as an indicator of economic activity, may not work efficiently. The effects of the two policies may differ across different sectors of economic activity, making the aggregate output gap a poor indicator for policy. The issue is especially important for a country like Pakistan, where, for example, the agriculture credit market is underdeveloped, and therefore effects of changes in monetary and fiscal policy instruments may not transmit symmetrically to agriculture and other sectors of the economy. Hence, there is a need to make a disaggregated analysis of the output gap. The research necessarily, therefore, involves the use of unobservable variables such as

aggregate and sectoral potential output and output gaps, equilibrium interest rate, cyclically adjusted fiscal magnitudes, knowledge of the country's inflation target, and monetary policy reaction function and its parameters.

Production is considered at two levels. The first potential output is the output that can be produced with full use of the country's productive capacity. This depends on the available physical and human capital. Technical progress is embedded in increasing the quality of human and physical capital. Productive capacity is driven by Gross Fixed Capital Formation (GFCF), both private and public. Secondly, observed production also depends on the degree of utilization of the existing production capacity (the output gap). On the equilibrium path, production equals potential. On this path, inflation equals the inflation target, nominal and real interest rates reflect their equilibrium values, fiscal policy is cyclically neutral, and current account and fiscal balances are sustainable.

Furthermore, the reference point for the policy interest rate is the economy-wide estimate of the natural (equilibrium) interest rate. Also, the relevance of this concept increases with the degree of homogeneity of this concept over the different sectors of the economy. Suppose productivity growth is markedly different in the main sectors, these sectors may require different equilibrium real interest rates. Also, fiscal and especially structural policies may be geared to specific sectoral issues. But then also, estimates of sectoral potential output and output gap estimates provide relevant information.

These arguments plead for augmenting estimates of economy-wide potential output and output gap estimates with similar estimates for the main sectors of the economy.

The real interest rate is the real return an investor can expect on his investment. When this real return is low, borrowing is cheap, which artificially stimulates absorption, which may contribute to current account deficits. If the real interest rate is too high, borrowing is too expensive and may therefore hamper economic growth. These observations lead to the conclusion that dependent on the economic structures of a country, there must be a natural/equilibrium real interest rate that is compatible with a sustainable equilibrium growth path. For policymakers in general and monetary policy in particular, it is therefore important to know what is the equilibrium level of domestic interest rates. However, the neutral (equilibrium) rate of interest is an unobservable parameter. Economic theory has pointed out the main potential determinants of the real

interest rate. The main identified factors are time preference and risk aversion of consumers, productivity and labor force growth, fiscal policy, uncertainty, and hence risk premia and the institutional structure of financial markets (see ECB 2004). There exists a whole range of methods to estimate it. For a short but useful survey see Magud and Tsounta (2012). The conclusion is that there is no single best method to estimate the neutral rate of interest. Therefore, all estimates are surrounded by a wide range of uncertainty.

Given this uncertainty related to the different estimation approaches, the approach presented here starts from the principle that an equilibrium interest rate only provides a benchmark when the economy is in equilibrium and expected inflation is on target. Therefore, the objective is to identify past balanced growth periods in Pakistan and to use economic theory, data, and judgment resulting in a range within which Pakistan's equilibrium real rate of interest rate may be estimated. Furthermore, given this range and the observed interest rates, it is possible to evaluate the stance of monetary policy in the past. The lessons learned from this analysis can be used to design an optimal monetary policy rule for Pakistan to be used in the future.

Finally, historically in Pakistan, high fiscal deficits adversely impacted the economy through multiple influences: First, is the extensive increase in public debt both foreign as well as domestic. Second, it was largely by banking system borrowing while third caused negative government savings which in turn caused low investment because of deficient overall savings. The overall public debt stood at Rs. 32.7 trillion, $73.4 billion; 84.8 % of GDP at the end of June which exceeded the limit (60%) set by the Fiscal Responsibility and Debt Limitation Act (FRDLA). Further, the revenue-expenditure gap, due to weak administration in revenue collection caused the lowest tax-to-GDP ratios in the world. Thus, putting strict constraints on the expenditure side of the fiscal due increase in interest payments both on domestic and foreign debt as well as auscultating debt risk.

# Chapter 3

## Economy of Pakistan – Macroeconomic Imbalances, Output Gaps, the Neutral Rate of Interest and Debt Dynamics – Policy Misalignments

### 3.1. Theoretical Framework

There is an absence of knowledge on the transmission of monetary policy at the sectoral level based on the literature reviewed, both generally and concerning Pakistan in particular. In a similar vein, nobody seems to know what effect interest rate policy will have on the national budget. Financing the government budget deficit with non-monetary financing tools is hindered by excessively high interest rates and the external financing restriction. High interest payments will have an effect, and the country's already-constrained budget will further exacerbate the problem. This could be due, in part, to the fact that the aggregate production gap is a key metric for monetary and fiscal policymakers alike. Using the aggregate production gap as a measure of economic activity, we postulate that fiscal and monetary interventions could not be effective. The aggregate production gap is not a good policy indicator since the two policies could have different impacts on various parts of the economy. If a nation like Pakistan has an undeveloped agricultural credit market, for instance, the consequences of shifts in fiscal and monetary policy tools could not trickle down to the agricultural sector in the same way they would to other parts of the economy. That is why breaking down the output gap into its component parts is essential. As a result, the study must rely on factors that cannot be seen, such as the equilibrium interest rate, the magnitudes of cyclically adjusted government spending, the parameters of the monetary policy reaction function, the country's inflation target, and the potential output and output gaps across sectors. So, when a nation's production capacity is used to its maximum, the resulting output is known as its potential output. On the route to equilibrium, output is equal to potential. On this course of action, inflation reaches the inflation objective, interest rates (both nominal and real) are in equilibrium, fiscal policy does not react to economic cycles, and the budget and current account deficits are manageable. Thus, the policy interest rate is based on the assessment of the natural (equilibrium) interest rate for the entire economy. There is a positive correlation between the degree to which this idea is uniform across economic sectors and its importance. If the primary sectors' productivity growth rates are significantly varied, then the equilibrium real interest rates

that each sector needs can also vary. In addition, certain fiscal and, more specifically, structural strategies may target problems unique to certain industries. Basically, what these arguments are trying to say is that we need more sector-specific estimates to supplement our overall estimates of potential production and the output gap. Discovering eras of balanced development in Pakistan's economic history is another goal of the research. By combining economic theory, statistics, and expert judgment, we want to determine a range within which Pakistan's equilibrium real interest rate may be determined. Additionally, the historical posture of monetary policy may be assessed using this range in conjunction with the observed interest rates. Optimal monetary policy rules for Pakistan may be crafted using the insights gained from this study. Lastly, there are several ways in which large budget deficits have hurt Pakistan's economy in the past. There has been a dramatic rise in both the national and international debt. Budget deficits also led to negative government savings, which in turn led to poor investment because of general savings deficiency. As a result, auscultating debt risk and increasing interest payments on both domestic and international debt have imposed severe limitations on fiscal expenditure. Thus, there is need to understand the Economy of Pakistan in the context of research objectives.

### 3.2. Understanding Economy of Pakistan in the Context of Research Objectives

Since independence, the economy of Pakistan has experienced significant fluctuations. It often happened that Pakistan faced significant economic challenges, including low foreign reserves, depreciating currency, high inflation, and unsustainable growth. Sometimes, macroeconomic imbalances were exacerbated due to political uncertainty and natural disasters, such as severe flooding. Further, the situation was also worsened by global economic factors, including increasing commodity prices and stricter global financing conditions. There can be many reasons for such performance including structural weaknesses and a lot of literature is available in this context. However, as mentioned earlier, this study explored a new direction of policy misalignment which also caused divergence and made economic conditions worse. Appendix – B provides the Economy of Pakistan – A Data-Based Description.

This chapter, therefore highlights the economic conditions that happened due to policy misalignments. Section 3.1 describes Macroeconomic Imbalances. Section 3.2 describes the performance of the Overall Potential Output & Output Gap to highlight the importance of Sectoral Disaggregation. In Section 3.3, an effort has been made to

emphasize the importance of measuring the Neutral Rate of Interest in Pakistan. Finally, Section 3.4. discusses Debt Dynamics

### 3.2.1. Macroeconomic Imbalances

Pakistan's GDP growth remained volatile since the beginning (Fig – 3.1).

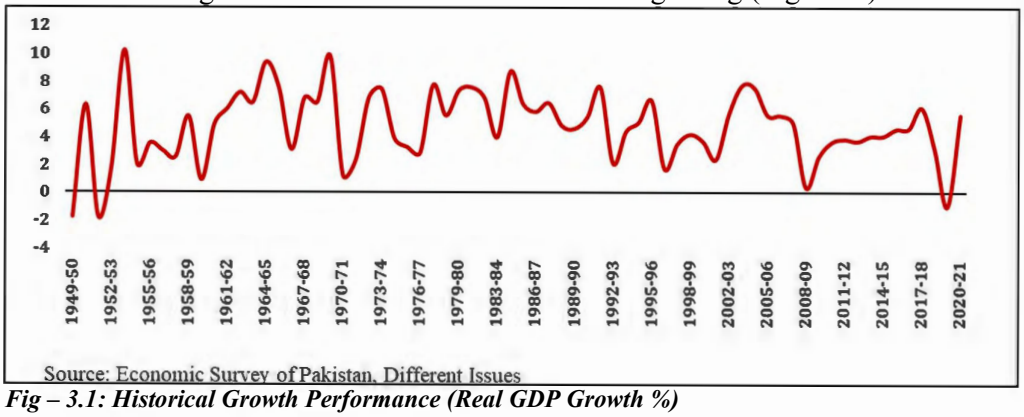



***Fig – 3.1: Historical Growth Performance (Real GDP Growth %)***

The economy grew rapidly but unevenly. The 1950s, 1970s, and 1990s saw moderate growth and high yearly growth rates, whereas the 1960s and 1980s saw great economic expansion. The 2000s grew slower than the 1990s, although only slightly. Growth subsequently slowed. External shocks affect economic growth. Most crucially, delayed adjustment measures have slowed economic recovery after crises. There are also some years, in which economic growth was so impressive that it exceeded its potential. Nevertheless, the rapid growth led to higher levels of consumption, which in turn had an impact on domestic prices, exchange rates, and foreign reserves.

In recent years, the economic situation has deteriorated more due to insufficient monetary policy, misalignment of exchange rates, and delayed fiscal adjustments leading to budget deficits. Furthermore, the distribution of unforeseen subsidies, especially in the power industry, has worsened the inadequate fiscal performance, thus increasing the fiscal limitations. The presence of misaligned policies led to a gradual erosion of macroeconomic buffers, an increase in external and public debt, and a depletion of international reserves. In addition, the economy encountered ongoing structural weaknesses, such as a narrow tax base and inefficient tax administration, which presented obstacles to business conditions. State-owned enterprises continued to exhibit poor productivity, while labor productivity remained low, despite the presence of a substantial informal economy[9]. Thus, the economic growth performance in

[9] IMF Staff Country Reports – Pakistan (Various Issues)

Pakistan demonstrates the significance of implementing suitable policies and priorities to achieve balanced growth across sectors. It is also mentionable that, along with unsustainable growth, the economy possessed episodes when a dramatic decline in Net Exports led to several BOP crises mainly reflected in a strong increase in consumption, both government and private consumption. Further, the fluctuation in investment growth mostly remained influenced by both domestic and international vulnerabilities. Further, in Pakistan, the absence of incentives for consumers to save rather than spend has resulted in a lack of widespread saving practices Moreover, a high rate of population growth resulted in a high age-dependence ratio also led to high consumption and low savings.

Fiscal performance also remained dismal. Most of the time, the country remained in a twin deficit. Interest payments continued to incline. In recent budgets especially in Budget 2023, net resources available with the federal government were less than interest payments

Pakistan's economy has underperformed, both in absolute terms and relative to the economic conditions in some of its neighboring countries. Contrary to countries like Bangladesh, China, and India, economic growth in Pakistan was lower, economic, and financial conditions more volatile, and external imbalances occurred much more frequently.

### 3.2.2. Potential Output & Output Gap: Overall and Sectoral Disaggregation

Gross domestic product (GDP) is widely employed as a key indicator for characterizing a nation's economic condition. Agriculture, Industry, and Services are the three sectors of the GDP from the production side. Earlier, agriculture was the main driver, but in recent years, GDP growth is now mostly driven by the services sector which has now almost 58% share of GDP while both agriculture and industry have 23% and 19% respectively.

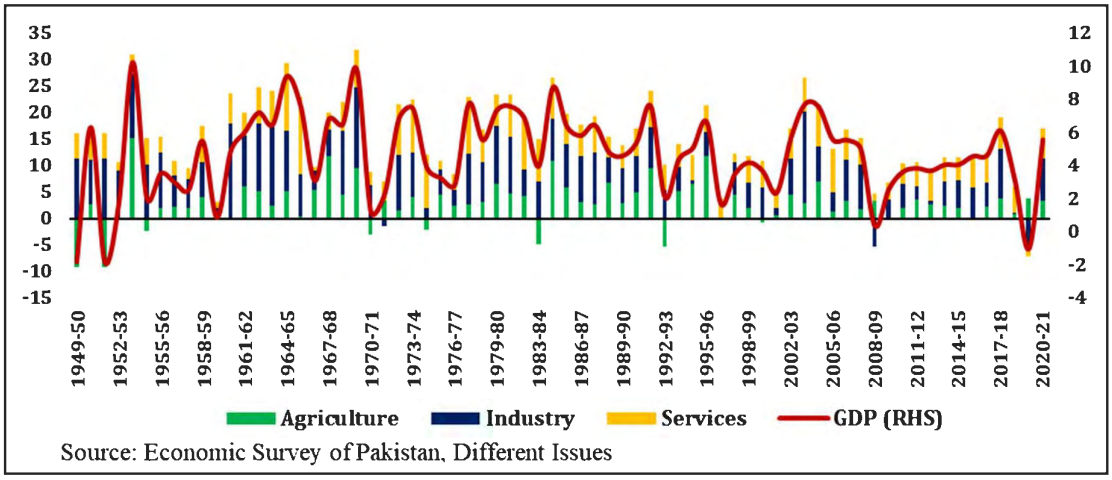



***Fig – 3.2: Growth Performance of GDP - Production Side***

It is mentionable that the agricultural sector has played and can play a significant role in the country's economic growth, ensuring food security, generating employment, and alleviating poverty. Likewise, this is the case in the industrial sector. However, the industrial sector suffered from gross inefficiencies resulting in economic cost to the country. (Kemal, 1998).

As mentioned, Pakistan's economy sometimes experienced substantial supply shock accompanied by extensive disruptions in the external sector. The shock originating in one sector has had a significant impact on the output of other sectors because of backward and forward linkages. Backward linkages denote the cross-sectoral exchanges between a particular sector and the sectors that provide the necessary inputs for its operations. When a sector has a high level of backward linkages, it means that it depends extensively on inputs from other sectors. The industrial sector has a backward linkage with agriculture as textiles depending on agriculture still have a significant share in industry. Forward linkages refer to the connections between a specific sector and the industries that buy its products or services. When a sector exhibits robust forward connections, it indicates that numerous other sectors rely on its products or services. This interdependence can manifest as market dominance, and the industry may emerge as a pivotal participant in the economy. Moreover, robust forward linkages have the potential to stimulate investments and foster growth in the sector, as the demand from other industries propels its expansion. Nevertheless, it can also give rise to vulnerabilities, as declines in the purchasing sectors may have an impact on the overall profitability of the sector.

Thus, whenever economies experience imbalances due to any reason, Policymakers have multiple solutions available depending on the problem's nature. In general, when there is a prolonged imbalance between aggregate domestic demand and supply, it often leads to a deterioration in external payments and a rise in inflation. The result necessitates macroeconomic adjustments to be made. In certain cases, an economy's challenges extend beyond demand fluctuations and persist for an extended period. These challenges often arise from government regulations or private actions that impede the efficient and equitable production of goods and services. Addressing these issues may require implementing structural measures, also referred to as economic structural changes. However, modifying the constituent elements of aggregate demand temporarily is comparatively simpler in comparison to enhancing a nation's resource productivity. Stabilization policies are generally regarded as more efficacious in the short term. Tax increases, spending cuts, interest rate adjustments, and changes in the money supply are all examples of stabilization policies.

The conceptualization and characteristics of stabilization can differ based on the underlying theoretical framework. The two main economic schools have contrasting views on the production gap and its characteristics. The classical approach suggests that the output gap is a temporary deviation from the long-term equilibrium level. External productivity shocks mainly cause this deviation to aggregate supply, which influences both long-term and short-term fluctuations in production (Scacciavillani, F., & Swagel, P., 1999). From this viewpoint, the deviation from the potential is temporary and can be rectified through the prompt implementation of appropriate economic policy measures. However, Keynesian economics posits that the production gap arises from a sustained disparity between supply and demand. This issue pertains to the limited ability to adjust prices and wages, which constrains the effectiveness of economic policy instruments in effecting change. However, both the two primary economic schools give importance to estimating the output gap regardless of having contrasting perspectives and attributes.

Thus, in macroeconomics, potential output and output gap are crucial concepts for analyzing the economy as they are associated with specific periods in economic dynamics. Potential output measures long-term fluctuations in economic growth, while the output gap measures short-term fluctuations (Hall & Taylor, 1991). Therefore, the

institutions in charge of implementing stabilization policy closely monitor the output gap, its relative changes, fluctuations in the business cycle, and inflation expectations.

Kuttner (1994) developed a model that incorporates a Phillips curve equation to explain the relationship between the output gap and inflation. Despite its atypical nature involving regression on an unobserved variable, this model has gained significant popularity. Kichian (1999) and Gerlach & Smets (1999) apply this methodology, with certain adjustments, to G7 nations, highlighting the value of the analysis in informing policy decisions.

Thus, many central banks to achieve price stability employed a range of monetary policy tools by utilizing macroeconomic models. Dynamic Stochastic General Equilibrium (DSGE) models have become widely used in contemporary macroeconomics, particularly within central banks. After the Great Financial Crisis of 2008-2009, there was significant criticism and scrutiny directed toward DSGE macroeconomists and the DSGE approach, both from within and outside the economics community. In recent times, numerous central banks have adopted the use of FPAS, which stands for Forecasting and Policy Analysis Systems. FPAS models have gained popularity in monetary policy analysis due to their ability to capture the essential aspects of an economy in a simple manner (Laxton et al., 2009). The model provides a means to comprehend the monetary transmission mechanism and the dynamics of economic shocks. It is also relevant for making predictions. All central banks primarily utilize these models to focus on their objective functions. These models relate to stabilization strategies that aim to reduce inflation, stabilize consumption, and stabilize investment. It is pertinent to mention that apart from inflation, Potential Output and Output Gap were the important variables in determining the state of the economy in these models.

In Pakistan, like other countries, the output gap was used as an indicator to measure the level of inflationary pressure within the economy. Thus, the output gap served as a crucial connection between the real sector (production of goods and services) of the economy and inflation. Pakistan has faced several Balance of Payments (BOP) crises in the past, leading to multiple instances of seeking assistance from IMF programs. These crises arise due to imbalances in production and expenditure. Production generates value-added income, which can be utilized for consumption and investments, including both private and public expenditures. When expenses surpass income, net

exports will be negative. If deficits in net exports cannot be financed by other current account elements, such as remittances and net capital inflows, then there would be a need to find alternative sources of financing. In such a scenario, the depletion of official reserves and/or a depreciation of the exchange rate may occur. Though GDP characterizes the economic condition of the country, Gross Fixed Capital Formation (GFCF) is used as a key driver of productive capacity, as it includes both private and public investment. However, if the level of production is affected by the degree of utilization of existing production capacity, it will also create an output gap. Hence the equilibrium path will be defined where production is equal to potential. In this scenario, inflation is equal to the targeted inflation rate, nominal and real interest rates accurately represent their equilibrium values, fiscal policy is neutral with economic cycles, and both the current account and fiscal balances are sustainable. Shocks in production and expenditures can disrupt the equilibrium path, resulting in imbalances in inflation, balance of payments, employment, and growth. To address these imbalances, it is necessary to implement suitable monetary and fiscal policies, along with structural policies, to minimize the magnitude and duration of these deviations same was the case seen in Pakistan. The State Bank of Pakistan conducted monetary policy intending to control inflation and to minimize the overall output gap in the economy mainly through changing policy or interest rates. Likewise, Fiscal policy can be utilized to address the output gap, either through expansionary or contractionary measures. Given the frequent occurrence of positive output gaps, in Pakistan, fiscal policy remained contractionary i.e., reducing government expenditure along with increasing taxes to decrease aggregate demand.

Monetary policy instruments impact the output gap and inflation through various transmission channels, including the interest rate, exchange rate, credit, asset prices, and expectations channels (IMF WP15/99, p.18). Likewise, in the case of fiscal policy instruments. The transmission channels and effectiveness of monetary policy and fiscal policy are enhanced if the degree of homogeneity in output gap fluctuations across various economic sectors increases. The importance of the output gap concept is heightened when there is greater heterogeneity across sectors in the economy. These arguments propose the inclusion of sector-specific estimates of potential output and output gaps in addition to economy-wide estimates. However, fiscal and structural policies can be targeted toward addressing sector-specific concerns. In such cases,

sectoral potential output and output gap estimates are informative and facilitate improved outcomes.

### 3.2.3. The Neutral Rate of Interest in Pakistan

Historically, central banks have manipulated interest rates to influence various economic factors, such as the demand for goods and services, economic productivity, the impact of the banking money multiplier, and inflation. However, the impacts of monetary policy often exhibit delays and pose challenges in terms of assessment. Furthermore, economic agents are increasingly responsive to signals conveyed through monetary policy and their anticipations for the future. There exists a substantial body of academic and official literature, primarily from central banks, that discusses the principles of optimal monetary policy and the factors that influence short-term policy rates.

In 1979, the Federal Reserve implemented a significant monetary policy tightening, raising interest rates from around 10% to nearly 14%. When adjusted for inflation, the real interest rate reached approximately 5%. At the time, many doubted whether this move would sufficiently combat the surging inflation. Unfortunately, these concerns proved justified. Inflation continued to rise, peaking at around 15% in the following year, prompting further interest rate hikes and a subsequent recession to address the crisis. Following the onset of the global financial crisis in 2007, central banks in advanced economies implemented expansionary monetary policies by lowering short-term interest rates to near-zero levels. This approach, however, constrained their capacity to implement additional reductions. In response to the global financial crisis of 2008, the Federal Reserve and other central banks worldwide lowered nominal and real interest rates to near-zero levels. This action was taken nearly three decades after a similar approach was implemented. Commentators and policymakers expressed concern over the perceived inadequacy of interest rates in stimulating demand and inflation. Once again, these concerns were justified, as inflation remained consistently low for most of the subsequent decade. These contrasting examples prompt a noticeable inquiry. How can a real interest rate of 5% be considered low and a real interest rate of 0% be considered high within the same country? Most responses assume that a specific real interest rate can have varying macroeconomic effects. The effect of real interest rates is relative to a specific reference point. When real interest rates drop below this benchmark, they have a stimulative impact, increasing demand and inflation.

Conversely, when real interest rates exceed this threshold, they become contractionary, leading to decreased output and inflation. It's important to note that this benchmark can shift over time, meaning the same real interest rate may be considered either high or low depending on the economic context.

Macroeconomists often refer to a specific interest rate as the "neutral" or "natural" rate, which neither boosts nor hinders economic growth. This rate aligns with the economy's potential output and maintains stable inflation. When the real interest rate falls below this natural rate, it's like stepping on the economic accelerator, while raising it above the natural rate is like applying the brakes. The natural rate is generally seen as independent of monetary policy, shaped by market forces. This rate plays a crucial role in assessing monetary policy and determining the sustainability of public debt. Policy rules, which incorporate key principles of sound monetary policy, are considered effective benchmarks. However, they also have limitations, including uncertainties around choosing inflation and economic activity measures, and the speed of response to changes in these variables. Moreover, the neutral interest rate, a critical component of policy rules, is subject to uncertainty and potential fluctuations over time. The decline in the neutral interest rate is thought to be caused by various factors, such as slower productivity growth, demographic changes, global saving and investment patterns, and increased demand for safe assets (Holston, Laubach, & Williams, 2017). The initial difference rule does not address this issue. Research suggests that this rule could result in higher levels of unemployment and inflation volatility, which may present additional challenges. Academic research on these rules is based on rational expectations models and assumes that economic agents possess a complete understanding of both the rule and the model. If the assumptions underlying the models are not satisfied, the anticipated advantages of employing simple rules may not be fully realized.

Monetary policies in Pakistan have experienced significant changes throughout its history. Historically, money was considered a crucial policy tool. However, starting in 2004, the focus of monetary policy has shifted towards interest rates. Furthermore, since August 2009, an interest rate corridor system has been adopted (Hanif, 2014).

Several studies have sought to establish the causal link between Pakistan's interest rate and its economic growth. An important consequence is that an increase in interest rates raises borrowing costs, leading to a decrease in investment. Higher income leads to

greater investment. The fiscal impact was disregarded in this debate. In the current era, the primary fiscal challenge is to assist the most vulnerable individuals in society, while also addressing the significant issue of increasing interest payment obligations.

Following the impact of Covid-19, Pakistan's economy has also been affected by inflation driven by food and energy prices. The overall price level continues to increase due to various contributing factors. Several significant factors contribute to the current situation, including the decline in foreign exchange reserves and the subsequent devaluation of the currency, the scarcity of essential crops caused by flash floods, and the prevailing political and economic uncertainty. As a response to the recent increase in prices, the SBP has adjusted its policy rate from 7 percent in June 2020 to 21 percent in April 2023 to address inflation. The SBP's tight policy stance has failed to effectively control inflation, leading to unintended consequences for real economic activity and placing a burden on government expenditure. The inflation rate and interest rate in Pakistan exhibit a positive co-movement, as depicted in the figure below.

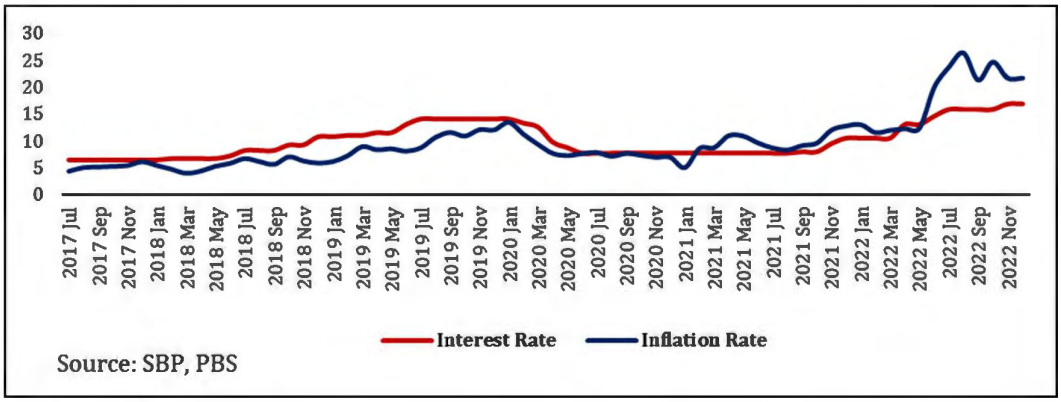



***Fig – 3.3: Trend Interest Rate and Inflation Rate***

However, it is unclear whether the interest rate influences the inflation rate or vice versa. Thus, we delve into a more in-depth analysis of the matter. Initially, a higher interest rate can have a favorable impact on the cost of borrowing, with producers passing on a portion of this to consumers. Interest rates and inflation rates are positively correlated. In addition, the impact of interest rates on investment is unfavorable as it increases the cost of borrowing for both fixed investment and working capital. This results in a decrease in economic activity, particularly within the industrial sector as shown in the figure below:

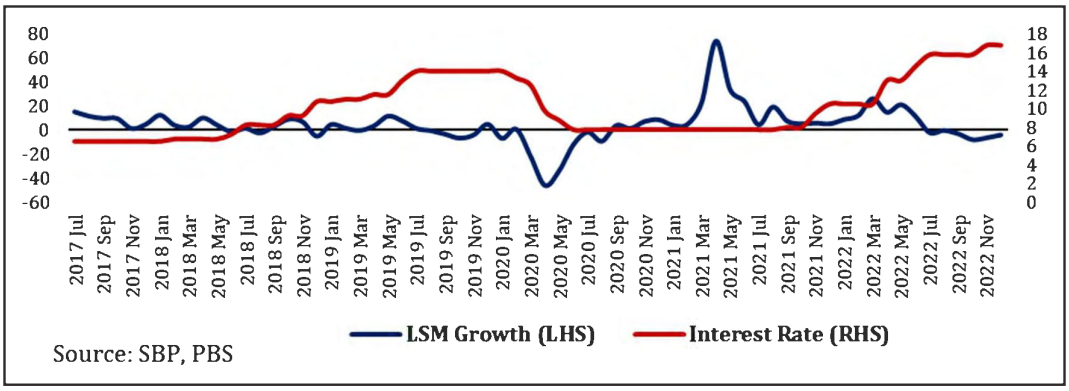



***Fig – 3.4: Trend Interest Rate and LSM Growth***

Thus, exacerbated supply shortages and contributed to the persistence of high inflation rates and monetary policy remained ineffective not only in addressing but also impacted economic activities. On the fiscal side, it was also impacted by a rise in government expenditure mainly due to interest payments.

Historically, whenever, Pakistan experienced significant imbalances between production and expenditures from a macroeconomic perspective, these imbalances led to a major crisis in the Balance of Payments (BOP), necessitating the implementation of multiple programs by the International Monetary Fund (IMF). The frequency of crises at the balance of payments (BOP) indicates a lack of sufficient response by policymakers to the diverse shocks encountered. Misaligned policies are responsible for the observed aberrations in terms of their magnitude and duration, resulting in a consistent rise in the overall public debt, both in absolute terms and relative to GDP. The most important aspect is the imposition of strict constraints on fiscal capacity due to a rise in the proportion of spending allocated to interest payments and a decreased ability to generate additional revenue. The economy's vulnerability and exposure to risk were heightened by the public debt, which stood at 216.4 billion dollars, equivalent to 87.2% of GDP, as of June 2020. The primary factor responsible for the increase in public debt, comprising 71% of the overall debt, is the accumulation of interest on overdue debt.

In the case of Pakistan, there has been a lack of focus on estimating neutral interest rates. In principle, the SBP should have an estimate of the neutral policy rate, but never communicated not published any estimate of this parameter. The study thus aims to estimate the neutral interest rate with the proposition that the divergence of the interest rate from the neutral rate could potentially amplify the macroeconomic imbalances.

### 3.2.4. Debt Dynamics

For the development of prudent macroeconomic policy in any economy, an evaluation of the factors influencing debt dynamics and debt sustainability is essential. The significance of macroeconomic flaws is closely tied to rising debt levels, particularly for nations with high levels of debt and financial constraints. High levels of public debt hinder capital accumulation and economic growth, making debt sustainability essential for achieving macroeconomic equilibrium in these economies. Developing nations are particularly vulnerable to this threat, as economically strong nations can fulfill their debt obligations logically. To develop appropriate macroeconomic policies for economies facing chronic budget deficits, weak macroeconomic fundamentals, and increasing debt levels, it is essential to analyze debt dynamics and assess debt sustainability. Countries accumulate debt through borrowing funds. Borrowing allows countries to fund essential development programs and projects, but excessive borrowing can strain a nation's finances and potentially result in default. The ability of low-income countries and emerging market economies to maintain high levels of debt has raised concerns in recent years. The COVID-19 pandemic has led to increased expenditure for countries as they strive to address the health and economic impacts of the virus. The rise in public debt is expected to worsen the conflict between achieving crucial development goals and managing debt risks.

Sustainable public debt refers to a situation where a country's government can fulfill its present and future payment obligations without relying on extraordinary financial aid or defaulting. Debt sustainability is essentially a probabilistic concept, according to Blanchard (2023). Debt can be considered sustainable if the likelihood of a debt explosion is low; however, he does not yet have a clear understanding of the word "explosion" or "small." Analysts examine the feasibility and compatibility of policies aimed at stabilizing debt to sustain growth potential and development progress. Refinancing risks are significant when countries borrow from financial markets.

The definition of public debt varies depending on its intended purpose. The conventional understanding of public debt encompasses various entities, such as the general government, public non-financial corporations, public financial corporations, and the central bank. Additionally, it encompasses publicly guaranteed debt, which refers to debt that is not held by the public sector but is still obligated to be funded, as well as external public debt, which refers to debt held by non-residents.

Each nation must develop a budgetary strategy to allocate funds for economic assistance during future recessions. Highly indebted nations must either increase their revenue or decrease their excessive expenditure. This is particularly relevant in cases where there is a disparity between current economic growth and long-term potential growth, such as in the United States, or when countries like Brazil and Italy face high borrowing costs and substantial financing requirements.

Nevertheless, these countries must continue investing in education, health, and infrastructure. This can be achieved by reallocating funds or expanding the tax base through the elimination of tax exemptions and the improvement of tax administration. In countries like Germany and Korea, where financing is not a major issue, policymakers can enhance the economy in the short term and foster inclusive growth in the long term by directing more investment toward infrastructure and education. Global economic development has slowed down in recent years, while public debt levels have remained high. Demographic shifts and technological development are currently altering the global economy. Debt sustainability is increasingly prioritized in policy, particularly within fiscal frameworks. Institute for International Finance research in its report 2021 indicates that worldwide debt reached approximately $300 trillion, equivalent to 356 percent of global GDP. Over the last five years, there has been a significant 30 percentage point increase in the global debt-to-GDP ratio, leading to an exceptional level of debt. Analysts are increasingly concerned about the potential adverse impacts of high levels of debt.

Pakistan has experienced persistent budget deficits. Higher fiscal deficits increase domestic and overseas borrowing, which raises debt to GDP. In 2016, the Fiscal Responsibility and Debt Limitation Act, of 2005 was revised to handle public debt. The debt-to-GDP ratio has risen from approximately 60 percent in 2010 to 74 percent in 2022. The increasing debt level has not only caused macroeconomic issues but also presented a risk of national insolvency. Given the prevailing circumstances, it is imperative to undertake a comprehensive analysis of Pakistan's debt dynamics. The following figure (3.5) depicts the debt as a percentage of GDP over the last few years:

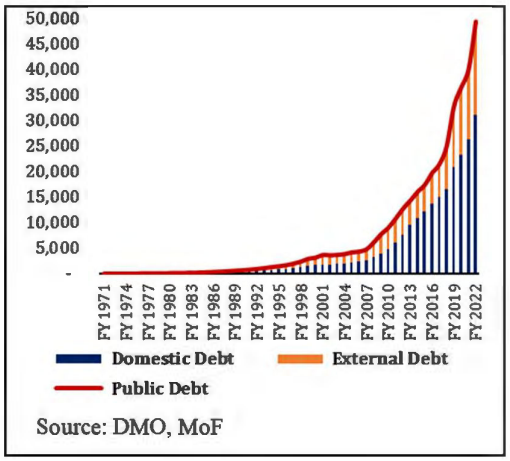



*Fig – 3.5.a: Public Debt (Rs Billion)*

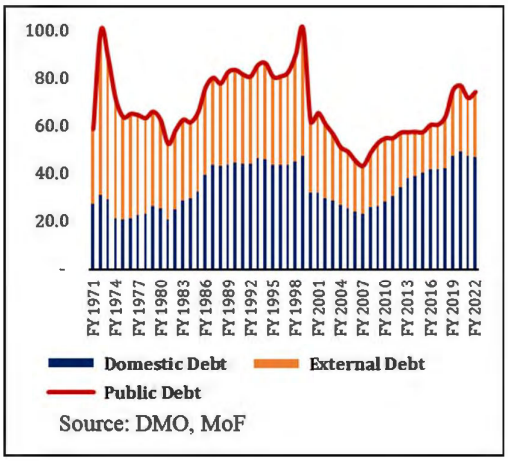



*Fig – 3.5.b: Public Debt to GDP Ratio*

Debt Management Office started publishing the Public Debt Bulletin in FY 2020, the major contribution to the change in debt was from interest expenses, exchange rate variations, and primary balance[10]. To understand debt dynamics, it is necessary to understand the composition of financing and government.

It is important to mention that in Pakistan, budget deficits are also financed by foreign grants, which are different from debt. As per the definition used by the Debt Management Office (DMO), Ministry of Finance[11], Total Public Debt is given as:

Total Public Debt = Domestic Debt + External Debt (which includes debt to IM by both the Federal Government, for budget support and by the Central Bank for BOP support).

The broad categories of Government Debt are Domestic Debt and External Debt which are further classified as:

- Domestic Debt:
    - Long Term Debt (PIBs, Sukuk, NSS, Prize Bonds)
    - Short-Term (T-Bills, MRTBs)
- External Debt:
    - Long-Term (Multilateral including IMF, Bilateral, Eurobonds)
        - Of which IMF (Budget Support)
        - Of which IMF (BOP Support)

[10] https://www.finance.gov.pk/dpco/Debt_Bulletin_Dec_2020.pdf
[11] https://www.finance.gov.pk/dpco_publications.html

- Short-Term (Commercial)

External Debt is reported in US$ but also translated into Rupees by using the End of Period Rs/US$ Exchange Rate. The last-day average exchange rates (to translate amounts from US$ into Rs and back) are provided by the Debt Management Office (DMO).

Furthermore, from DMO we additionally have the following distinction:

- Total Public Debt as defined above including all IMF Debt;
- Total Domestic Debt according to the FRDL act, which deducts Government deposits from Total Public Debt.

Hence, the difference between both debt definitions is Government Deposits.

There are two dimensions to Pakistan's debt characteristics. First, external debt is largely concessionary loans obtained from multilateral lenders. But at times also commercial loans are being contracted, mainly in the form of Floating Rate Notes. Both are contracted in foreign currencies so their debt servicing depends on foreign interest rates and the Rupee exchange rate. A particular complication concerning foreign currency debt is that repayment needs the availability of a sufficient stock of foreign currencies. If this stock of reserves is insufficient, issues concerning external debt defaults may arise. Therefore, the recourse to domestic currency debt remains a crucial financing channel.

Second, before the new SBP law, domestic debt was financed in large proportion by central bank financing. This reduced significantly the servicing cost of domestic debt by essentially removing the financing constraint. On the other hand, such financing is known to create potential negative economic consequences in the form of higher inflation and/or the creation of BOP deficits. But since FY 2018, the monetary budget financing tap has been closed off. Therefore, excessive domestic debt expansion is putting upward pressure on domestic interest rates and hence on debt servicing additionally it may seriously limit the fiscal space for policy initiatives if a growing proportion of current expenditure needs to be allocated to interest payments.

Debt sustainability analyses are necessary to examine vulnerabilities associated with both total public debt and the structure of debt, which is a significant source of risk. Short-term government debt that is tied to short-term interest rates or foreign exchange

rates can quickly lead to difficulties in repaying the debt when there are fluctuations in the domestic and foreign money markets and the foreign exchange markets. The study thus, discusses the various determinants of debt dynamics in Pakistan and explores future debt dynamics and uncertainties surrounding them. In Pakistan, the operational framework for avoiding debt instability and unsustainability is provided in the Fiscal Responsibility law. We find that converging to a Debt to GDP ratio of 60% as implied in the FRDL act would require a massive improvement in the primary balance and/or putting the economy on a higher potential growth path. Given the relationships between growth, cyclical conditions, interest rates, and public debt, the analysis of the dynamics in these macroeconomic magnitudes and their interrelationships are at the core of this thesis.

# Chapter – 4

## Data & Methodology

### 4.1. Data Collection and Variables Selection

The research consists of three analytical chapters that aim to discuss the desired objectives. Different variables were used in the analysis, based on the specific objective and hypothesis. The frequency of most of the variables is annual covering the period from 1971 to 2022. Sources for data on these variables are secondary as the requisite data have been taken from the State of Pakistan's Economy published by the State Bank of Pakistan, the Pakistan Economic Survey published by the Ministry of Finance, and Annual National Accounts published by the Pakistan Bureau of Statistics. An overview of Data for the requisite variables is given below:

**Ministry of Finance:**

- Fiscal Operations data (Revenues, Expenditures, Fiscal Balance, Primary Balance)
- Debt (External Debt, Domestic Debt)

**Pakistan Bureau of Statistics:**

- National Accounts data (GDP, Gross Fixed Capital Formation, Price Indices)

**State Bank of Pakistan:**

- Monetary Aggregates
- Policy Rate
- Exchange Rate

The selection of variables for the analysis was contingent upon the specific objective and hypothesis at hand. The following sections provide a brief overview of the variable names, abbreviations, and descriptions applied to each intended objective.

### 4.1.1. Potential Output & Output Gap: Overall Economy & Sectoral Disaggregation

The variables used are given as follows:

**Table – 4.1: Variables Used in Analysis of Potential Output & Output Gap**

| Abbreviation used | Name of the variable | Description | Rationale |
|---|---|---|---|
| TGVA | Gross Value Added | It is the total output (Agriculture + Industry + Services) Gross Value Added (GVA) at basic prices calculated after subtracting Intermediate consumption. Intermediate Consumption refers to the expenditure on goods and services used up in the production process before the final product is created. This expenditure is measured at the prices paid by the purchasers. | GDP characterizes economic activity. It represents actual value added at constant prices and is used in estimating potential output and the output gap. In Pakistan, Gross Value Added is used, therefore TGVA is used for estimating the overall Output Gap |
| TGVAAGRI | Gross Value Added in Agriculture | To estimate value added, the sector has been subdivided into Crops, Livestock, Forestry, and Fishing. Crop production and animal husbandry are the two primary agricultural activities. Cotton ginning has been categorized as an agricultural activity rather than a manufacturing one, and consequently moved to the cereals sub-class. The flower yield has been estimated via survey and is included in the subclass. Animal husbandry and hunting (both non-government and therefore private) are modified concurrently with livestock. | The study is interested in estimating the sectoral Output Gaps. Thus, Gross Value Added in Agriculture is used to estimate the Output Gap in Agriculture sector |
| TGVAIND | Gross Value Added in Industry | Gross Value Added (GVA) in the industrial sector encompasses Mining and Quarrying, Manufacturing, Construction, Electricity, Gas, and Water Supply. The manufacturing sector is the largest, consisting of two sub-sectors: large-scale manufacturing and small-scale manufacturing. Large-scale manufacturing encompasses establishments that are registered under the Factories Act of 1934 or meet the criteria for | The study is interested in estimating the sectoral Output Gaps. Thus, Gross Value Added in Industry is used to estimate the Output Gap in Industry sector |

| | | | |
|---|---|---|---|
| | | registration, which includes having a workforce of 10 or more employees. This category also includes repair and service industries. Small-scale manufacturing encompasses manufacturing establishments that are not included in large-scale manufacturing. | |
| TGVASER | Gross Value Added in Services | The (internationally agreed upon) Central Product Classification (CPC) is used to classify services as products. They could theoretically be produced or supplied by any industry. Real estate services, for instance, may be provided by any type of enterprise with under-utilized building capacity that can be rented out. Other examples include research or educational services that may be produced as a secondary activity by units classified as manufacturers based on their primary activity. Other Private Services, Finance & Insurance, Wholesale & Retail Trade, Transport, Storage & Communication, Housing Services (including home ownership), and General Government Services are the subcomponents. | The study is interested in estimating the sectoral Output Gaps. Thus, Gross Value Added in Services is to estimate the Output Gap in the Services sector |
| TGFCF | Gross Fixed Capital Formation | Gross fixed capital formation (GFCF) is the investment as it includes manufactured fixed assets used in manufacturing operations for more than a year. It is subdivided into public, general government, and private. For details, the Pakistan Bureau of Statistics website can be visited | Gross Fixed Capital Formation at constant prices is used for estimating potential output. |
| TGFCFAGRI | GFCF in Agriculture | Gross Fixed Capital Formation (GFCF) in agriculture has been computed by PBS separately for the private and public sectors due to variations in data sources. The primary elements of private sector gross fixed capital formation (GFCF) in agriculture include domestic production and imports of agricultural machinery, the | As the study estimates sectoral output gaps, the GFCF in Agriculture which is Fixed Investment in Agriculture is included in the analysis to estimate agricultural potential output and the output gap |

| | | | |
|---|---|---|---|
| | | installation of tube wells, cultivated assets such as livestock and timber, and land improvement.<br>The elements of rural infrastructure include farms, buildings, wells, farm transport, water courses, orchards, and non-monetized gross fixed capital formation (GFCF). | |
| TGFCFIND | GFCF in Industry | PBS provides estimates of the Gross Fixed Capital Formation of each component of the industry for the Private and Public Sectors as well as the General Government. | As the study estimates sectoral output gaps, the GFCF in Industry which is Fixed Investment in Industry is included in the analysis to estimate industrial potential output and the output gap |
| TGFCFSER | GFCF in Services | PBS provides estimates of the Gross Fixed Capital Formation of each component of Services for the Private and Public Sectors as well as General Government | As the study estimates sectoral output gaps, the GFCF in Services which is Fixed Investment in Services is included in the analysis to estimate services' potential output and the output gap |

After finding the potential output, the output gap has been calculated which is then used in the analysis. TGVAGAPAGRI is the output gap in agriculture, TGVAGAPIND is the output gap in the industry and TGVAGAPSER is the output gap in services.

To analyze the impact of monetary policy, Policy Rate (PR) has been used as a policy instrument while for fiscal policy Primary Fiscal Balance to GDP ratio (PFBR) has been used.

There is significant ambiguity regarding the identification of accurate official data for Pakistan. We engaged in a discussion regarding this matter with Pakistan Bureau of Statistics (PBS) personnel. Based on our discussions, it has been concluded that the official data published in the Pakistan Statistical Yearbooks (PSY) are considered the final data. These yearbooks are published annually. The data published in the PSY does not align with the NA data published in '50 Years of Pakistan Volume III, as they cover different time periods. There are discrepancies between the data published in the Economic Survey (ES) and the State Bank of Pakistan's Handbook for certain periods. The observed disparities stem from periodic data updates, specifically adjusted in the PSY but not uniformly across all time periods in the other publications mentioned.

Detailed National Accounts (NA) data have been collected from the PSY for these reasons.

Table 2 on the PBS website contains the NA main aggregates at constant prices. The tables distinguish three base periods: 1980-81, 1999-00, and 2005-06 prices. The data utilized in the thesis have four distinct base years: 1959-60, 1980-81, 1999-00, and 2005-06. Overlapping data for the relevant year are provided whenever there is a change in the base year. This enables the calculation of Conversion Factors (CF) for converting historical data to the current base period (Detailed Methodology is given in Appendix – A).

### 4.1.2. The Neutral Rate of Interest in Pakistan

For the neutral rate of interest, the variables used were Potential Output and Output Gap as estimated during the estimation of the output gap in each sector. The other variables used are given as follows:

**Table – 4.2: Variables Used in Analysis of Neutral Interest Rate**

| Abbreviation used | Name of the variable | Description | Rationale |
|---|---|---|---|
| CMR | Call Money Rate | the interest rate on short-term loans is published by the State Bank of Pakistan monthly which is aligned with the policy rate decided in the monetary policy of SBP. | The interest rate is used by all central banks to address the output gap. Call Money Rate/Reverse Repo Rate is used for the proxy of interest rate |
| M2 | Money Supply | It is the sum of Net Domestic Assets (NDA) and Net Foreign Assets (NFA) published by SBP weekly | Money supply is the supply side of the money market and hence a determinant of the equilibrium interest rate. |
| interest rate. | Gross Domestic Product | Gross Domestic Product (GDP) is determined by adding taxes on products within the Gross Value Added (GVA) and subtracting subsidies on products. | It is one of the determinants of, the demand for money. |
| CPI | Consumer Price Index | The growth in CPI measures inflation. The recent base year used by PBS for CPI calculation is 2015-16 | Is used as a deflator of nominal variables to express them in real purchasing power. |
| ER | Exchange Rate | An exchange rate refers to the rate at which one currency can be exchanged | Is used to translate foreign currency- |

| | | |
|---|---|---|
| | for another currency, and it has significant implications for international trade and the flow of capital across nations.<br>In analysis, we used it as a ratio of domestic currency expressed in foreign currency i.e., $, so 1 $ = X Rs, thus X was used as ER | denominated variables, such as foreign debt, into domestic values. |

When the interest rate deviates from the neutral rate, the estimated impact on the economy is determined by analyzing the impact of the deviation on the trade balance (TB) measured in dollars.

### 4.1.3. Debt Dynamics and Implications of Policy Misalignments

The statistical methodology for exploring this reconciliation between changes in stocks and flows is given below[12]:

CS = OS + T + VC + OCVA

Where CS = Closing Stock

OS = Opening Stock

T = Transactions

VC = Valuation Changes

OCVA = Other Changes in the Volume of Assets

For Debt analysis, the variables used are given below:

**Table – 4.3: Variables Used in Debt Analysis**

| Abbreviation used | Name of the variable | Description | Rationale |
|---|---|---|---|
| CDR | Change in Debt to GDP Ratio | It is the nominal value of Debt expressed in Rs divided by GDP at current prices | Is the main dependent variable in the debt analysis |
| GRGDP | Growth rate of GVA | GVA is defined earlier. It is the GVA at constant prices. Here we have used its growth rate | Is an important indicator of the debt dynamics |
| TDC | Weighted Implicit Cost Total Debt | implicit interest cost on domestic debt by dividing total domestic interest payments as reported in | Is an important indicator of the debt dynamic |

[12] Monetary and Financial Statistics Compilation Guide by IMF

| | | | |
|---|---|---|---|
| | | FO by the stock of domestic debt as reported at the end of the previous FY. Likewise implicit cost for foreign debt and then converted into weights as per the ratio of domestic and foreign debt in total debt | |
| PBR | Primary Balance to GDP Ratio | The primary balance is the fiscal balance minus interest payments. The ratio is obtained by dividing the primary balance by GDP at current prices. Positive primary balance implies surplus and negative primary balance shows deficit. | Is an important indicator of the debt dynamics |

### 4.1.4. Statistical Nature of Main Variables

The variable descriptions can be found in Appendix - IV. Presented in the following table is the statistical nature, as measured by the degree of integration:

**Table – 4.4: Statistical nature of main variables**

| | |
|---|---|
| TGVA | I (1) * |
| TGVAAGRI | I (1) |
| TGVAIND | I (1) |
| TGVASER | I (1) |
| TGFCF | I (1) |
| TGFCFAGRI | I (1) |
| TGFCFIND | I (1) |
| TGFCFSER | I (1) |
| CMR | I (0) |
| M2 | I (1) * |
| GDP | I (1) * |
| CPI | I (1) * |
| ER | I (1) * |
| CDR | I (0) |
| GRGDP | I (0) |
| TDC | I (0) |
| PBR | I (0) |

*Means I (2) according to the Augmented Dickey-Fuller test (ADF), and I (1) according to the Phillips-Perron test (PP)
Source: Author's Estimation

It is also mentionable that the default stationarity test, the Augmented Dickey-Fuller test (ADF), and the Auxiliary test: the Phillips Perron test (PP) were used

## 4.2. Methodology

As discussed earlier, this study aims to examine the misalignment in macroeconomic policies, specifically the monetary and fiscal policies, that have led to macroeconomic instabilities in Pakistan. These instabilities have been caused by the absence of knowledge on the sectoral transmission of monetary policy, unwarranted low or high interest rates in some periods, and periods of excessive expansionary fiscal policies. Macroeconomic instabilities arise when significant deviations occur between key macroeconomic indicators and policies from their equilibrium paths. In this regard, the research methodology is discussed describing the individual methodology needed to reach the respective objective. Firstly, the methodology to estimate the sectoral output gap is discussed, then the methodology for estimating a neutral interest rate, and finally the methodology for discussing debt dynamics is explained.

### 4.2.1. Potential Output & Output Gap: Overall Economy & Sectoral Disaggregates

The methodology used in this study is somewhat different from the traditional approaches. The overarching goal is to eliminate mechanical filters for some explanatory variables while staying true to neo-classical supply-side theory. The derivation is based on a traditional cost minimization approach with Cobb-Douglas production technology. However, even this derivation is somewhat non-conventional because of the necessity to circumvent the absence of data on the prices of production factors capital, and labor.

The production function relates the generation of GVA to increased inputs of Capital (K) and Labor (L) and technological progress. In a Cobb-Douglas production technology (with constant returns to scale and absence of technological progress): (Cobb & Douglas, 1928)

$$GVA_t = AK_t^{\alpha} L_t^{1-\alpha} \qquad (4.1.1)$$

Where A is a proportional technical coefficient and α is the technical coefficient of the production factor K. Technological progress can take different forms. Neutral disembodied technological progress neither uses nor saves capital or labor. Embodied technical change can be capital or labor-saving. The easiest way to incorporate neutral technical progress in the Cobb-Douglas case is to allow the scale parameter A to vary

over time in the form: $A_t = A_0 e^{\gamma . t}$ (Uzawa, 1961; Romer, P. 1990; Boskin and Lau 2000)

Where $A_0$ is a constant, t is a time trend, γ is the rate of technical progress, and e is the Napierian number.

Labor-saving technology can be considered by measuring the input of labor in terms of efficiency units such that L is measured as $\left(e^{\mu . t} L\right)^{1-\alpha}$

The production function then becomes

$$GVA_t = A_0 e^{\gamma . t} K_t^{\alpha} \left(e^{\mu . t} L_t\right)^{1-\alpha} \tag{4.1.2}$$

We expect the capital-labor ratio (where the latter is measured in efficiency units) to be constant on the equilibrium path (this expression results from cost minimization):

$$\frac{K}{e^{\mu . t} L} = \lambda \tag{4.1.3}$$

This will occur if real wage growth matches the growth in labor-embodied technical progress, implying that labor is not sharing the benefits of other types of technical progress. We make this assumption to be able to explain potential stylized facts.

Substituting (4.1.3) in (4.1.2), along the steady-state growth path:

$$GVA_t = \frac{A_0 e^{\gamma . t}}{\lambda^{1-\alpha}} K_t \tag{4.1.4}$$

In terms of changes:

$$\Delta GVA_t = \frac{A_0 e^{\gamma . t}}{\lambda^{1-\alpha}} \left[K_t - (1-\gamma) K_{t-1}\right] \tag{4.1.5}$$

The relationship between GFCF and capital stock accumulation is usually represented as:

$$GFCF_t = \Delta K_t + D_t \tag{4.1.6}$$

Where D is the depletion (depreciation) of the existing capital stock.

On depreciation, the standard assumption is that it is proportional to the existing capital stock:

$$D_t = \delta K_{t-1} \tag{4.1.7}$$

Where δ is the depreciation rate. Hence:

$$GFCF_t = \Delta K_t + \delta K_{t-1} = K_t - (1-\delta)K_{t-1} \quad (4.1.8)$$

From which:

$$K_t = GFCF_t + (1-\delta)K_{t-1} \quad (4.1.9)$$

The same expression must hold in all periods, e.g., in the previous period:

$$K_{t-1} = GFCF_{t-1} + (1-\delta)K_{t-2} \text{ and equally for all past periods} \quad (4.1.10)$$

Therefore:

$$K_t = GFCF_t + (1-\delta)GFCF_{t-1} + (1-\delta)^2 K_{t-2} \text{ and equally for all past periods} \quad (4.1.11)$$

If the growth rate of GFCF is a stationary variable (which in Pakistan it is), we can assume the existence of a steady state growth rate g, such that along the steady state:

$$\frac{GFCF_{t-1}}{GFCF_t} = \frac{1}{1+g} \quad (4.1.12)$$

Repeated substitution of (4.1.12) and (4.1.10) in (4.1.11) results in the following steady-state relation between the capital stock and GFCF:

$$K_t = \frac{(1+g)GFCF_t}{g+\delta} \quad (4.1.13)$$

And: $K_{t-1} = \frac{GFCF_t}{g+\delta}$ (4.1.14)

Substituting (4.1.13) and (4.1.14) in (4.1.5) gives the steady-state relation between GFCF and changes in GVA:

$$\Delta GVA = \frac{A_0 e^{\gamma \cdot t}}{\lambda^{1-\alpha}} \left( \frac{g+\gamma}{g+\delta} \right) GFCF \quad (4.1.15)$$

Equation (4.1.15) shows an inverse Incremental Capital Output Ratio (ICOR). However, due to technical changes, the effect of additional GFCF has an increasing output effect. This implies that the same amount of investment spending has a larger output effect today as compared to the past. The reason is that the economy increasingly gains in efficiency, making GFCF expenditures increasingly more productive.

In many studies and models (for example in FPAS models) potential output is calculated by applying a univariate approach, among which the Hodrick Prescot filter is the most popular one. The disadvantage of such an approach is that there is no

relationship with economic theory. It therefore gives no information on the long run drivers of economic growth. Economic theory suggests that the steady state path of output (or gross value-added creation) is driven by the production function, among which the Cobb-Douglas function is the most widely used. But this production function is only one part of the determination of production. It must be embedded in an optimal strategy by companies. Profit maximization/cost minimization subject to the production technology is required to obtain an optimized insight in production decisions. Such an approach leads to basic equilibrium relations between core supply side variables. Our approach starts with an approach based on cost minimization subject to a Cobb-Douglas production function. This optimization reveals fundamental equilibrium relationships, such as about the optimal capital-output ratio, optimal capital-labor input ratio, and equilibrium wage formation. According to the production function, value added is produced through the input of capital and labor. But since there exists an optimal relation between capital and labor, the equilibrium path of gross value added can be expressed as a function of capital input only. In terms of dynamics, this results in a relationship between additional value-added created and gross fixed capital formation. This happens to correspond to the inverse of the incremental capital-output ratio. Our approach has shown a theoretical justification of the inverse capital-output ratio.

Thus, the methodology of decomposing TGVA into potential level and deviations from potential which is the output gap. These calculations will be applied to the overall country GDP and the main sectors: Agriculture, Industry, and Services. The economy-wide equilibrium equation links the Total economy GVA (TGVA) to the Total economy-wide GFCF (TGFCF):

Since the empirical analysis showed the absence of neutral technical progress (only labor-saving productivity was detected), the equilibrium equation can be written as:

$$\Delta TGVA = \frac{A}{\lambda^{1-\alpha}}\left(\frac{g}{g+\delta}\right) GFCF \qquad (4.1.16)$$

Or written more compactly:

$$\Delta TGVA = \gamma . GFCF \qquad (4.1.17)$$

Equivalently, the equation (4.1.17) can be written for the three sectors of the economy i.e., Agriculture, Industry, and Services:

$\Delta TGVA_i = \gamma_i . GFCF_i$ whereas (i = Agriculture, Industry and Services) (4.1.18)

When both sides of this equation are divided by GVA:

$$\frac{\Delta GVA_i}{GVA_i} = \gamma_i . \frac{GFCF_i}{GVA_i} \quad (4.1.19)$$

The interpretation of equilibrium condition can now be interpreted as the fundamental long-run potential growth rate of the economy/sectors determined by their respective propensities to invest.

To take account of delayed adjustments with which new GFCF creates additional output (GVA), an ARDL eq is used. Recent empirical papers also include the so-called Autoregressive Distributed Lag (ARDL) test. This examination is based on Pesaran and Shin (1999) as well as Pesaran, Shin, and Smith (2001). This method reportedly offers numerous benefits. The test is based on a single ARDL equation as opposed to a VAR as in Johansen, thereby reducing the number of estimated parameters. In addition, unlike the Johansen method, the restrictions on the number of delays can be applied independently to each variable. Additionally, the ARDL method does not require pre-testing for the order of integration (0 or 1) of the model's variables (detail in Appendix – C).

For the total economy:

$$\Delta^2 TGVA_t = \alpha . \Delta TGVA_{t-1} + \beta . TGFCF_{t-1} \quad (4.1.20)$$

With $\alpha < 0$ and $\gamma = -\frac{\beta}{\alpha}$

$|\alpha| < 1$ indicates incomplete adjustment during one year.

The long-run relationship between GFCF and GVA acceleration is thus represented by the following equation:

$$\Delta^2 GVA_t = c(1)\Delta GVA_{t-1} + c(2)\left(Trend_{t-1} GFCF_{t-1}\right) + \sum_{i=3}^{n} c(i)\Delta^2 GVA_{t-i+3} + \sum_{j=n+1}^{m} c(j)\Delta\left(Trend_{t-j+n} GFCF_{t-j+n}\right) \quad (4.1.21)$$

In the short run deviations from this steady state ratio occur due to adjustment costs, reaction lags, and changing uncertainty of economic agents.

Similar ARDL equations were estimated for each of the three main sectors:

$$\Delta^2 GVA_{i,t} = \alpha_i . \Delta GVA_{i,t-1} + \beta_i . GFCF_{i,t-1} \quad (4.1.22)$$

With $\gamma_i = -\frac{\beta_i}{\alpha_i}$

Potential GVA for the total economy (TGVAPOT) and for each of the main sectors (GVAPOTAGRI, GVAPOTIND, GVAPOTSER) are calculated using the estimated ARDL equations to filter observed GVA as published by the PBS).

#### 4.2.1.1. The Rationale for Estimating Output Gaps Sector-wise

The output gaps in the different sectors may behave differently. The contemporaneous correlation coefficient between the OG in the agricultural sector with the other sectors is not statistically significant. The correlation coefficient between industry and services is less than 0. These observations in themselves advance an argument for sectoral disaggregation. Furthermore, a classical aggregation problem presents itself when estimating and using aggregate OG for policy purposes. In this study, it is defined that in each period t, the Output Gaps in each of the sectors i are defined as the percentage difference between the current Gross Value Added (GVA) and its Potential GVA (PGVA):

$OG_{it} = \frac{GVA_{it}}{PGVA_{it}}$ i =3 (AGRI, IND, SER) (4.1.23)

The Total OG (TOG) is then the percentage deviation of the Total GVA (TGVA) from the Total TPGVA (TPTGVA):

$TOG_t = \frac{TGVA_t}{TPGVA_t} - 1$ Or: $1 + TOG_t = \sum_1^i \frac{GVA_{it}}{\sum_1^i PGVA_{it}}$ (4.1.24)

This can be rewritten as: $1 + TOG_t = \sum_1^i \frac{PGVA_{it}}{\sum_1^i PGVA_{it}} \frac{GVA_{it}}{PGVA_{it}}$ (4.1.25)

Whereas, the share of each sector's PGVA in total economy PGVA is given by:

$S_{it} = \frac{PGV_{it}}{\sum_1^i PGVA_{it}}$ And since $OG_{it} = \frac{GVA_{it}}{PGVA_{it}}$

And because the sum of the shares = 1. We obtain the result that the TOG is the weighted average sum of the sectoral OG's are the weights reflect the share of each sector's PGVA in the sum of the sectoral PGVAs: $TOG_t = \sum_1^i S_{it} OG_{it}$

We suppose that the sectoral OG's, which represent the cyclical positions are themselves driven by, among other determinants, the stance of monetary and fiscal policies. The correlation analysis and VAR model estimation reveal that the sectors react differently to shocks in the variables affecting the OG's. So let us, for example,

concentrate on the stance of monetary policy (SMP) and relate this with the Output gaps in each of the sectors (i) over time t using a simple partial adjustment mechanism for illustrative purposes:

$$OG_{it} = \alpha_i + \beta_i SMP_t + \gamma_i OG_{it-1} \quad (4.1.26)$$

i=AGRI, IND, SER

Summing up to obtain the overall total output gap TOG:

$$TOG_t = \sum_1^i S_{it}(\alpha_i + \beta_i SMP_t + \gamma_i OG_{it-1}) \quad (4.1.27)$$

This is the economy-wide OG obtained from summing the sectoral OG equations

When estimating the equation directly on the aggregate OG (AOG):

$$AOG_t = \alpha + \beta SMP_t + \gamma AOG_{t-1} \quad (4.1.28)$$

This implies that:

$\alpha = \sum_1^i S_{it}\alpha_i$ and $\beta = \sum_1^i S_{it}\beta_i$

The coefficients $\alpha$ and $\beta$ when estimated on aggregate data will therefore be stable and correct only when the $S_{it}$ remain constant over time. Furthermore, there is no linear relationship between $\gamma AOG_{t-1}$ and $\sum_1^i S_{it}(\gamma_i OG_{it-1})$.

#### 4.2.1.2. Using Vector Autoregressive for Analyzing Policy Effectiveness

The formulation of VAR models can be achieved through non-recursive (or structural) orthogonalization of the innovation terms of a VAR model in reduced form. This provides an alternative approach to the recursive method. The process of Cholesky orthogonalization involves the researcher imposing theoretical restrictions to identify the orthogonal (structural) components of the error terms. On the other hand, an SVAR model enables the simulation of the dynamic effects of orthogonal structural shocks on the variable system. As a result, the predictions it provides, which involve impulses on the system variables, have a distinct nature compared to the predictions offered by VAR models. The VAR models can be viewed as a simplified version of SVAR models. SVAR models utilize theoretical information to establish the current relationships among the endogenous variables in the model (Kilian & Helmut, 2017). Therefore, many series are included in this study which thus necessitate the use of Vector Autoregressive (VAR) by incorporating a system of autoregressions. Thus, both

standard Vector Autoregressive (VAR) and Structural Vector Autoregressive (SVAR) were implied.

Structural equation:

$$Ay_t = C(L)y_t + Bu_t \quad (4.1.29)$$

Estimated reduced form VAR:

$$y_t = A^{-1}C(L)y_t + e_t \quad (4.1.30)$$

Where:

$A^{-1}Bu_t = e_t$ or $Ae_t = Bu_t$

Restrictions imposed in matrix form by a recursive Cholesky orthogonalization then can be written as:

$$e_t = S\varepsilon_t \quad (4.1.31)$$

**4.2.2. The Neutral Rate of Interest in Pakistan**

The estimation of the neutral rate in Pakistan was difficult due to several factors, including the lack of a single inflation target, high volatility in both inflation and the output gap, and ongoing structural economic and financial changes. The monetary policy strategy also has undergone significant changes in recent years.

The approach we adopted defines the neutral interest rate as the equilibrium interest rate that balances the money market. Our approach posits that inflation in Pakistan is primarily driven by monetary factors in the long term. The same was found by Kamal (2006) that an increase in money supply, in the long run, leads to a higher inflation rate, supporting the quantity theory of money. However, Hanif. et.al (2017) found that in Pakistan, inflation is also influenced by factors such as the exchange rate, international commodity prices, and changes in administered prices and taxes. It is mentionable that the money supply serves as the primary nominal anchor for the economy in the long run. In contrast, the demand for money is influenced by transaction volume, price level fluctuations, and interest rates. The equilibrium interest rate is determined by the point at which the quantity of money supplied is equal to the quantity of money demanded. The hypothesis posits the presence of a stable money demand function. The nominal interest rate can be determined based on the projected paths of real GDP and the factors

influencing inflation. The interest rate, referred to as the equilibrium rate, is subject to temporal fluctuations.

To estimate the unobserved and time-varying natural rate of interest, many econometric techniques have been presented in recent years. There are three broad classes into which these techniques fall: purely time series approaches, semi-structural approaches, and structural approaches.

The first strategy makes use of several distinct types of multivariate time-series models. These include but are not limited to, the univariate local level model, the time-varying-parameter vector autoregression model, and the multivariate trend-cycle decomposition method.

Time-series models offer greater flexibility in estimating the unobserved natural rate by utilizing the available data and imposing fewer constraints in comparison to structural models. Time-series models have limited accuracy in estimating the natural rate and depend on prior or non-structural identifying assumptions. The lack of incorporating the structural relationships between natural interest rates, inflation, and output hampers our ability to identify the factors driving fluctuations in the natural rate, impeding our objectives.

Another research approach involves using semi-structural econometric models, where the natural rate is considered a latent variable. The latent variable is influenced by the trend growth rate of potential output and a unit root process that considers additional determinants. The natural interest rate is determined by the interplay between the output gap, inflation, and the deviation of the real interest rate from its natural level. This is based on empirical evidence from the IS curve and the Phillips curve. Laubach and Williams (2003) were the first to establish this emerging field of study, which has since generated a substantial amount of subsequent research.4 Early research in this field primarily utilizes a closed-economy framework, as demonstrated by studies conducted by Laubach and Williams (2003), Mesonnier and Renne (2007), and Trehan and Wu (2007). Recent research has shown that foreign influences are becoming more significant in determining the natural interest rate in the United States. Natural interest rate estimates for four developed economies (Canada, the Euro area, the United States, and the United Kingdom) are found to have a high degree of international correlation

by Holston et al. (2017). This link between trend growth and natural interest rates shows the importance of global factors.

The semi-structural approach is more suitable for estimating the natural rate compared to pure time-series models because it explicitly represents the relationship between the natural rate and macroeconomic fundamentals. Fiorentini et al. (2018) suggest that the accuracy of estimates for the unobservable natural rate is contingent upon the flatness of either the IS curve or the Phillips curve. Evans et al. (2016) argue that the uncertainty associated with estimating natural rates poses risk management challenges for central banks in formulating monetary policy. Moreover, semi-structural approaches may fail to adequately capture the fundamental structural forces that contribute to the estimated natural rates.

The third strand of literature draws upon structural models, commonly dynamic stochastic general equilibrium (DSGE) or overlapping generations (OLG) models within the New Keynesian framework. When properly constrained, DSGE models permit an accurate assessment of the factors that contribute to changes in the natural rate while simultaneously protecting the integrity of the natural rate estimate. In contrast to pure time series and semi-structural models, DSGE models are useful for evaluating the best monetary policy response to shifts in the natural rate (Andrade et al., 2018). DSGE models estimate the natural interest rate's business-cycle frequency component. This is in contrast to time-series models and semi-structural methods, which give more importance to low-frequency variations in the natural rate. Previous research in the field of Dynamic Stochastic General Equilibrium (DSGE) has predominantly concentrated on estimating the natural interest rate within closed-economy models. This focus has primarily been on major economies such as the United States, the euro area, and Japan.

Estimation of the neutral rate in the case of Pakistan is mired by the absence of a single inflation target, by very high volatility of inflation itself and of the output gap, and by structural economic and financial changes. Also, the monetary policy strategy has been changing over the past.

Therefore, the approach we followed, defines/interprets the neutral interest rate in terms of an equilibrium interest rate, more specifically the rate of interest that equilibrates the money market. The basic premise of our approach is that in the long run, inflation in Pakistan is essentially a monetary phenomenon. Although the exchange rate,

international commodity prices, and changes in administered prices and taxes do influence inflation in Pakistan, in the long run, the nominal anchor of the economy is the money supply. On the other hand, money demand is driven by the volume of transactions, movements in the price level, and the interest rate. The equilibrium interest rate is the one that equates money supply and demand. The assumption made here is that the demand function for money is stable. In terms of monetary policy, for inflation in Pakistan to converge to a low and stable level, the required path of the money supply can be found. Based on forecasted paths of real GDP and the drivers of inflation, the required nominal interest rate can be derived. We will refer to this interest rate as the equilibrium one, which changes over time.

In what follows, a rather different approach will be followed, which mainly concentrates on the nominal interest rate. Furthermore, the emphasis will be on the equilibrium, market-clearing interest rate. In the recent world outlook in April 2023, the IMF has included a chapter on the natural rate of interest: drivers and implications for policy.

A natural way of thinking about the interest rate is as the price/return that clears the financial market or in other words, the interest rate balances the supply and demand for money:

$$MS = P.l(\overset{+}{Y}, \overset{-}{r}) \qquad (4.2.1)$$

Where $MS$ is Money Supply at current prices, $P$ the price level, and money demand $l$ is a positive function of transactions at constant prices, $Y$, and a negative function of the nominal rate of interest $r$. In log-linear form (lower case levels denote logarithms, except for the interest rate):

$$ms - p = \alpha + \beta.y - \gamma.r \qquad (4.2.2)$$

With $\alpha$ an intercept, $\beta$ the income elasticity of the demand for money, and $\gamma$ the semi-interest rate elasticity.

The money supply itself can be written as the product of the money multiplier, $m$, and the monetary base, which itself is the sum of the Net Domestic Assets ($NDA$) and Net Foreign Assets ($NFA$) of the Central Bank:

$$MS = m(NDA + NFA) \qquad (4.2.3)$$

In countries with a fixed exchange rate regime, the change in $NFA$ is directly related to the other transactions between residents and non-residents as they are recorded in the Balance of Payments (BOP). When the exchange rate is purely floating, this link between the BOP and the MS is non-existent. In the latter case, BOP disequilibria will be completely translated into exchange rate adjustments.

Pakistan, like many other countries, is a mixed case. The exchange rate is in principle floating, but the Central Bank regularly intervenes in the foreign exchange market or engages in foreign exchange transactions to avoid disorderly and unwanted movements in the exchange rate.

In fact, the traditional money demand equation (4.2.2) is based on a number of simplifying assumptions. A particularly relevant one is related to the interest rate concept. More precisely, the interpretation of $r$ is the return on non-monetary assets, such as the yield on bonds. In reality, there exists a spectrum of financial instruments, each with its return. Furthermore, Central Banks assume the role of lender of last resort. To that end, they, including the State Bank of Pakistan, offer standing facilities each with their interest rate and with the policy rate oftentimes in the middle of this interest rate corridor. This means that at least at the short end of the yield curve, the Central Bank has the power to set the short-term interbank rates at the level that corresponds to its monetary policy stance. Furthermore, Central Banks use forward guidance to steer market participants' expectations as to the future course of their policy rate. Since longer-term rates reflect these expectations, Central Banks also exert leverage on the longer-term segments of the yield curve (this is even stronger when Central Banks use quantitative easing/tapering).

Given these observations, eq (4.2.2) can also be interpreted as a monetary policy reaction function, with which the Central Bank takes over the market equilibrating role of the interest rate or at least steers the interest rate towards levels that are compatible with what the Central Bank considers to be necessary for overall economic equilibrium. In that case, eq (4.2.2) can be rewritten as (assuming a unitary income elasticity of money demand):

$$r = \frac{\alpha}{\gamma} - \frac{1}{\gamma}[ms - (y + p)] \qquad (4.2.4)$$

The general prices index ($p$) is a weighted average of domestic prices (non-tradable, $p^{NT}$) and of imported products (tradable, $p^{T}$):

$$p = \sigma p^T + (1 - \sigma)p^{NT} \quad (4.2.5)$$

The price of tradable goods is driven by foreign prices ($pf$) and the exchange rate ($e$):

$$p^T = pf + e \quad (4.2.6)$$

Combining equations (4.2.2) to (4.2.6) results in the following general expression of the equilibrium nominal interest rate:

$$r = c_1 - c_2\{log[m(NDA + NFA)] - y\} + c_3 p^{NT} + c_4(pf + e) \quad (4.2.7)$$

Where $c_i$ (i = 2 to 4) are coefficients (semi-elasticities) and $c_1$ is a constant term

Equation (4.2.7) is empirically estimated, based on the following premises:

- It is estimated using monthly data;
- The interest rate $r$ is the weighted overnight repo rate and the call money rate before the introduction of the repo rate. Both should be very close to the SBP's policy rate;
- The activity variable $y$ is measured by the GDP at constant basic prices;
- The money supply $m(NDA + NFA)$ is measured by M2;
- Price of non-tradable $p^{NT}$ is measured by the deflator of GDP at basic prices, which measures the costs of the domestic factors of production;
- The price of tradable goods $(pf + e)$ is approximated by the weighted average prices in Pakistan's main trading partners, converted into domestic currency by dividing with the Nominal Effective Exchange Rate (NEER);
- Equation (4.2.7) is an equilibrium relation. To account for possible lags in the interest rate responses to shocks, the equilibrium relation is cast into an ARDL equation.

The neutral interest rate has been a topic of heated discussion in recent decades. It has a significant role in the Taylor rule, which is included in DSGE and FPAS models and is considered to be a factor in monetary policy decisions made by central banks.

The Taylor rule is considered to be a rule that fixes the central bank's policy rate. In Pakistan this is currently the central rate in SBP's interest rate corridor. This rate is the target of the overnight money market repo rate. It is a nominal rate (R). The Taylor rule can be written as:

$$R = R^* + 1.5(\pi - \pi^T) + 0.5og$$

Where R is the policy rate (in our case approximated by the overnight repo rate)

$R^*$ is the nominal neutral rate

$\pi$ is the (expected) inflation rate

$\pi^T$ is the central bank's inflation target

$og$ is then output gap

The neutral rate $R^*$ can be interpreted as the policy rate that is valid when simultaneously (expected) inflation is on target and the output gap (deviation of current versus potential output) is zero. In this case the neutral rate is a nominal rate.

But the Taylor rule can also be rewritten in terms of the real rate, by acknowledging that the real rate (r) equals the nominal rate minus (expected) inflation:

$r = R - \pi$ and $r^* = R^* - \pi^T$

After substitution, the Taylor rule can be written in terms of the real interest rate:

$r = r^* + 0.5(\pi - \pi^T) + 0.5og$

It follows that the neutral rate can be written both in terms of both nominal and real terms. Both are equivalent: the nominal neutral rate equals the real neutral rate augmented with the central bank's inflation target. Both refer to the central bank's policy rate.

In any case the rule says that the nominal (real) policy rate equals the neutral nominal (real) rate in case inflation is on target and output equals potential output. In case of disequilibrium (inflation not on target or output gap open), the central bank will set its policy rate above or below the neutral rate.

Given a stable money demand function, the Taylor rule can also be written in terms of a money supply rule[13]. The real problem is finding the value of the neutral nominal/real policy rates. There exists a whole range of methods to estimate it (For a short but useful survey see e.g., Magud and Tsounta, 2012). The conclusion is that there is no single best method to estimate the neutral rate of interest. Therefore, all estimates are surrounded by a wide range of uncertainty.

Furthermore, in Pakistan, inflation and growth targets changed every year as they were published in the Annual plan. Further, our maintained hypothesis is that it is the money

[13] Orphanides, A. (2003). Historical monetary policy analysis and the Taylor rule. Journal of Monetary Economics, 50(7), 983-1022

supply that provides for the nominal anchor of Pakistan's economy. In steady state, it is the money supply path that is the main determinant of inflation in the long run. Therefore, in the thesis, we interpret the neutral rate as the interest rate that equilibrates the required path of money supply with the quantity of money that is required to finance transactions.

Thus, from equation (4.2.7), several shocks can be identified, each setting in motion transmission mechanisms that will affect the equilibrium interest rate. These shocks have to be interpreted on a ceteris paribus basis.

The first shock is a change in NFA. Suppose the current account and/or financial account register a deficit. The equilibrating mechanism can be twofold. If the central bank wants to stabilizer the exchange rate, it will sell foreign assets. Its NFA will decline. This will reduce the money supply (unless this decline is sterilized, which requires an additional shock in NDA). The reduction in liquidity will put upward pressure on the interest rate or in our case the central bank will increase its policy rate to counter the decline in reserve assets. The increase in interest rates will discourage domestic absorption and imports and will therefore improve the trade balance. Furthermore, provided financial capital mobility is positive, the rise in interest rates may improve the financial account. The interest rate will need to continue rising until the BOP is again in equilibrium. If the central bank does not intervene, the exchange rate will depreciate. Then the results are described under the third type of shock.

Secondly, an increase in economic activity, for example, due to additional fiscal stimulus that is non-monetary financed. In that case, domestic absorption and import interest rates will rise and the current account balance deteriorate. This will be solved by an increase in domestic interest rates that will discourage domestic absorption and imports and attract foreign capital.

Thirdly, an increase in prices either through domestic costs and/or by increased prices of imported goods and/or by the depreciation of the exchange rate will increase domestic prices/inflation, which requires a rise in prices to keep inflation in line with the target. If the price increase is of foreign origin (foreign example increase in international commodity prices such as oil), it will not only feed into inflation but will also worsen the current account balance. Again, the domestic interest rates will have to increase to restore equilibrium.

Fourthly, an expansionary monetary policy through an increase in the central bank's NDA. The impact effect of this liquidity injection would be a decline in the interest rates. But this will be compensated by capital outflows and worsening trade balance, which will reduce NFA and/or depreciate the exchange rate and cause increased inflation. In the end, the effect of the monetary expansion on the interest rates will be annihilated by these induced effects on NFA and/or exchange rate depreciation and inflation. When the direction of these shocks is reversed (from positive to negative or vice versa), the transmission mechanisms are reversed as well.

### 4.2.3. Debt Dynamics

We used the conventional method to evaluate fiscal sustainability, as evaluated by Chalk and Hemming (2000). IMF and World Bank have collaborated to create the Debt Sustainability Framework, a tool for assessing the sustainability of public and external debt in low-income countries. However, previous studies such as Tiwari and Canuto (2012) and Baduel and Price (2012) have primarily concentrated on external public debt levels.

**Theoretical underpinnings**

The intertemporal government budget constraint is the usual starting point for the examination of fiscal sustainability. A non-Ponzi game limitation is sometimes mentioned in conjunction with sustainability. This constraint requires that the present value of future primary surpluses should be greater than the present value of primary deficits. This is necessary to counterbalance the existing government debt. For a notable application of this analysis, please refer to Rial, Vincente (mimeo). Blanchard (2021) asserts that debt sustainability is a probabilistic concept, wherein debt is deemed sustainable when the likelihood of a debt explosion is low.

Usually, government budget constraint is given as:

$$G_t + i_t D_{t-1} = R_t + (D_t - D_{t-1}) + (M_t - M_{t-1}) \qquad (4.3.1)$$

whereas $G_t$ is non-interest Spending, $i_t D_{t-1}$ is interest spending where $i_t$ is the nominal interest rate, $(D_t - D_{t-1})$ is the change in Debt and $(M_t - M_{t-1})$ is other debt-reducing flows which include Money issuance (Seigniorage), Receipts from Privatization, and Debt forgiveness.

The overall balance can then be given as $OB_t = R_t - (G_t + i_t D_t)$ whereas the Primary Balance will be given by $PB_t = R_t - G_t$

Rearranging the government budget constraint eq (4.3.1), assuming there is no seigniorage, no privatization, no debt forgiveness, etc), we can rewrite as:

$G_t + i_t D_{t-1} = R_t + (D_t - D_{t-1})$ or more specifically: (4.3.2)

$D_t = (1 + i_t)D_{t-1} - PB_t$ (4.3.3)

Thus, the Inter-temporal budget constraint for t = N period can be written as:

$D_N = (1 + i)^N - \sum_{j=1}^{N}(1 + i)^{N-j}(PB_j)$ (4.3.4)

The Solvency Condition can be written as:

$D_0 = \sum_{j=1}^{N}(1 + i)^j(PB_j) + (\frac{1}{1+i})^N(D_N)$ (4.3.5)

Thus, the transversality condition (no-Ponzi scheme) is given by: $\lim_{N\to\infty}(\frac{1}{1+i})^N(D_N) = 0$ which will imply that the current debt has to be equal (or smaller) than the present value of future primary balances. The government budget constraint for periods t-1 to t can be written as eq (4.3.3). Dividing by nominal GDP ($P_t Y_t$) and rearranging we will get:

$\frac{D_t}{P_t Y_t} = \frac{(1+i_t)}{(1+\pi_t)(1+g_t)}\left(\frac{D_{t-1}}{P_{t-1}Y_{t-1}}\right) - \frac{PB_t}{P_t Y_t}$ (4.3.6)

whereas $\pi_t$ is GDP Deflator and $g_t$ is real GDP growth. Using lowercase letters to denote ratios to GDP

$d_t = \frac{(1+i_t)}{(1+\pi_t)(1+g_t)}(d_{t-1}) - pb_t = \varphi_t(d_{t-1}) - pb_t$ (4.3.7)

whereas $\varphi_t = \frac{(1+r_t)}{(1+g_t)}$ because $\frac{(1+i_t)}{(1+\pi_t)}$ is Fisher equation

Thus, the main recursive equation governing the dynamics of debt ratio can be written as:

$d_t = (1 + \lambda_t)(d_{t-1}) - pb_t$

(4.3.8)

and $\lambda_t = \frac{r-g}{1+g}$ and $(1 + \lambda) = \frac{1+r}{1+g}$

Thus, in a steady state, for a stable Debt to GDP ratio, The Short-Run Primary Balance ($pb$) needs to be positive if the Short-Run real interest rate ($r$) exceeds the Short-Run real growth rate ($g$). If the current ($r$) is larger than the Short-Run real interest rate ($r$), then the current Primary Balance ($pb$) needs to be larger than the Short-Run Primary Balance ($pb$). Otherwise, debt dynamics are on the rise.

Risks linked with public debt as a whole are not enough to ensure debt sustainability; instead, evaluations must also take into account risks related to the structure of debt. For instance, when a government's debt is short-term, indexed to short-term interest rates, or denominated in a currency other than the domestic one, it might quickly run into debt-servicing issues as a result of fluctuations in the money and foreign exchange markets. Thus, debt dynamics can be decomposed in effects coming from the real rate of interest, real economic growth, and fiscal adjustment (IMF, technical notes and manuals, January 2010, eq 28, p. 6):

$$d_t - d_{t-1} = \frac{r_t}{1+g_t} d_{t-1} - \frac{g_t}{1+g_t} d_{t-1} - p_t \qquad (4.3.9)$$

Whereas d = debt to GDP ratio, r = real interest rate, g = real GDP growth rate, and p = primary balance to GDP.

Eq (4.3.9) shows that the path of the primary deficit (p) to avoid unstable debt dynamics therefore crucially depends on knowledge about the structural (potential) growth rate of the economy, the neutral real interest rate (to which real interest rates should converge). Thus, the research will enlighten policymakers about the magnitudes of these important parameters.

It is important to mention that Public Debt is the sum of Domestic Debt and External Debt. When Debt is expressed in domestic currency, the dynamics of debt can be written as:

$$D_t - D_{t-1} = i.D_{t-1} - S_t \qquad (4.3.10)$$

Where: D = Public debt

i = Nominal interest rate

S = Primary surplus

Or in percentages of GDP, which grows at a rate g:

$$d_t - d_{t-1} = \frac{i-g}{1+g} d_{t-1} - s_t \qquad (4.3.11)$$

The primary surplus is obtained as:

$$S = T - PE \tag{4.3.12}$$

Where: T = Total receipts, and

PE = Primary Expenditures (that is, all expenditures except interest payments)

To achieve debt-to-GDP ratio stabilization, the necessary primary surplus can be represented as follows:

$$s^* = \frac{i-g}{1+g} d_{t-1} \tag{4.3.13}$$

All variables shown in lowercase are expressed as a percentage of nominal GDP.

k being the primary gap, is thus expressed as: $k = s^* - s$

The average tax rate can be determined if the primary expenditures are inflexible, thus:

$$t^* = s^* + pe \tag{4.3.14}$$

When Debt is expressed in foreign currency, the debt dynamic is written as follows:

TD = total debt expressed in domestic currency

$D_1$ = domestic currency debt (currency 1)

$D_2$ = debt expressed in currency 2

$E_2$ = exchange rate: foreign currency 2 expressed in terms of domestic currency

$i_1$ = interest rate on domestic currency debt

$i_2$ = interest rate on foreign currency debt (expressed in currency 2)

S = primary surplus

$$TD_t = D_{1t} + E_{2t} . D_{2t} \tag{4.3.15}$$

The variation in TD between two time periods is determined by the financial balance, which is calculated by subtracting total income from total outlays. Additionally, it includes the net capital losses resulting from changes in exchange rates on existing foreign currency debt.

$$TD_t - TD_{t-1} = i_{1t} . D_{1t-1} + i_{2t} . E_{2t} . D_{2t-1} - S_t + D_{2t-1} . \Delta E_{2t} \tag{4.3.16}$$

Defining:

$$\alpha_{1t} = \frac{D_{1t}}{TD_t},\ \alpha_{2t} = \frac{E_{2t}.D_{2t}}{TD_t},\ 1+g_t = \frac{GDP_t}{GDP_{t-1}},\ 1+\rho_{2t} = \frac{E_{2t}}{E_{2t-1}},\ \sum_{i=1}^{2} \alpha_{it} = 1$$

Then after working through the:

$$td_t - td_{t-1} = \left\{ \frac{\alpha_{1t-1}.i_{1t} + \alpha_{2t-1}\left[i_{2t}\left(1+\rho_{2t}\right)+\rho_{2t}\right] - g_t}{1+g_t} \right\} td_{t-1} - s_t \qquad (4.3.17)$$

The dynamics of total debt are affected by debt denominated in foreign currencies in three channels:

- Fluctuations in foreign debt interest rates
- Exchange rate movements impact foreign currency interest payments
- Debt outstanding in a foreign currency will lose or gain value as a result of fluctuations in the value of that currency relative to the dollar.

The aforementioned equation can be generalized to incorporate more than one foreign currency and more than one form of debt instrument denominated in each currency. The sum of all debts can be written like this if both domestic and foreign currency debts have two different types of debt instruments: those with fixed interest rates (F) and those with variable interest rates (V):

$$TD_t = D_{1Ft} + D_{1Vt} + E_{2t}.D_{2Ft} + E_{2t}.D_{2Vt} \qquad (4.3.18)$$

Then define:

$$\alpha_{1Ft} = \frac{D_{1Ft}}{TD_t},\quad \alpha_{1Vt} = \frac{D_{1Vt}}{TD_t},\quad \alpha_{2Ft} = \frac{E_{2t}.D_{2Ft}}{TD_t},\quad \alpha_{2Vt} = \frac{E_{2t}.D_{2Vt}}{TD_t}$$

The equation of debt dynamics can be expressed as follows.:

$$td_t - td_{t-1} = \left\{ \frac{\alpha_{1Ft-1}.i_{1Ft} + \alpha_{1Vt-1}.i_{1Ft} + \alpha_{2Ft-1}\left[i_{2Ft}\left(1+\rho_{2t}\right)+\rho_{2t}\right] + \alpha_{2Vt-1}\left[i_{2Vt}\left(1+\rho_{2t}\right)+\rho_{2t}\right] - g_t}{1+g_t} \right\} td_{t-1} - s_t \qquad (4.3.19)$$

***Statistical Discrepancy***

Given these inputs, the formula (4.3.19), adjusted for the elements discussed above, calculates the theoretical change in the debt ratio. When adjusting the formula, including the change in Government Deposits, the average statistical deviation since FY 2013 is equal to zero. This means that the formula does not show any bias over the

long run. But for the last 3 years, the average deviation is -0.3 % points. For prospective analysis of up to 3 years, we, therefore, adjusted the formula for this statistical discrepancy. However, the reasons for statistical deviations still need to be explored and understood in order to improve the reconciliation between FO and debt statistics. Equation (4.3.19) enables a more precise calculation of the primary gap, given a specific target for the future debt-to-GDP ratio. This allows for a more detailed and accurate assessment, particularly in scenarios where a stable debt ratio is desired.

By dividing interest payments by the outstanding amount of the associated debt instrument, the interest rate variables in the equation indicate implicit interest rates. Blanchard (2021) analyses the potential impacts of several sources of uncertainty on the long-term viability of debt. His research illustrates the interplay between the debt ratio, debt maturity, the distribution of primary balances both now and in the future, and the distribution of primary balances both now and in the future (i-g). It demonstrates the value of what he terms "stochastic debt sustainability analysis" (SDSA) for policymakers, financiers, and credit agencies. It also demonstrates that the likelihood that debt is sustainable is unaffected by reasonable reductions in debt from current levels, but the significance of contingency planning in case (i-g) grows and reverses sign is highlighted.

As discussed, the equation (4.3.18) has to be adjusted for the Inclusion of Foreign Grants (fg), the change in Government Deposits (gdep), and the statistical deviation (sd) capturing differences in reconciling flows (transactions) with changes in stocks (debt) other than those due to exchange rate effects, which are captured in the equation, all expressed in percentage of GDP. Thus, the equation (4.3.18) can be written as:

$$td_t - td_{t-1} = \left\{\frac{\alpha_{1t-1}.i_{1t}+\alpha_{2t-1}[i_{2t}(1+\rho_{2t})+\rho_{2t}]-g_t}{1+g_t}\right\} td_{t-1} - s_t - fg_t + gdep_t - sd_t \quad (4.3.20)$$

Equation (4.3.20) can be used to predict the future debt to GDP ratio for given predetermined future paths of the primary balance, foreign grants, and change in Government Deposits, all expressed in % of GDP. Alternatively, for a given target for the future change in $td$ and $gdep$, the target for the primary balance $s$ can be derived:

$$s_t^* = \left\{\frac{\alpha_{1t-1}.i_{1t}+\alpha_{2t-1}[i_{2t}(1+\rho_{2t})+\rho_{2t}]-g_t}{1+g_t}\right\} td_{t-1} - fg_t + gdep_t^* - \Delta td_t^* - sd_t \quad (4.3.21)$$

For example, for an objective that stabilizes the debt to GDP ratio and keeps the Government Deposits constant: $gdep_t^* = \Delta td_t^* = 0$

The required target for the primary balance to GDP ratio becomes:

$$s_t^* = \left\{\frac{\alpha_{1t-1}.i_{1t}+\alpha_{2t-1}[i_{2t}(1+\rho_{2t})+\rho_{2t}]-g_t}{1+g_t}\right\} td_{t-1} - fg_t - sd_t \quad (4.3.22)$$

Thus, the estimated debt equation was started from the eq (4.3.20) which is

$$td_t - td_{t-1} = \left\{\frac{\alpha_{1t-1}.i_{1t}+\alpha_{2t-1}[i_{2t}(1+\rho_{2t})+\rho_{2t}]-g_t}{1+g_t}\right\} td_{t-1} - s_t - fg_t + gdep_t$$

In which we now define, res = residual = $-fg_t + gdep_t$ and

tdc = Total Debt Cost = $\alpha_{1t-1}.i_{1t} + \alpha_{2t-1}[i_{2t}(1+\rho_{2t}) + \rho_{2t}]$

Thus, the final equation for our estimation is given by:

$$td_t - td_{t-1} = \left\{\frac{tdc_t-g_t}{1+g_t}\right\} td_{t-1} - s_t - res_t \quad (4.3.23)$$

The methodology used is based on mathematically formulated theories and empirical estimations of Pakistan data. This scientific approach has the advantage that conclusions can be based on sound theoretical grounds and the use of appropriate empirical methods applied to available Pakistan data. Of course, the validity of the conclusions therefore also depends on the quality of the available data and the specific theories and empirical methods used. Comparison with other studies could shed light on these qualifications, but unfortunately, no such alternative studies on the topics explored here seem to be available, at least not for the case of Pakistan.

# Chapter – 5

## . Results and Discussion

Prior to results and discussion, it is important to mention that Our modelling approach is based on the works of Pesaran, H. and Y. Shin (1999) and Pesaran, H., Y. Shin, and R. Smith (2001). They have developed an alternative to the Engle-Granger co-integration approach and assert that their Auto Regressive Distributed Lag (ARDL) approach includes co-integration analysis. They argue that co-integration testing is unnecessary, instead proposing two alternative bounds tests to assess the estimated equation: a Wald test and a t-test. If the F-statistic and the t-statistic for the lagged dependent variable are greater than the critical bounds published in tables CI (Asymptotic critical value bounds for the F -statistic. Testing for the existence of a levels relationship) and CII (Asymptotic critical value bounds of the t-statistic. Testing for the existence of a levels relationship), as discussed by Pesaran, H., Y. Shin, and R. Smith (2001), then we can reject the null hypothesis of no levels relationship (equilibrium relationship). However, the single equations estimated in the thesis can also be examined for co-integration through the application of the Engle-Granger test. This is a test conducted on the residuals of the long-term equilibrium equations. Co-integration is confirmed when the unit root hypothesis on the residuals in the equation is rejected. Therefore Appendix – E "**Assessing Long-Run Relationship - Cointegration Analysis**" is related to assessing the long-run relationship.

### 5.1. Potential Output & Output Gap: Overall Economy & Sectoral Disaggregation

#### 5.1.1. Incremental Capital Output Ratio (ICOR)

As discussed in Chapter 4, the methodology used for estimating potential output is novel to the existing literature in many respects:

Firstly, the calculation of potential output is based on neo-classical investment theory rather than any of the mechanical theory-neutral filters described in the literature. Further, the methodology is also not based on the growth accounting approaches that rely on the full details of a production function. Such an approach would have required quantitative data on hours worked, capital stock, etc. which are not readily available in countries like Pakistan. Finally, we use a dynamic ARDL model because it recognizes that equilibrium does not always occur right away (Sarkodie & Owusu, 2020). Further, the Rationale for Using ARDL is given in Appendix -III. Thus, the interpretation of the

equilibrium condition is that each sector's and the economy's underlying long-term potential growth rate is governed by its propensity to invest or the Incremental Capital Output Ratio (ICOR) (Khan, 1987).

The ICOR serves as a proxy indicator for assessing the efficiency of investment in an economy. ICOR holds significant importance in academic circles and policy-making as a crucial concept and it is used as an analytical tool for economic growth theory and development planning. The ICOR is a measure that quantifies the relationship between changes in capital and changes in output. The Harrod-Domar Model, for instance, attributes the decline in potential growth to reduced investments and an increasing Incremental Capital Output Ratio (ICOR). (William, 1997); Siraj & Bengali, 2007) (ICOR).

**5.1.1.a: Aggregate Economy**

We first analyze historically, the effect of additional investment (GFCF) on overall GVA/output. This relationship between additional GVA creation and GFCF comes straight from our theoretical model. The microeconomic underpinnings of this model are based on firms' cost minimization under Cobb-Douglas production technology (see Chapter 4). The long-run relationship is given in eq (4.1.15):

This equation determines the steady-state growth path of potential output. It is derived from the theoretical model presented in Chapter 4

$$\Delta GVA = \frac{A_0 e^{\gamma . t}}{\lambda^{1-\alpha}} \left(\frac{g+\gamma}{g+\delta}\right) GFCF \qquad (5.1.1)$$

But since no trend was found, then actual steady-state relation can be written in a more compact form as in eq (4.1.17)

$$\Delta TGVA = \gamma . GFCF \qquad (5.1.2)$$

Equivalently, the equation (4.1.17) can be written for the three sectors of the economy i.e., Agriculture, Industry, and Services:

$\Delta TGVA_i = \gamma_i . GFCF_i$ whereas (i = Agriculture, Industry and Services) (5.1.3)

But because of 'time to build' lags, expenditure on GFCF does not immediately translate into additional production value addition. Therefore, the steady-state long-run equilibrium relation was estimated with an ARDL model that encompasses the long run and allows for adjustment lags.

Thus, for the total economy:

$$\Delta^2 TGVA_t = \alpha.\Delta TGVA_{t-1} + \beta.TGFCF_{t-1} \quad (5.1.4)$$

In ARDL models, the choice of the lag structure is not based on cointegration tests. The statistical tests on the null hypothesis of the estimated coefficients (standard deviation and t-statistic) can be used, as well as Akaike and Schwarz information criteria.

With $\alpha < 0$ and $\gamma = -\frac{\beta}{\alpha}$

$|\alpha| < 1$ indicates incomplete adjustment during one year.

If $\alpha = 1$, then equation 6.1.4 reduces to: $\Delta TGVA_t = \gamma.TGFCF_{t-1}$

This implies that all adjustment has taken place after 1 year.

If $\alpha < 0$ then obviously adjustments need more time (more than one year). In other words, adjustment is incomplete after one year.

Thus, the equilibrium Inverse Incremental Capital Output Ratio (IICOR) was obtained. The observed volatility of the reverse ICOR is partly due to delayed responses of GVA to shocks in GFCF. The estimation result of the equation is shown below:

The validity of the estimated ARDL equation is based on bounds tests for which critical values are mentioned in Pesaran, Shin, and Smith (2001). Both the Wald test and the t-test on coefficient C(3) reject the hypothesis that there is no relationship between the dependent and independent variables.

**Table - 5.1.1.a: Estimated Result of Overall ARDL Equation**

Dependent Variable: D(D(TGVA))
D(D(TGVA)) = C(2)*D(TGVA(-1))+C(3)*TGFCF(-1)

| | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(TGVA (-1)) | -0.851261 | 0.186640 | -4.560984 | 0.0000 |
| TGFCF (-1) | 0.213417 | 0.048794 | 4.373854 | 0.0001 |

| | | | |
|---|---|---|---|
| R-squared | 0.346332 | Mean dependent var | 45421.34 |
| Adjusted R-squared | 0.329571 | S.D. dependent var | 538631.9 |
| S.E. of regression | 441030.4 | Akaike info criterion | 28.87917 |
| Sum squared residuals | 7.59E+12 | Schwarz criterion | 28.96275 |
| Log-likelihood | -590.0229 | Hannan-Quinn criterion | 28.90960 |
| Durbin-Watson stat | 1.755239 | | |

Source: Author's Estimation

As shown in Appendix-E:

- the equation's F-statistic and t-statistic lay on the right-hand side of the critical bounds published in tables CI and CII in Pesaran, H., Y. Shin, and R. Smith (2001). Therefore, the null hypothesis of no levels relationship (equilibrium relationship) can be rejected
- Furthermore, the equation passes the Engle-Granger co-integration test.

The ratio $-\frac{C(3)}{C(2)}$ is the equilibrium IICOR which shows that in the long run, economy-wide, one Rupee spent on GFCF creates additional value added by 0.25 Rupee. It is logical in the sense that when you invest in a house, the initial value of the house equals the investment. But the income it generates in the form of (imputed) income (value added) is less than the value of the house. Otherwise, the return on capital would be larger than 100%.

It is mentionable that in FY2020, COVID caused a very significant deviation between the estimated equilibrium (potential) value of TGVA and the observed value. If a dummy variable is introduced for that year, it forces equality between the estimated equilibrium and the observed value of TGVA. This implies an output gap = 0; in other words, it is then assumed that COVID caused a shock in potential output. Our interpretation is that COVID was a shock in the output gap causing a significant deviation of observed output from potential output. For that reason, no dummy variable was introduced. Thus, introducing a dummy or not would only influence the interpretation of what happened in 2020. Over the complete sample period, the estimated long-run equilibrium value of the IICOR changes very marginally: 0.25 with no dummy to 0.27 with the dummy.

It is mentionable that in the long run, Inverted ICOR is never larger than 1. Historically, the national accounts data shows no significant long-term trend in the $\frac{\Delta GVA}{GFCF}$ ratio which implies the absence of any trend in the IICOR (see Fig – 5.1.1.a).

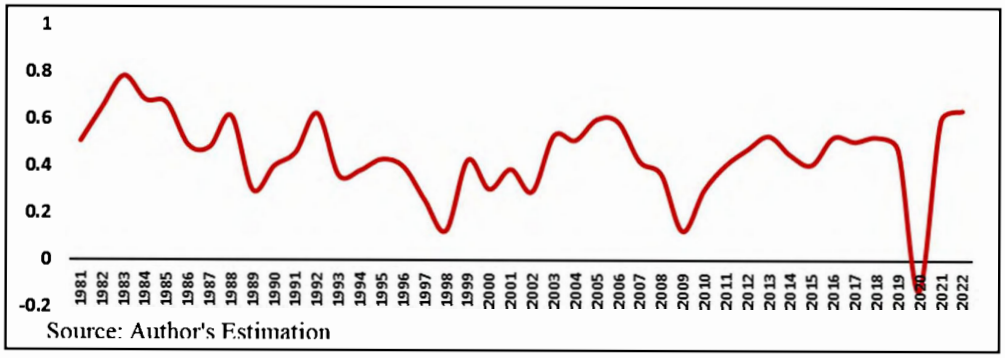



***Fig – 5.1.1.a: Inverse ICOR Total of Economy***

In fact, the series shown in Fig 5.1.1. a is tested by Augmented Dicky Fuller (ADF) test and it was found that Inverse ICOR (IICOR) is stationary not only in the case of the overall economy but also at the sectoral level.

### 5.1.1.b: Sectors of the Economy

In the study, we also estimated the sectoral Inverse ICOR with the analogy of methodology used in estimating Overall Inverse ICOR

Thus, Likewise, ARDL equations were estimated for each of the three main sectors

$$\Delta^2 GVA_t = \alpha_i . \Delta GVA_{t-1} + \beta_i . GFCF_{t-1} \qquad (5.1.5)$$

With $\gamma_i = -\frac{\beta_i}{\alpha_i}$ where $\gamma_i$ measures the long-run (equilibrium) effect of a change in GFCF on additional value-added creation.

### Agriculture Inverse ICOR

Using the same methodology discussed above, Inverse ICOR for Agriculture was estimated. The result is shown below:

**Table – 5.1.1.b.i: Estimated Result of Agriculture ARDL Equation**

D(D(TGVAAGRI))=C(2)*D(TGVAAGRI(-1))+C(3)*TGFCFAGRI(-1)

| | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(TGVAAGRI (-1)) | -1.111003 | 0.159343 | -6.972412 | 0.0000 |
| TGFCAGRI(-1) | 0.259564 | 0.042545 | 6.100907 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.555621 | Mean dependent var | 7380.456 |
| Adjusted R-squared | 0.544227 | S.D. dependent var | 161216.9 |
| S.E. of regression | 108839.1 | Akaike info criterion | 26.08068 |
| Sum squared resid | 4.62E+11 | Schwarz criterion | 26.16427 |
| Log likelihood | -532.6539 | Hannan-Quinn criter. | 26.11112 |
| Durbin-Watson stat | 1.929515 | | |

As shown in Appendix-E, the equation's F-statistic and t-statistic lay on the right-hand side of the critical bounds published in tables CI and CII in Pesaran, H., Y. Shin, and R. Smith (2001). Therefore, the null hypothesis of no levels relationship (equilibrium relationship) can be rejected. Furthermore, the equation passes the Engle-Granger co-integration test.

Theoretically the C(2) coefficient is bounded by: $0 < C(2) < -1$. In the estimation C(2) = - 1.1, which lies outside the bounds. However, C(2) is not statistically significantly different from -1, so it is restricted to -1. The estimation result then becomes:

**Table – 5.1.1.b.ii: Estimated Result of Agriculture ARDL Equation with Restriction**

| Dependent Variable: D(D(TGVAAGRI)) | | | | |
|---|---|---|---|---|
| D(D(TGVAAGRI))=-1*D(TGVAAGRI(-1))+C(3)*TGFCFAGRI(-1) | | | | |
| | Coefficient | Std. Error | t-Statistic | Prob. |
| TGFCFAGRI(-1) | 0.235012 | 0.023679 | 9.924817 | 0.0000 |
| R-squared | 0.550092 | Mean dependent var | | 7380.456 |
| Adjusted R-squared | 0.550092 | S.D. dependent var | | 161216.9 |
| S.E. of regression | 108136.5 | Akaike info criterion | | 26.04426 |
| Sum squared residual | 4.68E+11 | Schwarz criterion | | 26.08606 |
| Log-likelihood | -532.9074 | Hannan-Quinn criterion. | | 26.05948 |
| Durbin-Watson stat | 2.162459 | | | |
| Source: Author's Estimation | | | | |

In the agricultural sector, the coefficient of D(TGVAAGRI) has been found statistically insignificantly different from unity, implying that total adjustment takes place within one year. Therefore, the estimated equation omits further adjustment lags beyond 1 year and focuses on the long-run relationship. The C(3) coefficient, therefore, measures the long-run effect of GFCF on additional value-added creation in the agricultural sector. In the agricultural sector, the coefficient of D(TGVAAGRI) has been found statistically insignificantly different from unity, implying that total adjustment takes place within one year. Therefore, the estimated equation omits further adjustment lags beyond 1 year and focusses on the long-run relationship

In Figure – 5.1.1.b.i, data shows the volatility in the IICOR. An extraordinary performance was observed in 1995-1996 as almost 11.7% growth was observed in Agriculture while GDP growth remained at 6.6%[14]. There could be many reasons. One

[14] https://www.pbs.gov.pk/sites/default/files/tables/national_accounts/2021-22/Table_1.pdf

reason was the extraordinary growth of the livestock sector based on the results of the census of Livestock in 1996, the other was the huge subsidy of Rs. 6.3 billion on wheat[15]. Likewise, the construction of Small Dams, funded by the Asian Development Bank (ADB) in the 1990s also helped in significant growth in Agriculture.

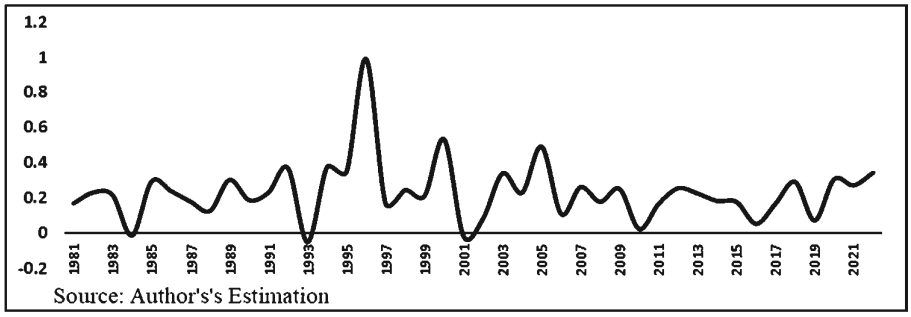



***Fig – 5.1.1.b.i: Inverse ICOR Agriculture***

## Industry Inverse ICOR

**Table – 5.1.1.b.iii: Estimated Result of Industry ARDL Equation**

| Dependent Variable: D(D(TGVAIND)) | | | | |
|---|---|---|---|---|
| D(D(TGVAIND))=C(2)*D(TGVAIND(-1))+C(3)*TGFCFIND(-1) | | | | |
| | Coefficient | Std. Error | t-Statistic | Prob. |
| D (TGVAIND (-1)) | -0.904797 | 0.169176 | -5.348261 | 0.0000 |
| TGFCFIND (-1) | 0.128255 | 0.036396 | 3.523890 | 0.0011 |
| R-squared | 0.422522 | Mean dependent var | | 10100.63 |
| Adjusted R-squared | 0.407715 | S.D. dependent var | | 252006.0 |
| S.E. of regression | 193944.0 | Akaike info criterion | | 27.23608 |
| Sum squared residual | 1.47E+12 | Schwarz criterion | | 27.31967 |
| Log-likelihood | -556.3396 | Hannan-Quinn criterion | | 27.26652 |
| Durbin-Watson stat | 1.887134 | | | |
| Source: Author's Estimation | | | | |

The F-statistic and t-statistic of the equation are located on the right-hand side of the critical bounds published in tables CI and CII in Pesaran, H., Y. Shin, and R. Smith (2001), as illustrated in Appendix-E. Consequently, the null hypothesis of the equilibrium relationship (no levels) can be rejected. Additionally, the equation satisfies the Engle-Granger co-integration test.

The ratio $-\frac{C(3)}{C(2)}$ is the equilibrium IICOR which shows that in the industrial sector, every Rupee invested in production capacity yields 0.14 Rupees of additional value added in that same sector. Historically, the data in Fig – 5.1.1.b.ii shows a change in the pattern after 2003. Textile exports from both Large-Scale Manufacturing (LSM)

[15] https://peri.punjab.gov.pk/node/219

and Small-Scale Manufacturing (SSM) sectors grew due to factors such as stable exchange rates, low refinance rates, expanded market access (including a 15 percent increase in quotas by the EU and duty-free access to value-added textile products), and the free cotton trade regime. Moreover, these favorable advancements have also stimulated investment in the textile industry for Balancing, Modernization, and Replacement (BMR), as well as expanding existing capacity.

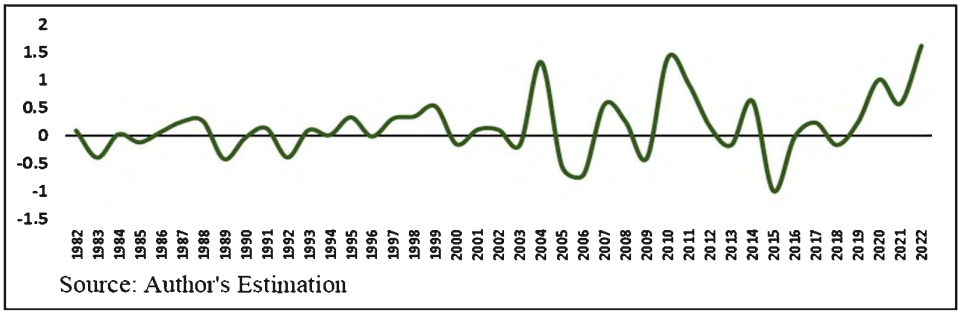



***Fig – 5.1.1.b.ii: Inverse ICOR Industry***

## Services Inverse ICOR

**Table – 5.1.1.b.iv: Estimated Result of Services ARDL Equation**

| Dependent Variable: D(D(TGVASER)) | | | | |
|---|---|---|---|---|
| D(D(TGVASER))=C(2)*D(TGVASER(-1))+C(3)*TGFCFSER(-1) | | | | |
| | Coefficient | Std. Error | t-Statistic | Prob. |
| D (TGVASER (-1) | -0.985723 | 0.183880 | -5.360679 | 0.0000 |
| TGFCFSER (-1) | 0.307220 | 0.059147 | 5.194190 | 0.0000 |
| R-squared | 0.423754 | Mean dependent var | | 27940.25 |
| Adjusted R-squared | 0.408978 | S.D. dependent var | | 326344.2 |
| S.E. of regression | 250886.7 | Akaike info criterion | | 27.75094 |
| Sum squared residual | 2.45E+12 | Schwarz criterion | | 27.83453 |
| Log-likelihood | -566.8943 | Hannan-Quinn criterion | | 27.78138 |
| Durbin-Watson stat | 1.687216 | | | |
| Source: Author's Estimation | | | | |

As shown in Appendix-E, the F-statistic and t-statistic of the equation are located to the right of the critical bounds provided in tables CI and CII in Pesaran, H., Y. Shin, and R. Smith's (2001) publication. Thus, it is possible to reject the null hypothesis of no relationship between levels (equilibrium relationship). In addition, the equation successfully passes the Engle-Granger co-integration test.

The ratio $-\frac{C(3)}{C(2)}$ is the equilibrium ICOR which shows that the effect of one Rupee spent on enlarging the productive capacity in the services sector yields 0.31 additional incomes. This is substantially larger than the effect in agriculture and double the effect in industry. However, the services sector has become the largest sector in the economy having almost 60 % share of the GDP. The service sector's accelerating growth rate can

be attributed to the remarkable expansion of the finance and insurance sector in the 2000s, fostered by the accommodative policies implemented by the State Bank of Pakistan. Nevertheless, the high ICOR (Incremental Capital Output Ratio) indicates that capital is relatively inexpensive compared to the output generated, suggesting inefficiencies in capital utilization. Further, high growth in the wholesale price index quickly transferred to the cost of capital while the income of the people which is the main input cost in the services sector does not adjust with inflation so quickly and even in the same proportion. In 2001, significant inflows of official aid from various sources, including the United States and other bilateral and multilateral entities, contributed to exceptional economic growth. Moreover, there was a notable rise in exports, remittances, and Foreign Direct Investment (FDI), particularly in the fields of Information Technology (IT), telecommunications, social sector, and education. The services sector has shown significant growth, with the value added in services increasing by almost twice its annual rate over the past seven years. (Figure – 5.1.1.b.iii.). It is also notable that the impact of COVID-19 was more severe in Services Sector which in turn negatively affected overall GDP growth[16].

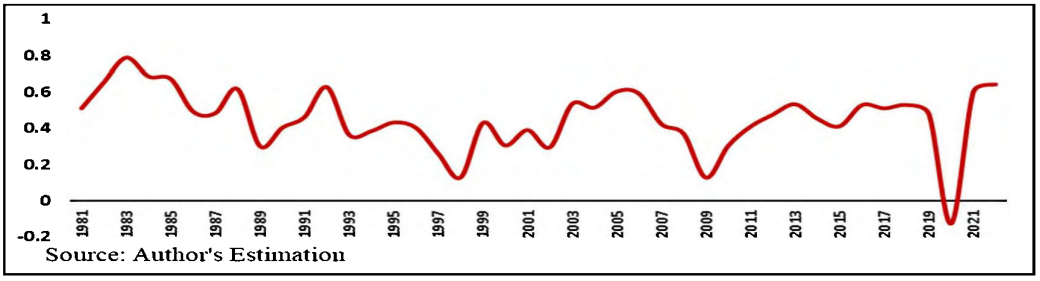



***Fig – 5.1.1.b.iii: Inverse ICOR Services***

## Comparison of IICORs at Aggregate and Sectoral Level

The results for the estimates of the parameters $\alpha$ and $\beta$ are C(2) and C(3) coefficients in (5.1.22 ) for the total economy and each of the main sectors is presented below:

**Table – 5.1.1.b.v: Relationship between Estimates**

| | $\alpha$ | | $\beta$ | | $\gamma$ |
|---|---|---|---|---|---|
| | Coefficient | T-stat | Coefficient | T-stat | |
| Total economy | -0.9 | -4.6 | 0.2 | 4.4 | 0.25 |
| Agriculture | -1* | | 0.2 | 9.9 | 0.24 |
| Industry | -0.9 | -5.3 | 0.1 | 3.5 | 0.14 |
| Services | -0.99 | -5.2 | 0.3 | 5.2 | 0.31 |

Source: Author's Estimation

[16] Impact of COVID-19 on Socioeconomic Situation of Pakistan, Pakistan Economic Survey 2019-20

*Since the absolute value of the estimated coefficient marginally exceeded 1, it was restricted to -1

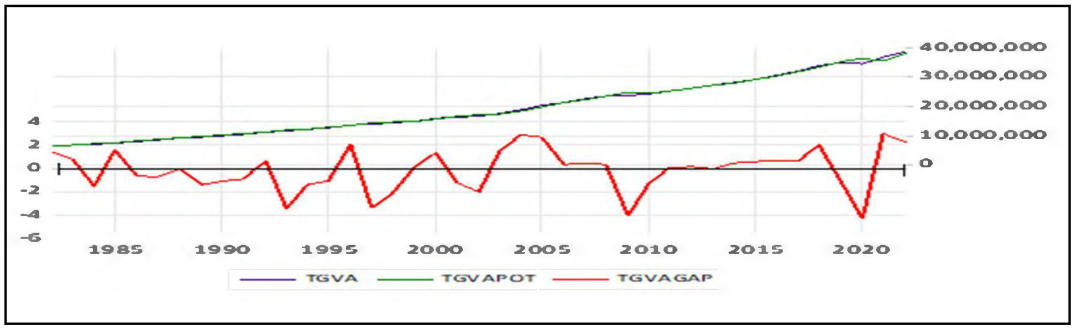
The γ parameter indicates the additional value-added that can be generated by one unit of GFCF. The higher the value of this parameter, the more effective is GFCF in generating additional output. The overall effect is 0.25. This implies that one-rupee GFCF is twice as effective in generating additional value added at constant prices in the services sector as compared to the industrial sector. The reason is that output in the agriculture sector is not only dependent on input but also some other uncontrollable variables like weather conditions, government policies related to agriculture, etc. In the services sector, the main input is wages and salaries of people working which are usually sticky.

### 5.1.2. Potential Output

As mentioned in Chapter 4 the Incremental Capital Output Ratio (ICOR) can be used as an indicator for assessing the efficiency of investment expenditures. If this efficiency is markedly different across sectors, it is useful to extend an aggregate approach to sectoral decomposition.

#### 5.1.2.a: Aggregate Output Gap

As discussed earlier, historically, the economy of Pakistan faced macroeconomic imbalances many times mainly due to an overheated economy i.e., potential output was below the actual output. At levels, the following figure shows periods when the potential output was above the actual output and when it remained below the actual output. It is to be mentioned that TGVA and TGVAPOT are based on national accounts, therefore they are expressed in millions, while TGVAGAP is the percentage deviation of observed GVA from potential GVA.




Source: Author's Estimation

***Fig – 5.1.2.a: Relationship of Potential Output with Actual Output***

In the figure, TGVA represents the Actual Gross Value Addition at constant prices (observed), TGVAPOT is the Potential Output and TGVAGAP is the difference between Actual and Potential. The difference between observed and potential shows the stance of the economic cycle. Deviations between observed and potential can be related to over or under-spending. Situations of overspending imply a higher risk of trade balance deficits and therefore a loss of foreign exchange reserves and/or currency depreciation. Further, economic growth depends on the growth of potential TGVA and net accelerations of the business cycle (the TGVAGAP).

From FY1993 up to FY2002, observed TGVA remained below its potential for most of the time. Pakistan signed nine agreements with the International Monetary Fund (IMF) between 1988 and 2000. Many other arrangements were not fully executed, resulting in nearly half of the agreed amount remaining unutilized. The economy of Pakistan experienced a decline during the 1990s, which is often referred to as a 'lost decade'. The program was fully implemented from 2000 to 2002 without interruption, and the progress on the approved Poverty Reduction and Growth Facility (PRGF) in 2001 is also on schedule. The external sector has achieved stability and the macroeconomic stability indicators are positive. The growth rate has remained low and there has been limited progress in reducing poverty. Pakistan's economy experienced significant challenges and setbacks during the 1990s. External sector security and macroeconomic stability indicators are favorable. However, the efforts to reduce poverty and promote economic growth have yielded unsatisfactory results. In the fourth quarter of 2001, there was a significant increase in government reserves and a slight appreciation of the rupee, attributed to favorable external events. Exports decreased by only 3% from the previous quarter as exporters honored pre-9/11 contracts. Imports decreased by 9% due to a decline in oil and petroleum product imports. The decrease in volume can be attributed to several factors, including the slowdown in manufacturing activity, the depletion of stocks accumulated in anticipation of rupee depreciation, the transition of many enterprises to domestically sourced gas and coal, and the decline in demand for petroleum products for re-export to Afghanistan following the military campaign. Investment led to a decline in imports of machinery and capital equipment. The events of 9/11 disrupted ongoing projects. The trade balance showed a significant improvement. During 2004-05, the global economy experienced a significant decline in 2005 following a period of robust and widespread growth in 2004. The global

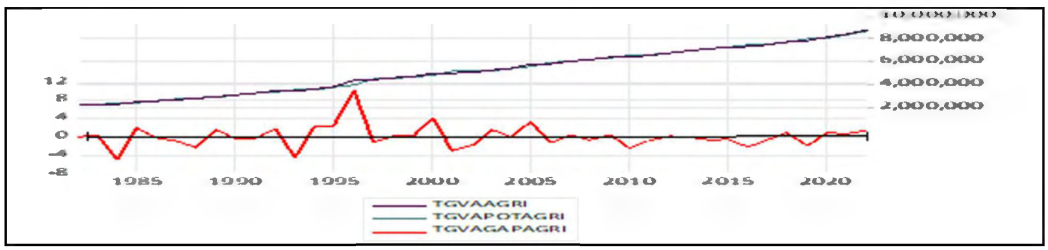
imbalances, such as the increasing external deficit of the United States and the growing surpluses in Asian, European, and oil-exporting economies, contributed to this situation. The combination of increasing oil prices, natural disasters, and geopolitical instability posed a potential risk to developing nations. However, for Pakistan bumper cotton production of 14.3 billion bales in 2004-05 and 13.1 billion bales in 2005-06 helped in achieving economic growth of 7.5 and 5.6 percent in respective years. The global financial crisis that occurred in 2008 also affected Pakistan's economy. However, the crisis was followed by a V-shaped recovery in 2010 and 2011.

It is mentionable that Pakistan's economy experienced unsustainable growth momentum in 2010 and 2018 due to macroeconomic imbalances, specifically high and increasing fiscal and current account deficits. In 2018, the Pakistani economy experienced persistent twin deficits. Further, the implementation of measures to control inflation and stabilize the exchange rate has led to an increase in domestic demand. The significant increase in consumption expenditure and government spending resulted in a substantial rise in imports. Moreover, FY2018 being an election year, certain necessary modifications to fiscal accounts and exchange rates were postponed. This delay led to a decrease in foreign reserves and an increase in monetary borrowing[17].

2020 was the era of the pandemic (COVID-19) which resulted in the global recession. In FY2021 and 2022 a sharp V-shape recovery was boosted by expansionary fiscal and monetary policies. However, Current Account Balance went into sharp deficit, before unseen currency depreciation and loss of foreign exchange reserves.

### 5.1.2.b: Sectors of Economy

**Agriculture:**




Source: Author's Estimation

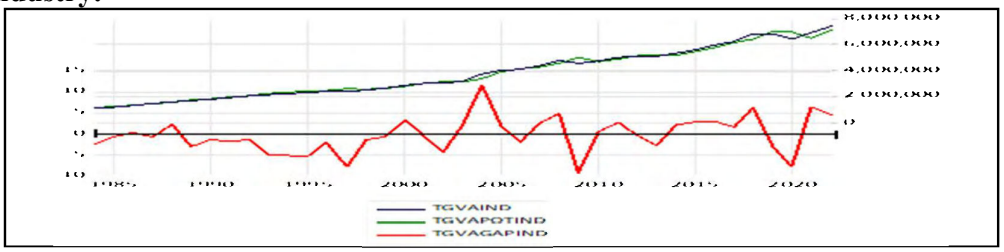
***Fig – 5.1.2.b.i: Relationship of Potential Output with Actual Output (Agriculture)***

[17] Growth and Investment, Pakistan Economic Survey 2018-19

In the figure, TGVAAGRI represents the Total Gross Value Addition in Agriculture at constant prices (observed), TGVAPOTAGRI is the Potential Output of Agriculture and TGVAGAPAGRI is the percentage difference between Actual and Potential output in agriculture. The distinction between observed and potential reflects the position of the economic cycle. Differences between observed and potential values may be attributed to either excessive or insufficient expenditures.

During the 1990s, there was a significant fiscal issue as the budget deficit remained at approximately 6 percent of the Gross Domestic Product (GDP). As anticipated, this was accompanied by a decline in economic performance, with growth slowing to an average of 4 percent per year, compared to an average annual rate of 6 percent in the 1980s. Inflation rates reached double-digit levels, with an average annual rate of 12 percent. The current account balance experienced a significant decline, leading to a decrease in foreign exchange reserves to a level equivalent to two weeks of imports by the end of 1996. The Federal Government increased the assessment rate of land to Rs. 400 per Produce Index Unit (PIU) and eliminated certain exemptions and loopholes in the 1996/1997 budget. As a result, the revenue generated from land assessment increased from Rs. 30 million in 1994/95 to Rs. 110 million in 1996/97. Ali. S (2004) discovered that Total Factor Productivity (TFP) experienced a consistent annual growth rate of 2.3% throughout the period from 1960-61 to 1995-96. This constitutes approximately 58% of the overall increase in output within the country during this specific time frame. Productivity growth has been a major factor contributing to the performance of the agriculture sector in Pakistan for 36 years. The primary driver of growth in total factor productivity (TFP) has been the technological advancements found in high-yielding varieties of grains and cotton. This progress has been supported by public investments in irrigation, agricultural research and extension (R&E), and physical infrastructure. To sustain and enhance Pakistan's agricultural productivity, it is necessary to strengthen and deepen agricultural markets and increase funding for agricultural research.

**Industry:**



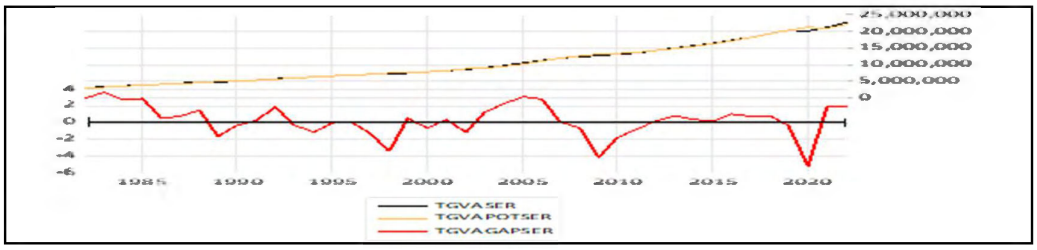
Source: Author's Estimation

***Fig –5.1.2.b.ii: Relationship of Potential Output with Actual Output (Industry)***

In the figure, TGVAIND represents the Total Gross Value Addition in the Industry at constant prices (observed), TGVAPOTIND is the Potential Output of the Industry and TGVAGAPIND is the percentage difference between the Actual and Potential output in the industry. The industrial sector in Pakistan initially faced structural issues, leading to sluggish growth rates in investment, output, and exports. Some factors contributing to the lack of competitiveness of Pakistani products in the global market are the absence of diversification and inefficiencies in allocation and technology. Additionally, the poor quality of products and low levels of research and development activities further hinder productivity growth rates. Traditional industries, such as food and textile, continue to dominate the manufacturing sector in terms of output. During the period of 2002-2006, the country experienced significant GDP growth, averaging above 7 percent, primarily driven by remittances and a surge in consumption. However, this growth declined to 4 percent in 2008 and further dropped to 2 percent in 2009, partly due to the global economic crisis. Large-scale manufacturing experienced a significant increase of 20 percent in 2005. However, it subsequently faced a sharp decline due to factors such as declining aggregate demand, severe power shortages, and worsening security conditions. From 2013 to 2015, the growth of the large-scale manufacturing (LSM) sector, a significant component of the industry, was negatively impacted by various factors. These included energy shortages, decreasing prices of cotton and edible oil, increasing production costs, and a lack of demand for cotton yarn, cloth, and cement in international markets. In the fiscal year 2015-16, there was a notable acceleration in the growth of Large-Scale Manufacturing, resulting in significant growth.

**Services:**

In Fig 5.1.2.b.iii, TGVASER represents the Actual Gross Value Addition in Services at constant prices (observed), TGVAPOTSER is the Potential Output of the Services and TGVAGAPSER is the percentage difference between the Actual and Potential output in the Services.

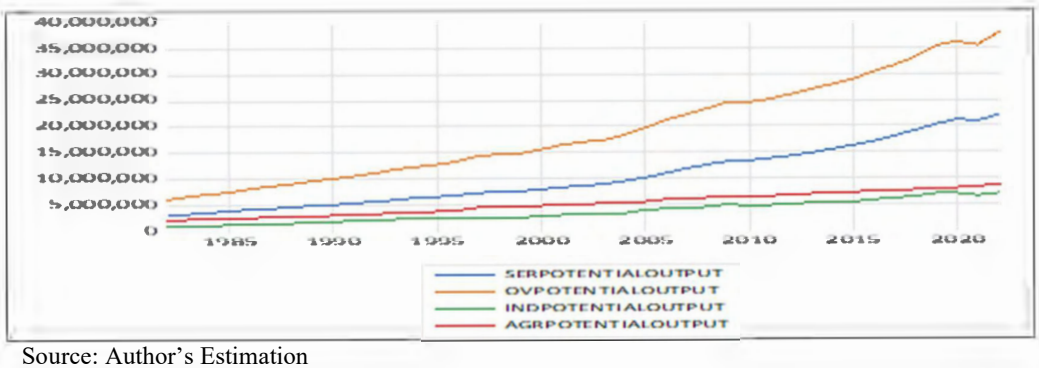



Source: Author's Estimation

***Fig – 5.1.2.b.iii: Relationship of Potential Output with Actual Output (Services)***

In the late 1990s, the reform of policies in the services sector presented a significant opportunity for policymakers to enhance employment, productivity, and innovation. Between 1990 and 2005, the services sector experienced remarkable growth, largely fueled by the rapid development of communication services, financial services, business services (particularly IT), and community services. Key drivers of this growth included the high demand for services among high-income individuals, increased reliance on services by other industries, a surge in service exports, and supply-side factors such as reforms, technological advancements, and investments in infrastructure. These factors combined to create a robust environment for services growth during this period. Presently, the services sector is contributing almost 60% to GVA. From the figures (5.1.2.b.i to 5.1.b.iii), it can be depicted that the cyclical volatility was lowest in the services sector. The standard deviation of the services output gap was 1.9%, which is lower than in agriculture (2.5%) and markedly lower than in industry (4.2%). The observed cyclical volatility in Pakistan's economy can therefore be mainly attributed to the pronounced volatility in industrial activity.

Further, it has been observed that the most dynamic sector in terms of the creation of potential value added has been the services sector. It has been observed that the services sector exhibits a higher growth rate compared to both the agriculture and industrial sectors. The services sector contributes approximately 58% to the Gross Domestic Product (GDP) and slightly over one-third of the total employment. The services sector is closely interconnected with other sectors of the economy, as it plays a vital role in providing necessary inputs to both the agriculture and manufacturing sectors.




Source: Author's Estimation

***Fig – 5.1.2.c: Aggregate and Sectoral Potential Outputs***

Further, from the above figure, it can also be depicted that the share of potential output in the services sector has been increasing since the early 2000s at the expense of the declining share of agriculture. It implies that the services sector has attracted an increasing share of total GFCF to the detriment of both other sectors.

## Correlations

Potential GVA growth in each sector is correlated with total potential output growth. However, the correlations of industrial and services sectors with total growth of potential GVA are strong and statistically significant. Those in the agricultural sector are much weaker. Moreover, potential output growth in the agriculture sector is insignificantly correlated with that in the industry and services sector. In terms of growth rates of potential GVA, the following correlations have been estimated:

**Table – 5.1.2: Correlations between growth rates of potential GVA (t-stats in parentheses)**

| | Total Economy | Agriculture | Industry | Services |
|---|---|---|---|---|
| Total economy | 1 | | | |
| Agriculture | 0.55 (4.0) | 1 | | |
| Industry | 0.83 (9.1) | 0.21 (1.3) | 1 | |
| Services | 0.83 (9.0) | 0.12 (0.8) | 0.6 (5.1) | 1 |

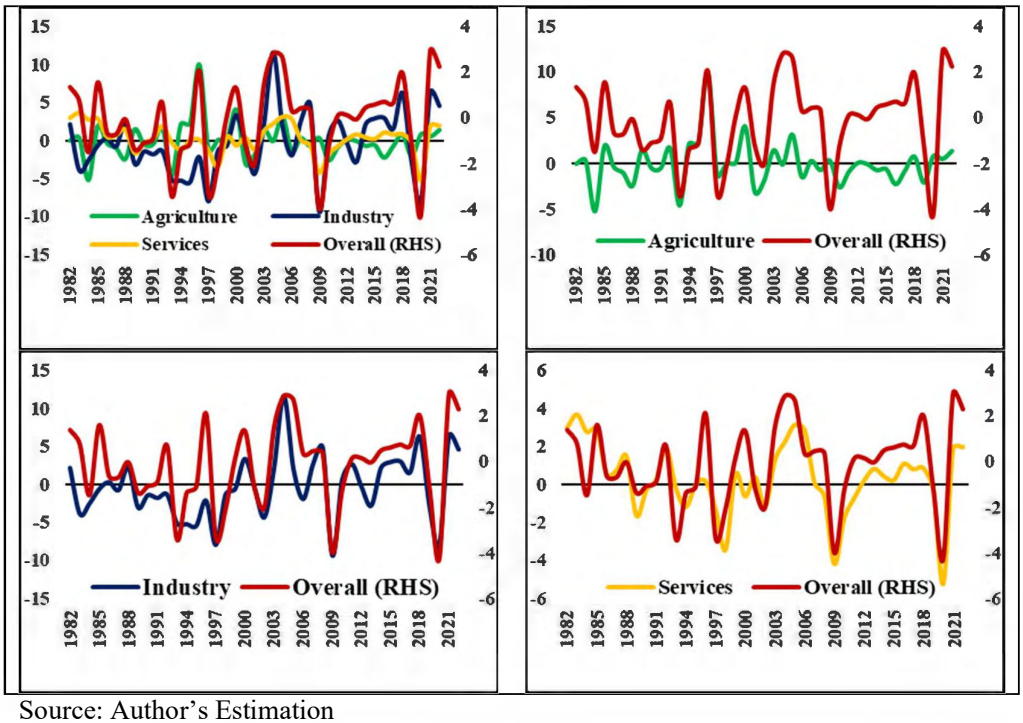
Source: Author's Estimation

For stationary series, a t-value >2 indicates that the correlation coefficient is statistically different from zero at the 95% probability range. Thus, aggregate policies such as monetary policy may have markedly different effects among the major sectors of the economy.

### 5.1.3. Output Gaps: Relationship between Overall Economy and its Sectors

The output gaps in Fig 5.1.3. i show the cyclical movements in the overall economy and the different sectors. The data shows an oversupply resulting from decreased

demand during the specified period. Periods of excess capacity were followed by frequent fluctuations in demand and supply pressures. Supply pressure persisted, but at times it contracted due to the frequent emergence of demand pressures. It is mentionable that overall, OG remained positive from 2002 to 2008. The reason being; this was because of the huge remittance inflow and consequent expansionary monetary policy after 9/11.




Source: Author's Estimation

***Fig – 5.1.3.a: Relationship between Output Gaps***

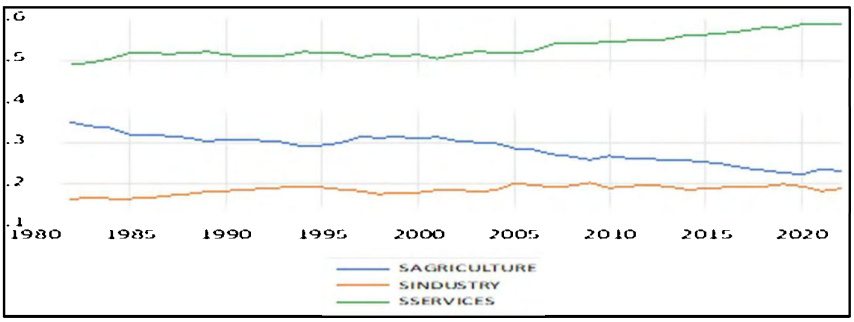
As mentioned earlier the cyclical positions of sectoral OGs are influenced by various factors, including monetary and fiscal policies. The correlation analysis and VAR model estimation demonstrate that the sectors exhibit varied responses to shocks in the variables that influence the overall economy. Let us focus on the relationship between monetary policy stance (SMP) and the Output Gap in each sector (i) over time t. We will use a simple partial adjustment mechanism for illustrative purposes.

Thus, estimating the eq (4.1.28) directly on the aggregate OG (AOG) is given by

$AOG_t = \alpha + \beta SMP_t + \gamma AOG_{t-1}$ whereas $\alpha = \sum_1^i S_{it}\alpha_i$ and $\beta = \sum_1^i S_{it}\beta_i$

The coefficients $\alpha$ and $\beta$ when estimated on aggregate data will therefore be stable and correct only when the $S_{it}$ remain constant over time. However, as shown in Figure

5.1.3.ii, this does not seem to be the case. Furthermore, comparing $\gamma AOG_{t-1}$ with $\sum_1^i S_{it}(\gamma_i OG_{it-1})$ shows that there is no linear relationship between them.




Source: Author's Estimation

***Fig – 5.1.3.b: Performance of Sectoral Output Gaps***

Furthermore, comparing $\gamma AOG_{t-1}$ with $\sum_1^i S_{it}(\gamma_i OG_{it-1})$ shows that there is no linear relationship between them.

Correlations between output gaps in the total economy and the main sectors

**Table – 5.1.3.a: Correlation Matrix (t-stats in parentheses)**

| | Total Economy | Agriculture | Industry | Services |
|---|---|---|---|---|
| Total economy | 1 | | | |
| Agriculture | -0.13 (-0.8) | 1 | | |
| Industry | 0.81 (8.4) | -0.01 (-0.7) | 1 | |
| Services | 0.72 (6.5) | 0.07 (0.4) | 0.47 (3.3) | 1 |
| Source: Author's Estimation | | | | |

The most remarkable result here is that the cyclical movements in the agricultural sector are not correlated with the output gaps in the industry and services sectors. On the other hand, there is a strong and significant correlation between the output gaps in the industrial and services sectors. The possibility of a correlation of the one-year lag of the output gap in agriculture with the output gap of the total economy current year is checked but no change in results is found:

**Table – 5.1.3.b: Correlation Matrix with lag in Agriculture (t-stats in parentheses)**

| | Total Economy | Agriculture (-1) | Industry | Services |
|---|---|---|---|---|
| Total economy | 1 | | | |
| Agriculture (-1) | 0.42 (2.9) | 1 | | |
| Industry | 0.81 (8.6) | 0.04 (0.2) | 1 | |
| Services | 0.73 (6.7) | -0.01 (0) | 0.48 (3.4) | 1 |
| Source: Author's Estimation | | | | |

### 5.1.4. Impact of Shocks

In order to look at sectoral dependencies to estimate a VAR model. The Vector Autoregressive (VAR) model enables the consideration of feedback or reverse causality between dependent and independent regressors by incorporating their past values. The general VAR model assumes that all regressors are endogenous, therefore no exogenous variables are required. In this approach, we want to estimate the dependence of each sector's output gap on country-wide shocks, represented by the overall country OG (which therefore from a sectoral point of view is an exogenous variable). In the endogenous part of the VAR, the sectoral output gaps (OG's) are included as endogenous variables.

As mentioned earlier the cyclical positions of sectoral OGs are influenced by various factors, including monetary and fiscal policies. The correlation analysis and VAR model estimation demonstrate that the sectors exhibit varied responses to shocks in the variables that influence the overall economy. Let us focus on the relationship between monetary policy stance (SMP) and the Output Gap in each sector (i) over time t. We have used a simple partial adjustment mechanism for this purpose.

Cyclical volatility is in principle addressed by demand management policies (monetary and fiscal policy). These results show that when these policies are based on cyclical information on the overall economy, they are in fact addressed to the industry and services sectors only. Given the absence of a correlation between the cyclical stance in agriculture and the other sectors, it requires that specific policies for agriculture should be designed. t is also mentionable that VAR is inferior to VECM in the case of I(1) variables. As in our case VAR uses I(0) variables, all traditional econometric techniques remain valid, including standard error and t-values on estimated coefficients, hence significance tests are valid. Furthermore, in that case, there is no problem in applying a general to a specific approach, eliminating insignificant coefficients. The imposed restrictions were:

$$\begin{bmatrix} TGVAGAPAGRI \\ TGVAGAPIND \\ TGVAGAPSER \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \end{bmatrix} \begin{bmatrix} TGVAGAPAGRI(-1) \\ TGVAGAPIND(-1) \\ TGVAGAPSER(-1) \\ TGVAGAP \end{bmatrix}$$

Restrictions imposed: $a_{11} = a_{12} = a_{13} = a_{21} = a_{22} = a_{23} = 0$:

$$\begin{bmatrix} TGVAGAPAGRI \\ TGVAGAPIND \\ TGVAGAPSER \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 & a_{14} \\ 0 & 0 & 0 & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \end{bmatrix} \begin{bmatrix} TGVAGAPAGRI(-1) \\ TGVAGAPIND(-1) \\ TGVAGAPSER(-1) \\ TGVAGAP \end{bmatrix}$$

It is also mentioned that although there is no AR part in the first two equations, however, it remains a system of equations. Thus, it can be represented as VAR. The results of this VAR:

**Table – 5.1.4.a: VAR Model to Estimate the Sectoral Effects of Economy-Wise Shocks**

| | TGVAGAPAGR | TGVAGAPIND | TGVAGAPSER |
|---|---|---|---|
| TGVAGAPAGRI(-1) | 0.000000 | 0.000000 | 0.101844 |
| | --- | --- | (0.03812) |
| | | | [ 2.67147] |
| TGVAGAPIND(-1) | 0.000000 | 0.000000 | -0.069556 |
| | --- | --- | (0.02556) |
| | | | [-2.72111] |
| TGVAGAPSER(-1) | 0.000000 | 0.000000 | 0.310012 |
| | --- | --- | (0.05431) |
| | | | [ 5.70869] |
| TGVAGAP | 0.580164 | 1.891067 | 0.768945 |
| | (0.19873) | (0.21820) | (0.09949) |
| | [ 2.91931] | [ 8.66684] | [ 7.72878] |
| R-squared | 0.174891 | 0.650853 | 0.639108 |

Source: Author's Estimation
Values in () brackets are standard deviations, and those mentioned in [] brackets are t-values

The zero coefficients are the result of the restrictions imposed on the VAR as mentioned in the matrix representation of the VAR discussed above. The following inferences can be drawn:

- Contemporaneous country-wide shocks affect the industrial sector the most. The long run coefficient of a one percentage point increase in the country-wide OG affects the industry sector OG by 1.9 percentage points;
- Output gaps are percentage deviation from PO and PR is also a % hence these are elasticities. Thus, the overall shock has the second largest impact on the services sector and the long-run elasticity is 1.1;
- The agricultural sector is much less affected with an elasticity equal to 0.58;
- Contemporaneous country-wide shocks are passed through within t time-lapse of one year in the agricultural and industrial sectors, whereas they last longer than one year in the services sector.

### 5.1.4.a. Impact of Monetary Policy Shock

It is mentionable that systematic country-wide shocks can be attributed to shocks originating in the rest of the world and domestic fiscal and monetary policy shocks. Further, other unsystematic shocks such as climatological or political shocks are also present but these are unpredictable. Considering monetary policy shock as one particular shock of interest country-wide, the specific effect of changes in the Policy Interest Rate (PR) is investigated. Thus, to perform VAR, we selected the Overall Output gap (TGVAGAP), Sectoral Output gap (TGVAGAOIND), Policy rate (PR), Primary Balance Ratio to GDP (PFBR), and Inflation (GRCPI) and estimated lag length from lag length selection criteria. The result is given below:

**Table – 5.1.4.b.i: VAR Model Estimating Sectoral Effects of A Monetary Policy Shock**

| | TGVAGAPAGR | TGVAGAPIND | TGVAGAPSER |
|---|---|---|---|
| TGVAGAPAGRI(-1) | -0.129779 | -0.032546 | 0.132166 |
| | (0.17089) | (0.23476) | (0.09702) |
| | [-0.75943] | [-0.13863] | [ 1.36229] |
| TGVAGAPIND(-1) | -0.020289 | 0.099236 | -0.013794 |
| | (0.11526) | (0.15833) | (0.06543) |
| | [-0.17604] | [ 0.62675] | [-0.21081] |
| TGVAGAPSER(-1) | -0.055687 | -0.485907 | 0.287182 |
| | (0.24893) | (0.34198) | (0.14132) |
| | [-0.22370] | [-1.42088] | [ 2.03210] |
| C | -0.263820 | 8.185618 | 3.691956 |
| | (1.55577) | (2.13727) | (0.88324) |
| | [-0.16958] | [ 3.82994] | [ 4.18003] |
| PR | 0.041571 | -0.977820 | -0.414498 |
| | (0.17653) | (0.24251) | (0.10022) |
| | [ 0.23549] | [-4.03215] | [-4.13603] |
| R-squared | 0.022242 | 0.352257 | 0.440641 |

Source: Author's Estimation
Values in () brackets are standard deviations, and those mentioned in [] brackets are t-values

The low R-square on the agricultural output gap equation confirms the conclusion that monetary policy has insignificant effects on value-added creation in the agricultural sector.

The results suggest that its impact on the different sectors may be substantially different in both magnitude and duration. It seems to be the case that the industrial sector is affected the most, followed by the services sector in which the shock needs more time to be fully reflected in economic activity in that sector. The agricultural sector is the

least affected. These asymmetric effects confirm the results in terms of correlation analysis.

These results demonstrate that the policy rate (PR) has no effect on the agricultural output gap (OG), but has strong negative effects on both other sectors. We, therefore, complete the analysis by excluding the agricultural OG from the analysis and restricting insignificant coefficients to zero. The result then is:

**Table – 5.1.4.b.ii: VAR Model Estimating The Effects of A Monetary Policy Shock on Industry And Services (Excluding Agriculture)**

| | TGVAGAPIND | TGVAGAPSER |
|---|---|---|
| TGVAGAPIND(-1) | 0.000000 | 0.000000 |
| | --- | --- |
| TGVAGAPSER(-1) | 0.000000 | 0.327698 |
| | --- | (0.11644) |
| | | [ 2.81427] |
| C | 7.720805 | 3.389073 |
| | (1.94663) | (0.82873) |
| | [ 3.96625] | [ 4.08950] |
| PR | -0.944277 | -0.379038 |
| | (0.22034) | (0.09310) |
| | [-4.28548] | [-4.07132] |
| R-squared | 0.314662 | 0.408203 |

Source: Author's Estimation
Values in () brackets are standard deviations, and those mentioned in [] brackets are t-values

To evaluate the effectiveness of monetary and fiscal policy on the overall and sector-specific output gaps, researchers may opt to employ a structural vector autoregression (SVAR) model instead of a VAR model. This involves imposing suitable constraints on the structural parameters during estimation. The purpose of this model is to represent the sequence of events that impact important variables. As a result, the structure of the model is designed to accurately depict the timeline of reactions. Assuming the central bank foresees a forthcoming inflationary rise.

The results suggest that its impact on the different sectors may be substantially different in both magnitude and duration. It seems to be the case that the industrial sector is affected the most, followed by the services sector in which the shock needs more time to be fully reflected in economic activity in that sector. The agricultural sector is the least affected. These asymmetric effects confirm the results in terms of correlation analysis.

From the analysis, the following results can be drawn:

- Changes in the PR have the most effects on the industrial OG: a 1 %point change in the PR inversely affects industrial OG by 0.94% points;
- The effect on the services OG is also very significant: the long-run effect of a 1%-point change has an inverse effect on the services OG by 0.38% points;
- The effects of PR need more time to materialize in the services sector as compared to the industry.

**Structural Vector Autoregression (SVAR) – Another Estimation**

To evaluate the effectiveness of monetary and fiscal policy on the overall and sector-specific output gaps, researchers may opt to employ a structural vector autoregression (SVAR) model instead of a VAR model. This involves imposing suitable constraints on the structural parameters during estimation. The purpose of this model is to represent the sequence of events that impact important variables. As a result, the structure of the model is designed to accurately depict the timeline of reactions. Thus, keeping in view the variables affected by monetary and fiscal policy, we selected Overall Output gap (TGVAGAP), Policy rate (PR), Primary Balance Ratio to GDP (PFBR), and Inflation (GRCPI) and estimated lag length from lag length selection criteria.

The result is given below:

**Table – 5.1.4.c: VAR Lag Order Selection Criteria**

Endogenous Variables : TGVAGAP PR PFBR GRCPI

| Lag | Log L | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 0 | -343.2345 | NA | 1016.417 | 18.27550 | 18.44788 | 18.33683 |
| 1 | -280.7055 | 108.6030* | 88.34366* | 15.82660* | 16.68849* | 16.13326* |
| 2 | -267.5257 | 20.11652 | 105.6570 | 15.97504 | 17.52643 | 16.52701 |
| 3 | -257.9930 | 12.54306 | 160.5921 | 16.31542 | 18.55633 | 17.11272 |

Source: Author's Estimation

* Indicates lag order selected by the criterion. It implies that lag length can be taken 1 which seems appropriate in annual data (Jeffery Wooldridge, 2002).

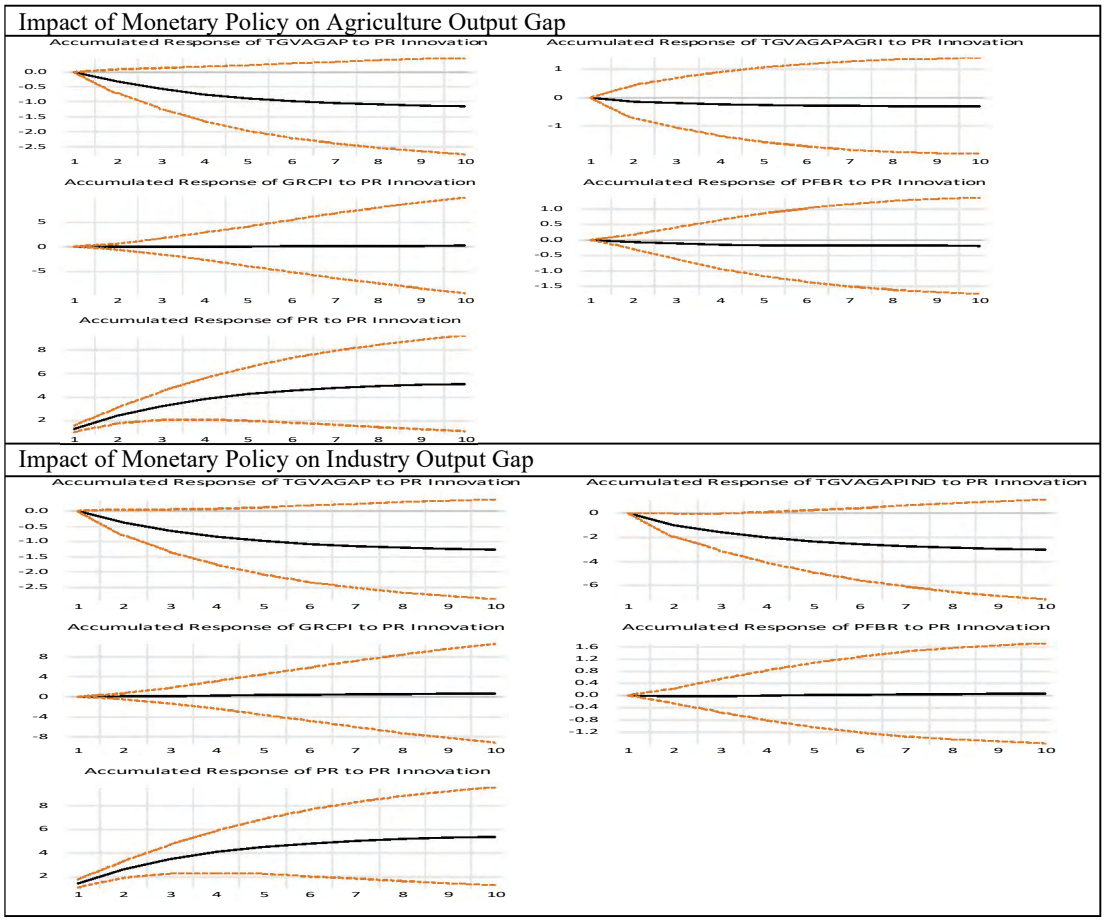
Assuming the central bank foresees a forthcoming inflationary rise. To address this upward trend, the central bank has the option to increase its primary policy rate. Inflation persists in its upward trajectory. Like fiscal policy, the use of SVAR prevents us from drawing the incorrect conclusion that raising the policy rate leads to an increase in inflation. Thus, to perform SVAR, a total of n(n-1)/2 restrictions are required on the

matrix of structural parameters, which are imposed to uniquely determine the system. Restrictions imposed are given in the following matrix:

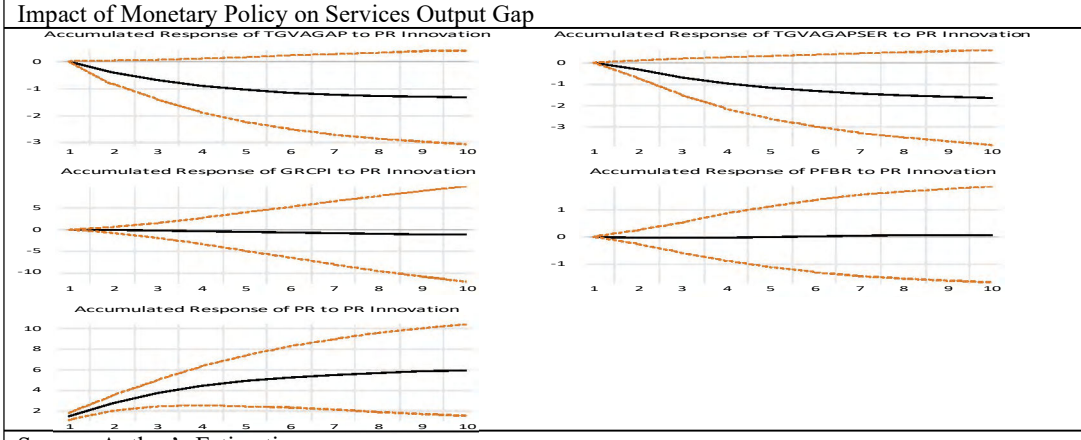
$$\begin{bmatrix} e^{TGVGAP} \\ e^{TGVGAPX_i} \\ e^{pfbr} \\ e^{GRCPI} \\ e^{pr} \end{bmatrix} = \begin{bmatrix} S_{11} & 0 & 0 & 0 & 0 \\ S_{21} & S_{22} & 0 & 0 & 0 \\ S_{31} & S_{32} & S_{33} & 0 & 0 \\ S_{41} & S_{42} & S_{43} & S_{44} & 0 \\ S_{51} & S_{52} & S_{53} & S_{54} & S_{55} \end{bmatrix} \begin{bmatrix} \varepsilon^{TGVGAP} \\ \varepsilon^{TGVGAPX_i} \\ \varepsilon^{pfbr} \\ \varepsilon^{GRCPI} \\ \varepsilon^{pr} \end{bmatrix}$$

$X_i$ implies that it is used for Agriculture, Industry, and Services separately.

In our case, we started with the policy rate being the first variable to be affected. The reason is that the monetary policy is presented approximately eight times in a fiscal year in Pakistan. In certain circumstances, special monetary policy may also be implemented. The State Bank of Pakistan (SBP) releases a semiannual schedule of Monetary Policy Committee (MPC) meetings to increase predictability and openness in monetary policymaking. Thus, the policy rate is the first one which can directly be affected. Next is the CPI, linking it with the cost of borrowing. Then the primary balance to GDP ratio, after the sectoral output gap, and last is the overall output gap.



Impact of Monetary Policy on Services Output Gap




Source: Author's Estimation

***Fig – 5.1.4.a: Impact of Monetary Policy (Policy Rate)***

### 5.1.4. b. Impact of Fiscal Policy Shock

Fiscal Policy Shock can also be a country-wide shock. Thus, an attempt has been made to analyze the specific effect of changes in fiscal policy. However, no significant results were obtained using fiscal policy tools like the Primary Fiscal Balance to GDP Ratio (PFBR).

**Table – 5.1.4.d: VAR Model Estimating the Sectoral Effects of a Fiscal Policy Shock**

| | TGVAGAPAGRI | TGVAGAPIND | TGVAGAPSER |
|---|---|---|---|
| TGVAGAPAGRI (-1) | -0.202815 | -0.002425 | 0.177499 |
| | (0.17536) | (0.24775) | (0.09894) |
| | [-1.15656] | [-0.00979] | [ 1.79406] |
| TGVAGAPIND (-1) | -0.010713 | 0.095287 | -0.019738 |
| | (0.11359) | (0.16048) | (0.06409) |
| | [-0.09431] | [ 0.59376] | [-0.30798] |
| TGVAGAPSER (-1) | 0.021183 | -0.517610 | 0.239469 |
| | (0.25048) | (0.35387) | (0.14132) |
| | [ 0.08457] | [-1.46273] | [ 1.69456] |
| C | 0.271477 | 7.964851 | 3.359695 |
| | (1.57367) | (2.22324) | (0.88785) |
| | [ 0.17251] | [ 3.58254] | [ 3.78407] |
| PR | 0.058852 | -0.984947 | -0.425224 |
| | (0.17409) | (0.24595) | (0.09822) |
| | [ 0.33806] | [-4.00468] | [-4.32931] |
| PFBR | 0.540481 | -0.222905 | -0.335478 |
| | (0.36842) | (0.52049) | (0.20786) |
| | [ 1.46703] | [-0.42826] | [-1.61397] |
| R-squared | 0.080449 | 0.355732 | 0.480446 |

Source: Author's Estimation
Values in () brackets are standard deviations, and those mentioned in [] brackets are t-values

Based on estimation, it can be argued that Monetary policy is seen to have significant effects on the output gaps in the industrial and services sectors. On the other hand, fiscal policy, measured by the primary balance shows insignificant effects on sectoral output gaps. These results cast doubt on the effectiveness of fiscal policy as a cyclical demand management policy instrument. There are many reasons for fiscal policy ineffectiveness. The government does not utilize complete information while making the policy. Likewise, during time within the fiscal year, fiscal policy becomes less responsive to the changes happening in the economy. The government decides the fiscal policy not based on economic conditions but in response to the reaction of the public. Further, Neo-Ricardian equivalence, proposed by Barro, suggests that individuals are forward-thinking and consider the government's budget constraint when making consumption choices. However, more research is needed to define more precise indicators for the stance of fiscal policy (cyclical neutral expenditure and revenue indicators). In the absence of these, no clear prescriptions for the role of fiscal policy as a policy instrument can be derived. But in any case, the estimation results do not support the use of fiscal rules in the function of cyclical conditions. The estimation results do show that long-run potential economic growth depends on the propensity to invest. Fiscal policy can contribute to this by reserving a significant proportion of the available resources towards GFCF. Therefore, a long-run fiscal policy rule in which the primary deficit is a constraint to equal the efficient part of Public Development Expenditures (PSDP) expenditure may be recommended.

The government's fiscal stance can be observed from the primary balance. The central bank also foresees a forthcoming inflationary pressure so can address it by changing policy rates. Restrictions imposed are given in the following matrix:

$$\begin{bmatrix} e^{pfbr} \\ e^{TGVGAPX_i} \\ e^{TGVGAPX_i} \\ e^{GRCPI} \\ e^{pr} \end{bmatrix} = \begin{bmatrix} S_{11} & 0 & 0 & 0 & 0 \\ S_{21} & S_{22} & 0 & 0 & 0 \\ S_{31} & S_{32} & S_{33} & 0 & 0 \\ S_{41} & S_{42} & S_{43} & S_{44} & 0 \\ S_{51} & S_{52} & S_{53} & S_{54} & S_{55} \end{bmatrix} \begin{bmatrix} \varepsilon^{pfbr} \\ \varepsilon^{TGVGAP} \\ \varepsilon^{TGVGAPX_i} \\ \varepsilon^{GRCPI} \\ \varepsilon^{pr} \end{bmatrix}$$

In our case, we again started with the assumption that the policy rate can change more quickly than other mentioned variables. Next is the CPI, linking it with the cost of borrowing. In Fiscal Policy, the primary balance to GDP ratio will be the last one to respond.

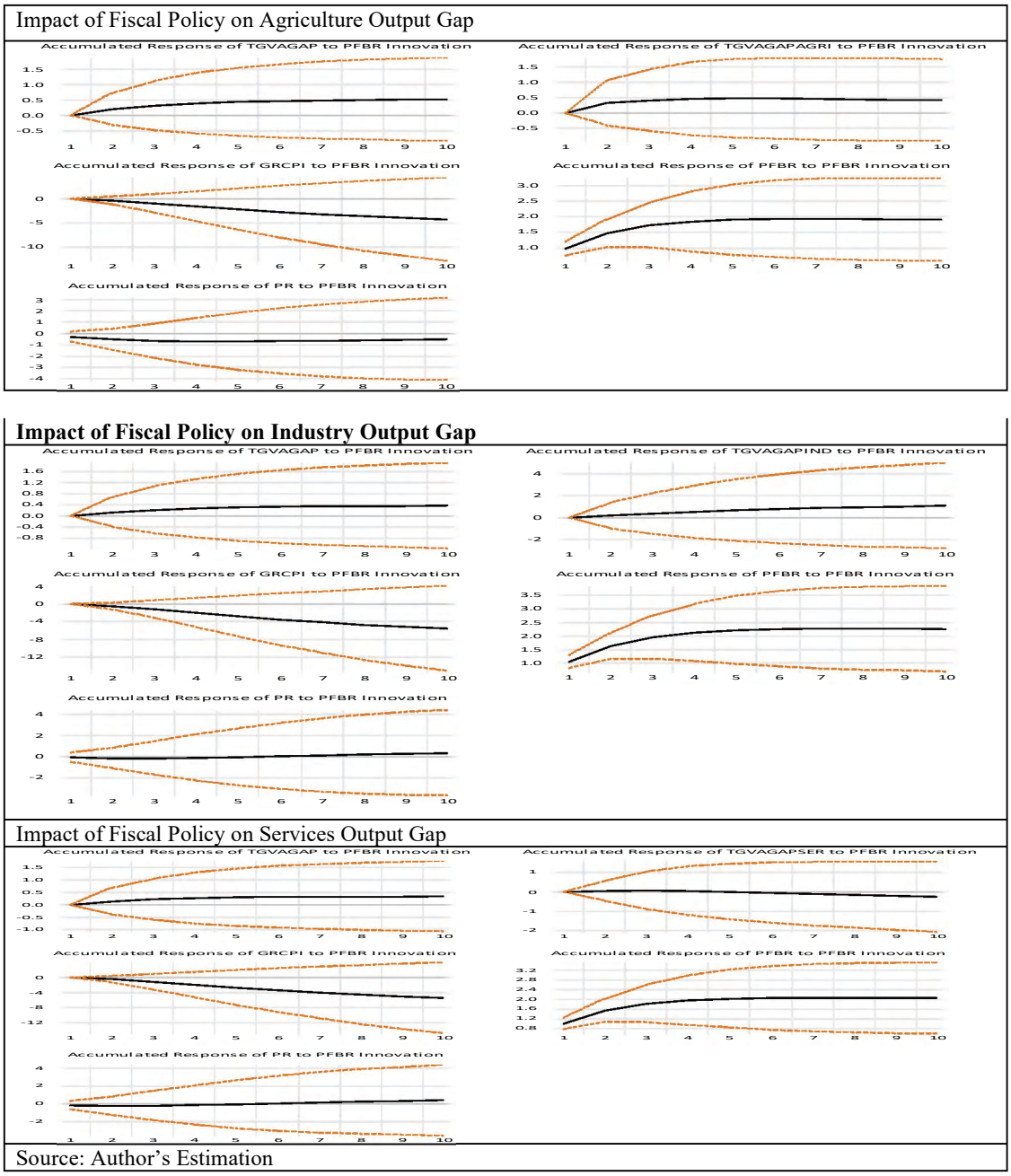



***Fig – 5.1.4.b: Impact of Fiscal Policy (Primary Balance to GDP Ratio)***

### 5.1.5. Discussion of Results

Most of the macroeconomic models that have been developed in recent years originate in central banks. Pakistan is no exception. These models are mainly designed to take optimal monetary policy decisions. Optimal monetary policy reaction functions are dependent on the gap between predicted output and potential output (the output gap) and the difference between predicted inflation and the inflation target (the inflation gap). Monetary policy models, therefore, concentrate only on aggregate output and

inflation gaps. While these models' focus on forecasting economic growth as the sum of potential growth and the change in the output gap, is useful from a broader economic perspective the singular focus on the aggregate economy may be insufficient. From a broader economic policy point of view, sectoral disaggregation seems more insightful and useful. This requires testing whether the sectoral potential growth rates and the output gaps behave similarly or whether they respond differently to different shocks and policies. This study initially presents answers to this question for the three main sectors of the economy: agriculture, industry, and services. That analysis leads to several relevant conclusions and policy recommendations.

First, the growth rates of potential output (measured as value added) of the industry and services sectors are highly and significantly correlated with the potential growth rate of the overall economy. Furthermore, the potential growth rates of industry and services are significantly correlated with each other. On the other hand, the potential growth rate of agriculture, although statistically significant, is much less correlated with the aggregate potential growth and is not correlated with the potential growth rates in the industry and services sectors. This is an extremely important result. It shows that one-size-fits policies based on aggregate output and the aggregate output gap, as is done in Pakistan, do not apply as effectively to Agriculture as they do to industry and services. Agriculture is still an important sector of the economy (see Appendix B) and nearly 37 percent of the population is directly dependent upon it (Labor Force Survey 2020-21). Policies based on estimates of the aggregate output and output gap are therefore misaligned to stabilize the overall economy.

Second, the same results apply to the cyclical stances in these sectors. The cyclical position of each sector is defined as the percentage deviation of current from potential output. The results demonstrate that the output gaps in industry and services are highly and significantly correlated with the overall economy output gap, but this is far less in the case of the output gap of the agricultural sector. The output gaps of the industrial and services sectors show strong and statistically significant correlations, whereas the output gap in agriculture is not correlated with those in the other sectors.

Third, a structural VAR analysis shows that country-wide shocks affect the industrial sector the most. The second largest effect is on services while agriculture comes in last. Whereas country-wide shocks show their effects on industry and agriculture within one year, the effects on services last longer.

Fourth, structural VAR analysis shows that the policy interest rate does not affect the output gap of agriculture. It does, however, affect strongly the cyclical stance of industry and services. The impact on industry is strongest and quickest, whereas the effects on services take more time to materialize and are somewhat less strong than that in the industrial sector. This is an important finding that confirms that monetary policy is more effective for the industry than for services and does not similarly impact the agriculture sector.

Fifth, and much more significantly no conclusive evidence was found as to the effects of fiscal policy on the cyclical stances in any of the three sectors. While this finding needs more research before drawing hard conclusions is strongly supportive of the assertion of structural rigidities within the existing fiscal system and the generally held feeling that these policies are only focused on meeting the revenue needs of the Governments and not focused on stabilization or enhancing and nurturing growth.

These results all support the fact that the agriculture sector has a structure that is quite dissimilar, and as such aggregation of the three sectors to estimate output and output gaps only generates biased estimates. Policies based on these aggregate estimates are therefore inherently misaligned to maximize overall growth and reduce the output gap. Our results indicate that the agricultural sector, both in terms of long-term potential output growth and short-term fluctuations in the output gap, behaves quite differently from the other two sectors. Economy-wide shocks would affect the agricultural sector very differently as compared to industry and services. Furthermore, demand management policies, such as monetary policy, do not seem to affect the agriculture sector's cyclical position. Economic growth and economic shocks within the agricultural sector need differently designed policies.

### 5.2. The Neutral Rate of Interest in Pakistan

As previously mentioned, the interest rate can be understood as the price or return that achieves equilibrium in the financial market. In other words, the interest rate ensures a balance between the supply and demand for money. This can be expressed as the general equilibrium nominal interest rate as mentioned in eq (4.2.6).

$$r = c_1 - c_2\{log[m(NDA + NFA)] - y\} + c_3 p^{NT} + c_4(pf + e) \qquad (5.2.1)$$

Where $c_i$ (i = 2 to 4) are coefficients (semi-elasticities) and $c_1$ is a constant term

Thus, the estimated ARDL equation is:

$$\Delta r_t = -26.70 - 0.216 r_{t-1} - 4.019\{log[m(NDA + NFA)]_{t-1} - y_{t-1}\} + 2.528 {p^{NT}}_{t-1} + 2.528(pf + e)_{t-1} - 2.886\Delta\{log[m(NDA + NFA)]_t - y_t\} + 31.636\Delta log p_{t-1} - 0.175\Delta r_{t-1} \quad (5.2.2)$$

The actual estimation results are reported in 6.2.i. The following variables were used:

$m(NDA + NFA)$ = M2

$p^{NT} = GDPBPD\_0$ (baseline GDP deflator)

$pf + e = CPIF/NEER$ (CPIF is the weighted average foreign prices in foreign currencies, and NEER is the nominal effective exchange rate)

$p = CPI$ (CPI is the domestic consumer price index)

Further, the data frequency in this analysis was monthly and to capture possible monthly seasonal effects, eleven seasonal dummies were used.

**Table – 5.2.a: Equilibrium Interest Rate**

Dependent Variable: D(CMR)

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| Constant | -26.70067 | 9.622146 | -2.774918 | 0.0059 |
| CMR (-1) | -0.210190 | 0.039749 | -5.287874 | 0.0000 |
| LOG (1000*M2(-1))-LOG(GDPBP_0(-1)) | -4.018968 | 1.510086 | -2.661417 | 0.0082 |
| D (CMR (-1)) | -0.175080 | 0.058810 | -2.977030 | 0.0032 |
| D(LOG(1000*M2)-LOG(GDPBP_0)) | -2.885817 | 7.004647 | -0.411986 | 0.6807 |
| LOG(GDPBPD_0(-1)) | 2.527863 | 1.913371 | 1.321157 | 0.1876 |
| LOG (100*(CPIF (-1)/NEER (-1))) | 2.595769 | 1.457022 | 1.781558 | 0.0759 |
| D (LOG (CPI (-1))) | 31.63583 | 14.47468 | 2.185598 | 0.0297 |
| D_1 | 0.217296 | 0.570952 | 0.380584 | 0.7038 |
| D_2 | 0.017374 | 0.541744 | 0.032070 | 0.9744 |
| D_3 | 0.369630 | 0.503512 | 0.734104 | 0.4635 |
| D_4 | 1.226528 | 0.516998 | 2.372405 | 0.0184 |
| D_5 | -0.308772 | 0.482135 | -0.640428 | 0.5224 |
| D_6 | 0.061022 | 0.471754 | 0.129352 | 0.8972 |
| D_7 | 0.693337 | 0.629390 | 1.101602 | 0.2716 |
| D_8 | -0.204809 | 0.477822 | -0.428630 | 0.6685 |
| D_9 | 0.143400 | 0.489271 | 0.293088 | 0.7697 |
| D_10 | 0.644968 | 0.518456 | 1.244016 | 0.2146 |
| D_11 | 0.337190 | 0.490330 | 0.687680 | 0.4922 |
| R-squared | 0.227257 | | | |

Source: Author's Estimation

The coefficients are stable over time and the estimated equation passes the Wald and T bound tests as prescribed in Pesaran, Shin, and Smith (2001). The F-statistic and t-statistic in the equation are located on the right-hand side of the critical bounds provided in tables CI and CII in Pesaran, H., Y. Shin, and R. Smith's (2001) publication. Thus,

the null hypothesis of no relationship between levels (equilibrium relationship) can be rejected. In addition, the equation successfully passes the Engle-Granger co-integration test (See Appendix -E).

The relatively low R-squared of this equation is due to two factors. First, the dependent variable is in terms of changes in the interest rate and second, it implies that over the past, the observed interest rate frequently deviated from the equilibrium rate (based on the theoretical proposition.

Given the reliable nature of this estimated dynamic ARDL equation (5.2.2), we can estimate separately the levels part of this equation to assign that part of the intercept that can be attributed to the equilibrium interest rate. Thus, The long-run equation:

$$r_t = -129.427040314 - 20.3818645288 * (LOG(1000 * M2) - LOG(GDPBP\_0)) + 16.9141609214 * LOG(GDPBPD\_0) + 8.19702724429 * LOG(100 * (CPIF/NEER)) \quad (5.2.3)$$

Equation (5.2.3) provides an estimate of the path of the interest rate that is required to equilibrate shocks to the BOP, potential output, domestic costs, foreign prices, and the exchange rate. It can be compared with the observed interest rate to identify periods during which the interest rate was not in equilibrium (Figure – 5.2A). The difference between the observed and equilibrium interest rates is shown in Figure – 5.2B.



Source: Author's Calculation

***Fig – 5.2. a: Observed versus equilibrium rate of interest***

***Fig – 5.2. b: Observed minus equilibrium rate of interest***

The figures also document periods of excess expansionary or contractionary monetary policies. The observed interest rate fell below the equilibrium rate from FY2013 up to early FY2019. Monetary policy became very restrictive during the COVID period. Further, the following implications can be identified:

- Though not constant, the equilibrium interest rate is less volatile than actual rates.
- There are prolonged periods in which the interest rate, compared to its equilibrium value, is either too high or too low;

- From FY 2013 up to FY 2018, the interest rate was too low. From mid-FY 2019 up to the end of FY 2020, the interest rate exceeded its equilibrium value. From FY 2021 up to FY2022m9, the interest rate fell back below equilibrium. Since then, it has been at or above equilibrium;
- Based on these results, it can be concluded that in some periods, the policy interest rate was above equilibrium and in other periods it was below. The former periods are therefore characterized as restrictive monetary policy and the latter periods as accommodative policy. Our analysis does not provide any information as to why monetary policy was restrictive or accommodative in some periods. It could be policy "mistakes" or deliberate policy to serve one or another objective;

### 5.2.1 Effect of Interest Rate on Aggregate and Sectoral Output Gap

It was desirable to analyze the impact of the deviation between the neutral interest rate and the actual interest rate on the aggregate and sectoral output gap. This will help in testing the hypothesis that tuning the interest rate at the aggregate level has different implications at the sectoral level. In this regard, a partial adjustment model was used. The partial adjustment model consists of two components: a static component that explains the determination of the desired amount, and a dynamic partial adjustment process. Given that the variables in this analysis are integrated of order zero (I (0)), it would be better to employ a conventional partial adjustment mechanism. The results are given below:

**Table - 5.2.b: Partial Adjustment Mechanism**

| Independent | Dependent | Coefficient | Prob. |
|---|---|---|---|
| Overall | CMRDISEQUIL1 | -0.444 | 0.0011 |
| | OUTPUTGAP (-1) | 0.077 | 0.6384 |
| | C | 0.284 | 0.3562 |
| Agriculture | CMRDISEQUIL1 | -0.074 | 0.5731 |
| | OUTPUTGAPAGRI (-1) | -0.226 | 0.2953 |
| | C | -0.108 | 0.7531 |
| Industry | CMRDISEQUIL1 | -0.913 | 0.0080 |
| | OUTPUTGAPIND (-1) | -0.139 | 0.4420 |
| | C | 1.385 | 0.1004 |
| Services | CMRDISEQUIL1 | -0.495 | 0.0002 |
| | OUTPUTGAPSER (-1) | 0.239 | 0.1274 |
| | C | 0.206 | 0.4933 |

Source: Author's Estimation

From the table, deviation from neutral rate of interest (CMRdisequil1) has significant negative effects on output gap of overall economy, industry and services but no effect on agriculture output gap. The partial adjustment (lagged dependent variables) in the

equations is not significant which implies that complete adjustment takes place within 1 year. Thus, the following results can be inferred from the above table

- In all cases, the coefficient on the lagged dependent variable is not significant, it says that all adjustment takes place in the current year.
- There is a negative relationship between deviation from a neutral interest rate and the output gap. This effect in the industry is nearly double that in the services sector.
- The relationship is insignificant only in the agriculture sector reinforcing our earlier claim that demand management policy through interest rate is not affecting the output gap in the agriculture sector.

In the analysis, we also found that there is a very significant positive correlation between the deviation of the policy rate from equilibrium and the trade balance. Both the disequilibrium in the policy rate and the trade balance are non-stationary time series. Johansen co-integration test indicates that there exists a positive long-run equilibrium relation between both. This finding was confirmed by estimating a VECM model with the trade balance as the dependent variable. When using the policy rate deviation from equilibrium as the dependent variable the test was far less conclusive. This implies that the relationship between the policy rate and the trade balance is not a policy reaction function, but shows that when the policy rate was above its equilibrium value, the trade balance improved and vice versa. Fig – 5.2.C confirms a positive relationship between these two variables.

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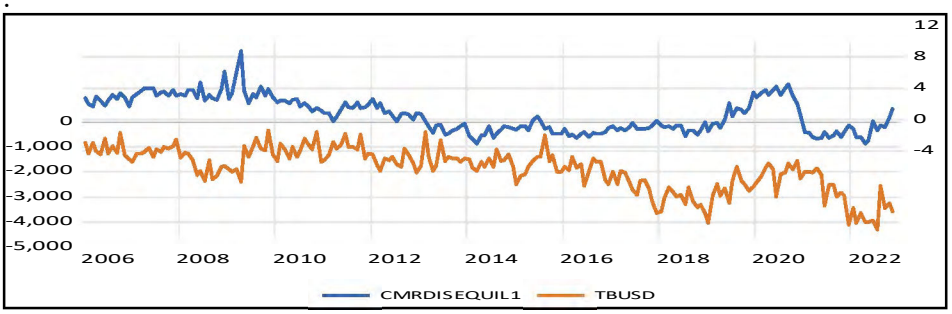


Source: Author's Calculations

***Fig – 5.3: Relationship between Disequilibrium in Policy Rate & Trade Balance***

Another important issue of large and sustained deviations of the interest rate from equilibrium concerns its implication for public finance. Up till 2018, a substantial proportion of Government budget deficits were financed by direct central bank credit.

Due to the specific arrangements between the Government and the SBP, interest payments on domestic debt were largely shielded from changes in domestic interest rates. However, since the amendment in the SBP Act regarding independence, budget deficits need to be financed in large part from the domestic financial market, mainly through loans obtained from banks. Large deficits, therefore, drive up the domestic interest rates and increase the interest payments on domestic debt. This entails the risk of falling into unsustainable debt dynamics.

### 5.2.2. Discussion of Results

Monetary policy is built around the concept of the maintenance of a rate of interest that is consistent with the potential output and therefore is most conducive to maximizing overall economic growth. This neutral rate of interest is therefore also dependent upon the ability to correctly forecast output, output gaps, and associated prices. In this regard, the findings of the first part of our analysis discussed above and the inherent aggregation biases in how it is estimated become critical.

In this the definition of what is the neutral or equilibrium interest rate has been the subject of intense discussions in the literature. The estimation of this neutral /equilibrium interest rate is also surrounded by a lot of uncertainties. Different methods have been applied, yielding different estimations. The overall conclusion is that no single best method exists.

The conclusion reached for developed economies is even more valid in emerging markets such as Pakistan. Pakistan has witnessed high volatilities in inflation, real economic growth, frequent and large shocks in potential output and output gap, structural economic and financial changes, changes in the conduct of monetary policy, and the financing of budget deficits. Furthermore, no single well-defined level of inflation target has been officially announced.

Nonetheless, the notion and the estimation of an equilibrium interest rate, in the case of Pakistan also remains a necessary and important task. It is a crucial parameter in the conduct of monetary policy and fiscal management. Financial institutions and private enterprises need to know the benchmark interest rate in the economy, even if it may be subject to frequent changes.

Therefore, in this study, we adopted an approach that may best serve these purposes and yields robust estimations. The underlying hypothesis is the existence of a stable money demand function in Pakistan, which is confirmed by our estimation results. The equilibrium interest rate is then estimated as the rate that is compatible with the money supply path and with the trajectories of real transactions and prices. For the future conduct of monetary policy, it is the policy rate that is coherent with the necessary money supply path to let inflation converge to its target range and with the forecast of real GDP and prices. Whenever the interest rate is set above its equilibrium level, monetary policy is defined as restrictive. In the opposite case, it is deemed to be accommodative.

Over the past, it has been observed that a restrictive (accommodative) monetary policy stance was accompanied by improvements (deterioration) in the trade balance (the difference between export receipts and import payments). Given that Pakistan has suffered large trade deficits in the past, monetary policy could have helped in containing these deficits. But on the contrary, often monetary policy was too accommodative. On the other hand, as recent experience has shown, restrictive monetary policy increases public debt servicing considerably. Furthermore, studies have shown a negative correlation between the interest rate and cyclical economic activity in the industry and services sectors. On top of that, restrictive monetary policy can discourage investments, which negatively affects the growth of potential output and hence the long-term equilibrium growth rate in all sectors. Therefore, at times, severe policy conflicts are present. The main lesson that can be drawn from the analysis is that the interest rate should be kept close to its equilibrium level. This level is not constant but depends on economic circumstances such as the potential long-term growth rate, the inflation target, and the growth rate of the money supply that is compatible with the inflation target (range). This implies that monetary policy should not be used as an instrument to increase economic growth. The same observation holds for fiscal policy. The primary fiscal balance should be coherent with sustainable debt levels and it should not be used as an instrument to increase economic growth. Long-term equilibrium growth depends on the propensity to invest. Stimulating this propensity requires supply-side economic policies, not demand stimulus. Demand management policies should be confined to steering the observed economic activity toward its supply-determined potential level. The analysis has also shown that the agricultural sector requires special

treatment since it behaves quite differently from the other sectors. This applies to both its potential growth rate and cyclical deviations from it.

### 5.3. Debt Dynamics and Implications of Policy Misalignments

Regarding, the nature of fiscal policies that are compatible with a low and stable debt-to-GDP ratio (as prescribed by the Fiscal Responsibility & Debt Limitation Act, 2005 amended Jun 2022[18]) and with the objective of attaining a sustainable Balance of Payments (external debt servicing in foreign currencies may burden the BOP and official reserves, following debt equation was derived in Chapter Research Methodology.

$$td_t - td_{t-1} = \left\{\frac{\alpha_{1t-1}.i_{1t}+\alpha_{2t-1}[i_{2t}(1+\rho_{2t})+\rho_{2t}]-g_t}{1+g_t}\right\} td_{t-1} - s_t - fg_t + gdep_t \quad (5.3.1)$$

res = residual = $-fg_t + gdep_t$

tdc = Total Debt Cost

$$td_t - td_{t-1} = \left\{\frac{tdc_t-g_t}{1+g_t}\right\} td_{t-1} - s_t - res_t \quad (5.3.2)$$

**Table - 5.3: ARDL equation explaining the major determinants of the change in the debt ratio**

D(CDR)=C (1) +C (2) *CDR (-1) +C (3) *GRGDP (-1) +C (4) *TDC (-1) +C (5) *RES (-1) +C (6) *PBR (-1) + C (7) *D(GRGDP)+C (8) *D(TDC)+C (9) *D(PBR)+C (10) *D(RES)

| | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| Constant | -0.308298 | 0.405747 | -0.759829 | 0.4535 |
| CDR (-1) | -0.839374 | 0.198787 | -4.222468 | 0.0002 |
| GRGDP (-1) | -0.428103 | 0.106823 | -4.007589 | 0.0004 |
| TDC (-1) | 0.457922 | 0.106638 | 4.294162 | 0.0002 |
| RES (-1) | 0.839126 | 0.210080 | 3.994317 | 0.0004 |
| PBR (-1) | -0.844457 | 0.216278 | -3.904501 | 0.0005 |
| D(GRGDP) | -0.502667 | 0.020728 | -24.25068 | 0.0000 |
| D(TDC) | 0.545833 | 0.019638 | 27.79436 | 0.0000 |
| D(PBR) | -0.952744 | 0.079023 | -12.05651 | 0.0000 |
| D(RES) | 0.989355 | 0.040956 | 24.15674 | 0.0000 |
| R-squared | 0.994491 | Mean dependent var | | -0.042511 |

Source: Author's Calculation

In this case, the T-statistics is -4.2 which exceeds the t-test upper bound (-2.86 – -3.99)

[18] https://www.finance.gov.pk/publications/frdla2005_amended_2022.pdf

therefore the null hypothesis of no levels relation is rejected. Further, variables used in estimations are not I (1), therefore a co-integration test is not valid.

Results:

- The bulk of the effects of shocks in GDP growth, debt cost and the residual occur in the same year that the shock takes place.
- Long-run effects on change of debt to GDP ratio (in percentage points):
    - one percentage point change in nominal GDP leads to a reduction of debt ratio by about half of a percentage point
    - one percentage point change in total debt cost (due to interest rate and exchange rate changes) will increase the debt by almost half a percentage point
    - One percentage point change in primary balance will reduce debt with the same percentage
    - One percentage point increase in residual will increase the debt by the same percentage point and vice versa
- The implications of these results can be used for defining potential future debt dynamics. Based on the following assumption:
    - Inflation may converge to inflation target range: 5-7%
    - Real economic growth may remain limited to around 3.5% given the current IICOR, the equilibrium rate of economic growth will be around 3.5%
    - Policy rate may be required to remain high (as explained in the chapter on Neutral rate of interest)

Hence r-g parameter may become neutral to unfavorable in the future. This will not be a major source of reduction of Debt Ratio (DR). it remains the Primary Balance Ratio (PBR). Reducing the DR from the current ratio of around 73% to 60% as implied by the FRDL Act, would require a massive improvement of the Primary Balance Ratio (PBR). This can be accomplished either by reducing future fiscal deficits, or by increasing the long-run growth path of the economy, or by a combination of both. In any case, the reduction of the Debt Ratio (DR) will need to be a gradual process. As a corollary, avoiding further increases in the Debt Ratio (DR) will require fiscal discipline. The error correcting term C (2) = 0.84, implying that 84% of the adjustment of the dependent variable to shocks occurs within 1 year.

### 5.3.1. Discussion of Results

Our results indicate that the policy variables significantly impact the debt dynamics of the economy.

A one percentage point surplus in the primary balance reduces the debt-to-GDP ratio by an equal magnitude (1 percentage point of GDP). The primary balance is the main instrument to control the change in debt to GDP ratio.

We find that the nominal GDP growth and debt cost have similar but opposite effects on the debt ratio, ceteris paribus: a one percentage point increase in nominal GDP growth reduces the debt ratio by 0.51 percentage points. A reduction in the debt cost by 1 percentage point, reduces the debt ratio by 0.54 percentage points.

Further, the effect of changes in total debt costs is substantial. Total debt costs depend on interest rates on domestic and foreign debt, as well as on the exchange rate movements that convert foreign currency debt servicing into domestic currency and translate the outstanding foreign currency debt stock into domestic currency. Interest rate and exchange rate misalignment, therefore, contribute to the debt ratio.

Our estimation results noted above are based on other things remaining equal (ceteris paribus). For example, an improvement in the primary balance may affect nominal GDP growth. However, the effect on nominal GDP growth is unclear. Fiscal consolidation may reduce real GDP growth temporarily, but it may also strengthen the exchange rate and hence reduce inflation. These interactions merit further detailed analysis.

We used our analysis to define an indicative equilibrium path for the debt-to-GDP ratio. It has been found that reducing the debt ratio to 60% (as required under the FRDL Act of 2015) from the current level of around 73% would require about 13% points improvement of the PBR in total all other things remaining equal. This would be a daunting exercise. But, given these prospects, even avoiding further future increases in the Debt ratio (DR) will require a large dose of fiscal discipline which has been absent in the past.

# Chapter – 6

## Conclusions & Policy Recommendations

This study examines the misalignment in macroeconomic policies, particularly monetary and fiscal policies, that caused macroeconomic instabilities in Pakistan due to biassed underlying aggregate parameter estimates that squeezed fiscal space and created significant debt. When important macroeconomic indicators diverge significantly from equilibrium, macroeconomic instability arises. Economic policies, especially monetary and fiscal ones, must correct such deviations. The research thus aimed to identify and measure deviations from equilibrium, the appropriate policy responses which we compare with the observed policies.

Economic research has just barely touched on the sectoral output gaps and their policy implications, and Pakistan has no study available to date. Discussion of neutral interest rates are prominent in international economic literature. However, no research has been done on Pakistan in this area. Thus, this study examined the misalignment in macroeconomic policies, particularly monetary and fiscal policies, that have caused macroeconomic instabilities in Pakistan, focusing on the sectoral output gap, neutral rate of interest, and debt dynamics, three distinct but interrelated aspects of the complexity behind Pakistan's historical inability to maintain a stable growth path.

The study was based on addressing research questions related to the three areas: Sectoral Output gaps, Neutral Interest Rate, and Debt Dynamics. The analysis was used to highlight potential policy misalignments in Pakistan and their implications for output - gaps (and hence steady state optimal growth), neutral rate of interest, and debt dynamics.

This Chapter, therefore summarizes the Contributions of the research to the Literature and the Policy Debate and presents the Main Results, Conclusions, and Policy Recommendations. In the end, Contributions versus Limitations and areas for Future Research are discussed.

### 6.1. Contributions to the Literature and the Policy Debate

In the past, Pakistan has been plagued by frequent economic crises and the subsequent need to request finance and economic advice from the IMF. The basic question

therefore is to find reasons why this has been the case and how this can be avoided in the future.

These questions need to be answered effectively based on macroeconomic analysis. In this respect, the contribution and novelty of this thesis rests on its focus on identifying and distinguishing between the country's equilibrium path (the sustainable path) and the deviations from this path (the unsustainable path). To that end, the thesis identifies equilibrium from disequilibrium in three crucial macroeconomic domains. The first one relates to potential (sustainable) economic growth and deviations in terms of output gaps at the sectoral level. The second searches for the equilibrium interest rate and deviations from equilibrium. The third one investigates the origins of government debt dynamics and how to bring them back to an operational target that is prescribed by law and that is sustainable. Upon identification of these equilibria/disequilibria, the common thread of this thesis is the necessary policy responses to keep the economy as close as possible to the equilibrium macroeconomic path. Wrong policies historically contributed to vicious macroeconomic cycles. It was observed that exploring the available macroeconomic publications on Pakistan, the approach and research strategy followed in this thesis is a novel approach to the policy debate in Pakistan.

### 6.2. Main Results and Conclusions

Pakistan's economy has historically experienced domestic and external imbalances, which have impeded macroeconomic stability. To rectify these disparities, there has remained a pressing requirement for the consistent implementation of appropriate policies. Both fiscal and monetary policies remained less than fully effective as economic activity went through frequent booms and busts lowering the average growth rate, while inflation remained in double digits, most of the time. We hypothesize in this thesis that such a poor response to Pakistan's economy can be attributed to the lack of effectiveness of fiscal policy, which remained focused on arranging resources for debt servicing, and an inappropriate monetary policy stance that ignored asymmetries in its effectiveness across different sectors. There is, however, limited research available at the sectoral level which would permit a fuller understanding.

With this background, this thesis sets three objectives. The first is to estimate the output gaps in different sectors and analyze their correlation with the overall output gap. The effectiveness of fiscal and monetary policies in stabilizing output has also been

analyzed for overall and sectoral output gaps. The second objective is to estimate the equilibrium rate of interest, the "neutral rate of interest", and then examine the impact of deviation of actual interest rate from equilibrium on overall and sectoral output gaps. Finally, the third objective is to analyze Pakistan's General Government debt dynamics and the necessary conditions to converge to the 60% level, which is the operational target defined in the FRDL Act.

To satisfy these objectives different methodologies have been adopted. Output gaps, in the overall economy as well as at the sectoral level, have been estimated using respective Inverse Incremental Capital-Output ratios. The effectiveness of fiscal and monetary policies to stabilize the output gap has been estimated through (Structural) Vector Autoregressive Models. Using appropriate identifying restrictions for Pakistan's economy, impulse response functions have been estimated to find short-run and long-run policy multipliers. The equilibrium interest rate has been estimated in an Autoregressive Distributed Lag Framework applied to money market equilibrium conditions. Effects of the gap between actual and equilibrium interest rates on overall and sectoral output gaps have been estimated using the Partial Adjustment Model. Finally, the debt equation has been estimated in an ARDL framework, which is then used to analyze the debt. The time selected for the analysis spans 1981 to 2022 with annual frequency.

It has been found that sectoral Potential Gross Value Addition in each sector is significantly correlated with aggregate total potential output growth. However, these correlations have been found much stronger for the industrial and services sectors as compared to the agricultural sector. The most remarkable result here is that the cyclical movements in the agricultural sector are not correlated with those in the industry and services. On the other hand, there is a strong and significant correlation between the output gaps in the industrial and services sectors. Moreover, as far as the effectiveness of policies is concerned, it has been found that monetary policy has significant effects on overall and on industry and services output gaps; while fiscal policy has been found to have insignificant effects on overall as well as all sectors' output gaps.

These findings raise concerns about the efficacy of fiscal policy, as implemented, as a tool for managing cyclical fluctuations in economic activity. Further research on this matter is imperative to identify more effective indicators for assessing the position of

fiscal policy. Without these, it is not possible to determine the specific role of fiscal policy as a policy instrument.

Regarding the "Neutral Rate of Interest," it has been found that the policy interest rate has deviated considerably from the equilibrium interest rate rather it fluctuated above or below the equilibrium level for considerable periods. Moreover, there appears to be a significant negative effect of the deviation of the policy rate from equilibrium on the overall output gap and that in the industry and services sectors.

We also find a positive correlation between the interest rate gap and the trade balance.

Finally, in debt sustainability analysis, this study has found that the primary balance serves as the primary tool for managing fluctuations in the debt-to-GDP ratio (assuming all other factors remain constant). A surplus of 1 percentage point in the primary balance results in a reduction of the debt-to-GDP ratio by an equivalent magnitude, i.e. a reduction of 1 percentage point of GDP. Similarly, under unchanged conditions, nominal GDP growth and debt cost have comparable but opposite impacts on the debt ratio. A 1% increase in nominal GDP growth leads to a 0.51% decrease in the debt ratio. On the other hand, a one percentage point decrease in debt cost results in a 0.54 percentage point decrease in the debt ratio. The total costs of debt are influenced by interest rates on both domestic and foreign debt, as well as by changes in exchange rates that convert foreign currency debt payments into domestic currency and translate the total amount of foreign currency debt into domestic currency. Therefore, interest rate and exchange rate misalignments can impact the debt ratio significantly. For instance, changes in the primary balance can influence nominal GDP growth. However, the impact on nominal GDP growth remains uncertain. Fiscal consolidation can lead to a temporary decline in real GDP growth, but it can also enhance the exchange rate, resulting in a decrease in inflation. Further research is warranted for these interactions.

### 6.3. Policy Recommendations

The primary goal of economic policy is to maximize citizen's welfare. An important element is to maximize per capita economic growth. But here policymakers should not declare and pursue unsustainable growth rate targets. In this respect, policymakers should be aware that increasing economic growth on a sustainable level, requires structural policies directed at increasing the share of income generated that is spent on

investments into future economic growth. This can be done by promoting domestic investments and attracting Foreign Direct Investments.

Once sustainable economic growth is identified, economic policy should be aimed to keep the economy close to the sustainable path by using monetary and fiscal policy instruments. These policies are commonly known as demand management policies. Such policies should recognize their different effects between economic sectors and consider their effects not only on growth but also on debt dynamics. Our analysis suggests some specific policy recommendations. First, the fact that the three major sectors of the economy are dissimilar in response to fiscal and monetary policy instruments makes one-size-fits policies inappropriate. Therefore, sectoral consideration and side effects of interest rates must be taken up especially while formulating and implementing monetary policy. More specifically, the analysis shows that the restrictive stance of monetary policy is significantly detrimental to industrial activity and (to a somewhat lesser degree) to the services industry. Also, it increases Government interest payments thereby significantly limiting the available fiscal space.

Second, the analysis does not find any role for fiscal policy as a demand management tool. Hence fiscal policy needs to be disciplined to avoid adding expenditures that are not backed by domestic value-added creation and to avoid unstable debt dynamics. Whenever demand management policies are inappropriate, periods of internal and external imbalances emerge, adding to the instability of the economy in terms of boom-and-bust cycles, adding to uncertainty, and hampering investment decisions. Therefore, to avoid such situations in the future and to keep debt within sustainable limits, it is imperative to maintain fiscal discipline by generating a primary surplus. Third, within the available fiscal space (considering the Debt to GDP target as defined by law) the analysis leads to conclude that fiscal policy should avoid stimulating the economy above its potential, but instead reallocate expenditures towards stimulating sustainable growth. In the past PSDP spending was the residual that was reduced when the fiscal deficit was increasing above target. Instead, it should become a primary focus of supply-side-oriented fiscal policy. More generally, fiscal policy, apart from fighting poverty through income support programs, should contribute to the potential growth of the economy. Tax expenditures and headline expenditures should be tested on their effectiveness to support potential growth. Finally, long-run economic expansion is the result of the addition of new capital stock through gross fixed capital formation.

Translated in terms of long-run economic growth, it depends on the share of income that is spent on gross fixed capital formation (at the detriment of consumption) as indicated in eq 6.1.2 and 6.1.3 in which growth of TGVA was related to the propensity to invest. Further, instead of announcing unrealistically high growth targets (which surpass the potential growth rates by large margins), the government should design policies that stimulate investment relative to consumption.

Thus, in the context of Pakistan, the policy implications can be concluded as:

**1. Sectoral Alignment:**

Align policies to leverage the strong relationship between industry and services sectors to boost aggregate potential output growth. Develop strategies to enhance the weaker link between agriculture and the other two sectors.

**2. Monetary Policy:**

Effectively utilize monetary policy to manage output gaps in industry and services, as it significantly impacts these sectors. Consider the neutral rate of interest to avoid deviations that harm output gaps. Also, to keep output gaps from getting worse, keep the policy rate around the equilibrium level. Monitor the interest rate gap and adjust policies to minimize its negative impact on the trade balance.

**3. Fiscal Policy:**

Optimize fiscal policy to have a more substantial impact on output gaps, particularly in the agriculture sector. Enhance the effectiveness of fiscal policy tools to complement monetary policy efforts.

**4. Debt Management:**

Utilize primary balance surpluses to reduce the debt-to-GDP ratio. Implement policies to boost nominal GDP growth, as it reduces the debt ratio. Also, stabilize exchange rates to minimize the impact of foreign currency debt payments. Thus, mitigating the impact of interest rate and exchange rate misalignments on debt expenses.

**5. Policy Coordination:**

Ensure coordination between monetary and fiscal policies to align sectoral growth, manage output gaps, and maintain a sustainable debt trajectory.

By implementing these policy implications, Pakistan's economy can potentially benefit from more effective sectoral alignment, improved output gap management, and sustainable debt dynamics.

### 6.4. Contributions versus Limitations and Future Research

The thesis has focused on designing a strategy to identify the causes of Pakistan's past economic instability. Following this analysis, several policy recommendations were formulated. More research is needed to further fine-tune these recommendations into more detail and identify their respective effects on the economy by mapping specific instruments to specific economic variables. More specifically, the analysis of the effects of fiscal policy needs to be refined by developing better measures of discretionary fiscal policy and from there the stance of fiscal policy. Furthermore, the analysis can be refined by exploring higher-frequency data. Recently, the PBS has published quarterly national accounts, the use of which may enrich the macroeconomic analysis. In the end, more analysis is required on the policy mix that is best suited to guide Pakistan's economy on a higher but sustainable economic and employment growth path.

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# Appendix – A

## Building a Coherent and Detailed Pakistan National Accounts Databank

### Introduction

The objective is to build a databank for Pakistan's National Accounts (NA) that is as detailed as possible, both at current and constant prices. The original NA data at constant prices will be reported for each base period as published by the Pakistan Bureau of Statistics (PBS). But we will also construct constant price data on a common base year (more specifically at 2005-06 prices) over the whole sample period. Such conversions on a common base period are normally not provided by official statistical bureaus, but rather by the users of NA data. The NA at current prices will also be reported as published by PBS. But we will also construct the series that eliminates the structural breaks due to changes in the methodology applied by the PBS in years in which the base year changes. The sample period will start in Fiscal Year (FY) 1971-72, i.e., after the separation from Bangladesh.

### Sources for data on National Accounts of Pakistan

There is considerable confusion as to which data should be considered the correct official National Accounts data for Pakistan. We discussed this issue with staff at the Pakistan Bureau of Statistics (PBS). From these discussions, we conclude that the final official data are those that are published in the Pakistan Statistical Yearbooks (PSY), which are published every year. These data seem to be fully coherent with tables 2 and 3 entitled 'National Accounts Main Aggregates at current and constant prices, which cover a time period starting from FY 1960-61 and which are available from the PBS website. The latter tables only contain the main aggregates, whereas the PSY contains the maximum details available at PBS.

The data published in the PSY are for several periods not coherent with NA data published in '50 Years of Pakistan Volume III. They also differ for some periods with the data published in the Economic Survey (ES) and those in the State Bank of Pakistan's Handbook. These differences are the result of regular updates to the data, which are adjusted in the PSY, but not necessarily for all periods in the other mentioned publications.

For these reasons, detailed NA data were taken from the PSY. Unfortunately, these data are only available in hard copy format. They were manually entered in Excel sheets, making sure that for every year the most recent and therefore fully updated data were selected.

### Special Issues Concerning National Accounts Data at Constant Prices

The NA main aggregates at constant prices are published in the aforementioned Table 2 on the PBS website. In these tables, three base periods are distinguished: at constant 1980-81, constant 1999-00 prices, and constant 2005-06 prices. In the SYB and therefore also in the original data we use 4 base year periods distinguished: 1959-60, 1980-81, 1999-00, and 2005-

06. However, most recently PBS has published National Accounts data for the base year 2015-16.

Whenever there is a change in the base year, overlapping data for the relevant year are provided. That allows for the calculation of Conversion Factors (CF) for converting past data on the most recent base period. One corollary of this method is that when applied to e.g. detailed subsectors of Gross Domestic Product (GDP) at constant factor cost, as well as on the sectoral aggregates and the overall GDP-aggregate, the adding-up restriction is not verified. For that matter, we have imposed the adding-up restriction by applying the CF method to the most detailed sectoral data available and calculating the sub- and overall aggregates by making the sum of their components. As a result, the growth rates of the aggregates, converted in a common base year by the CF method, may slightly differ from the growth rates in each of the different base year periods mentioned in Table 2 on the PBS website. This should be considered normal since the growth rates are calculated at different base year prices, the structure of which can be different in different base years. Fig – A1 compares the growth rates for GDP converted at the constant of 2005-2006 with the original growth rates calculated over the different base year periods. The series named GDPfcSUM presents the growth rates of GDP at factor cost after conversion to the common base period (2005-06), with the application of the adding-up restriction. The series named GDPfcG presents the original growth rates, but are not converted into a common base year and therefore not comparable over time. As can be seen, both series are very close to each other. And for the period from 2005-06 no differences exist, because there has been no further change in the base year.

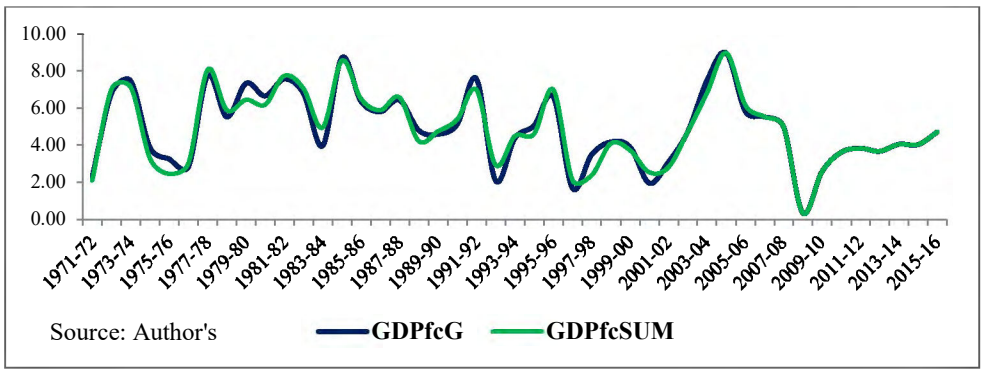


**Fig – A1: Comparison**

An alternative approach for the conversion of all data into a common base year over the whole sample period is to use the Growth Rate (GR) method. For the detailed components of the NA data, we can use the levels of the data available in the PSY to calculate their growth rates. Using these growth rates together with the growth rate formula, we can start from the

most recently available FY and work backward to FY 1971-72 to obtain a coherent series at constant 2005-06 base year prices. The aggregates again are calculated as the sum of the components.

A third approach is the Contribution to Growth (CTG) method. For the detailed components of the NA data, we can use the levels of the data available in the PSY to calculate the contributions of each single component to overall GDP growth. Using these CTG rates together with the CTG formula, we can start from the most recently available FY and work backward to FY 1971-72 to obtain coherent series at constant 2005-06 base year prices. The aggregates again are calculated as the sum of the components.

It turns out that, as expected, all three methods produce the same results. But in case some original variables would take zero value or even become negative (e.g. in case of change in inventories, which is a component of total investment expenditures in the expenditure approach to GDP), we would have to use the CF method in the case that zero values are present, or the CTG-method in case of negative values.

Income-related variables, such as Net factor Income from abroad and Gross National Product and Income will not be reported at constant prices. The income approach to GDP is always reported at current prices.

In the dataset which we construct, all original data published in the PSY will be included. For the data at constant prices, these data cover different base years and therefore are not comparable over time. To obtain back data on a common base year (currently 2005 – 2006). More precisely, we use the CF method for all detailed items. Aggregates are obtained by adding up the components. In the expenditure approach, following PBS practice, GDP at constant market prices is taken from the value-added approach, and consumption is calculated as the residual.

### Special Issues Concerning NA Data at Current Prices and The Deflators

Another question is how to deal with the structural breaks in the NA data at current prices. Here we can follow two alternatives:

- We can keep the NA data at current prices as they are published in the PSY. These series would then suffer from severe structural breaks in the years in which the base years were changed. Also, when using the aforementioned NA data at constant prices with those at current prices to calculate the deflators, the latter would contain structural breaks;
- We can construct back data for the NA at current prices using the CF or GR method.

For our analysis, we prefer the second option to avoid the severe structural breaks in the NA data at current prices as well as in the deflators. The deflators of each NA component and its aggregates are calculated by dividing NA data at current prices by their equivalents at constant prices. When using the NA data at constant prices, converted to a common base year over the whole period will therefore deliver deflators at also a common base year (the same as the common base year for the constant price data). But these deflators will exhibit substantial structural breaks in those years where in the original data, the base year changes. That is since in those years, PBS has changed its methodology considerably. This can be avoided if we recalculate the back data at current prices, using the CF or GR methods.

**Appendix – B**

**The Economy of Pakistan – A Data-Based Description**

Since independence, Pakistan's economic performance has demonstrated the importance of implementing appropriate policies and priorities for balanced sectoral growth. Though there was an intense need to implement social sector and infrastructure development policies, however, some aligned policies were also needed to address internal and external shocks that significantly influenced economic growth. Public finance plays a crucial role in supporting economic growth by implementing demand management policies. One such policy is sound public finance, which aims to ensure price stability by minimizing inflationary seignorage. Furthermore, it mitigates distortions resulting from the tax system and promotes favorable investment outcomes by maintaining low real interest rates. A fiscal position that is not sustainable requires future adjustments by the government, which can create uncertainty. This uncertainty can negatively impact economic growth as investors may delay or forego investments due to uncertainty about the timing and nature of these future measures. Furthermore, the public finance sector's weaknesses are mirrored in the struggling external sector, highlighting the need for fiscal consolidation and structural reforms to restore macroeconomic stability and promote sustainable growth. This is evident through a consistent deficit in the current account and an unstable exchange rate.

Pakistan has exhibited both remarkable and disappointing variations in its GDP growth rate since achieving independence. The acceleration of economic growth after independence has been a remarkable achievement for a country that was considered economically non-viable by some. The economy experienced rapid growth, but this was accompanied by periods of uneven development. The 1960s and 1980s exhibited significant economic expansion, whereas the 1950s, 1970s, and 1990s were characterized by both sluggish growth and considerable volatility in annual growth rates. Similarly, the 2000s exhibited a slower growth rate compared to the 1990s, although the improvement was only marginal. Subsequently, the growth performance was lackluster. External shocks contribute to the variability in economic growth performance. But most importantly, delayed adjustment policies have also contributed to the sluggish recovery experienced by the economy following each crisis.

The most notable characteristic of the 1960s was the strong reliance on private sector initiatives and effective economic management for achieving economic growth.

In the 1970s, there was a shift towards nationalization and an increased role for the public sector in economic management. The 1980s witnessed liberalization, deregulation, and privatization, among other changes. Pakistan also implemented structural reforms and stabilization measures during this period. Pakistan experienced a period of strong economic growth in the 1980s, with an average GDP growth rate of around 6 percent. During this time, it was regarded as the most developed country in South Asia. The significant growth rates were primarily driven by the influx of external capital. The presence of external financing resulted in a significant and unattended structural imbalance, primarily in the fiscal and external sector accounts.

The situation differed in the 1990s and subsequent years. Pakistan's economic performance, as measured by GDP and sectoral growth, was the weakest among the SAARC countries. The decline in capital inflows had a significant impact on the growth rate. The economic performance in the 1990s worsened due to the inability to control fiscal and current account deficits, resulting in exceptionally high and unsustainable levels of public debt. In addition, various other macroeconomic indicators experienced deterioration, such as a stagnant tax-to-GDP ratio, double-digit inflation, low levels of investment, deteriorating infrastructure, poor social sector indicators, and inadequate governance of institutions. The supply-side policies of deregulation, liberalization, and privatization implemented in the early 1990s did not achieve their intended goals due to the absence of necessary demand-side adjustments required to stabilize significant macroeconomic imbalances.

This period was characterized by external shocks such as economic sanctions, the September 11 event, and tension in the Afghanistan border area. The 1990s is commonly referred to as a lost decade by numerous analysts. The 2000s were marked by the challenges of poverty and unemployment growth, fiscal and external sector imbalances, and external shocks caused by the war on terrorism. In addition, COVID-19 in 2020 has disrupted the lives of people across the globe and has had a greater negative impact on global economic development in 2020 than anything seen in nearly a century. Even before the COVID-19 pandemic, many low-income countries were already struggling with high debt levels, leaving them vulnerable to debt distress. In fact, nearly half of these countries were either already in debt distress or at a high risk of it, which severely limited their ability to implement fiscal policies that could support the poor and vulnerable populations who were disproportionately affected by the

pandemic. Thus, the economy experienced rapid but imbalanced growth in recent years due to unsustainable policies, resulting in a significant increase in debt and depletion of reserves. Therefore, the economy has recently witnessed a slowdown as it adapts to the implementation of new policies. The most recent high-frequency indicators suggest a varied situation, characterized by a decline in large-scale manufacturing activity, but an increase in food and textile exports, as well as a boost in domestic cement production. Unemployment may be increasing. However, there is a possibility that the extent of this rise is not accurately reflected due to significant underemployment within the informal sector. The social conditions continue to present challenges.

**Structure of the Economy**

Regarding the Product Approach, in the 1960s agriculture was the main driver, now growth is mostly driven by the services sector as the share of services in real GDP is almost 60 percent as shown in Figure – B1.

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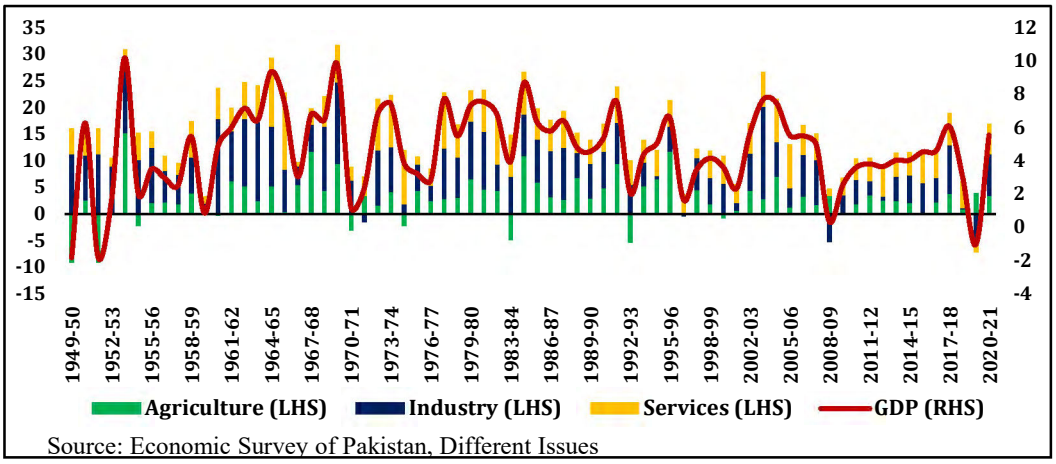



Source: Economic Survey of Pakistan, Different Issues

**Fig – B1: Growth Performance - Production Side**

It is important to note that the expenditure approach is rudimental because only a few of the summands (collective consumption, capital formation, and export minus imports) are calculated independently, whereas the summand with the largest value (private consumption) is calculated as a residual in relation to the GDP when it is measured using the production approach (Figure -B2). Further, the income approach in national account data is still missing.

It is also mentionable that data on Gross Fixed Capital Formation at both Public and Private levels along with sector-wise started in 1980. However, the net export value

went down dramatically, putting a severe limit on demand to drive growth, especially since mid-2000. Some improvement in Pakistan's openness to trade was seen after 2005. Nevertheless, in GDP (MP), there was an increase in the share of imports while the share of exports declined.

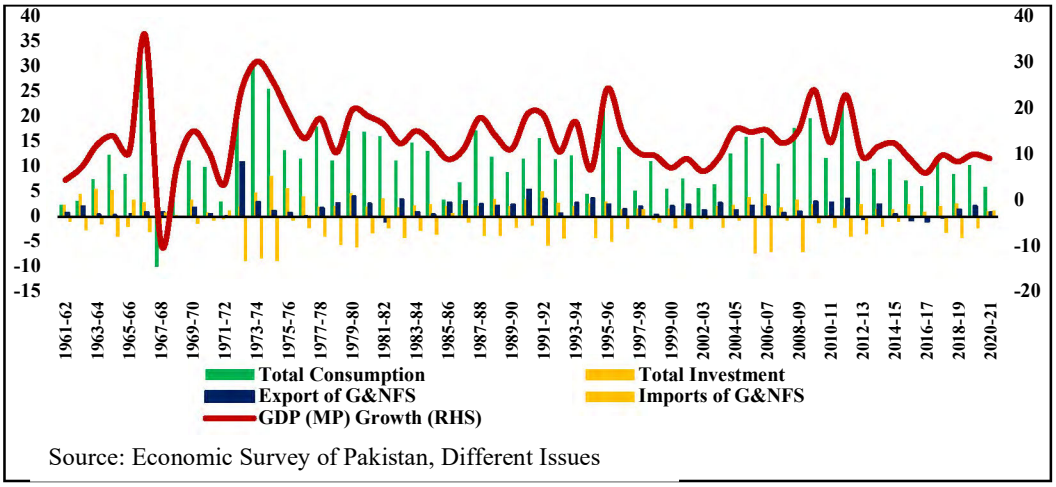



**Fig – B2: Performance of GDP; Contribution of Component in Expenditure**

Thus, the economy possessed episodes when a dramatic decline in Net Exports led to several BOP crises mainly reflected in a strong increase in consumption, both government and private consumption which increased the Saving-Investment Gap thus as a percentage of GDP, it remained volatile as well (Figure – B3)

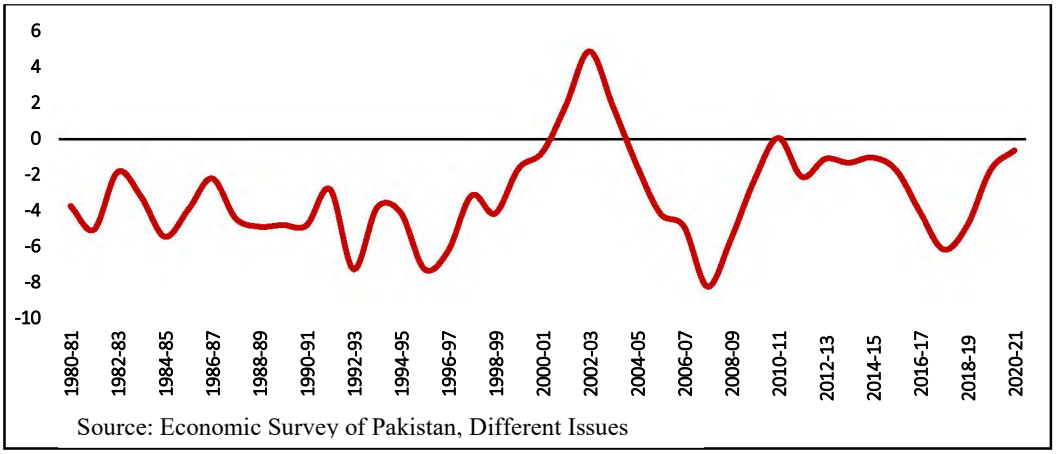



**Fig – B3: Saving-Investment Gap as % of GDP**

A high consumption pattern was one cause for the negative difference between savings and investments; yet, consumption has always remained the primary contributor to the expansion of GDP (MP). In addition, there has been a persistent drop in people's desire to invest, which has been accompanied by an increase in the

proportion of the economy that is spent by the government. The reduction in the tendency to make investments was mirrored by a fall in the frequency with which people imported goods. On the other hand, there was no rise in export intensity because capacity expansion was slower. However, Pakistan's economy experienced rapid expansion up to the middle of the 1980s. This indicates that the actual income created by productive activities was being spent on areas of expenditure other than investment. Further Investment growth was variable due to local and foreign vulnerabilities, which contributed to GDP volatility. As a result of this, further GDP growth was likewise volatile. One more reason was the possibility of making savings. In Pakistan, there is no incentive for customers to save money rather than spend it, hence saving is not a common practice. In addition, a high rate of population growth helps to maintain a high age-dependence ratio, which contributes to the ongoing expansion of consumption at the expense of saving. The high level of household savings that resulted was consequently quite low. As a result, the propensity to invest remained continuously declining. (Figure – B4)

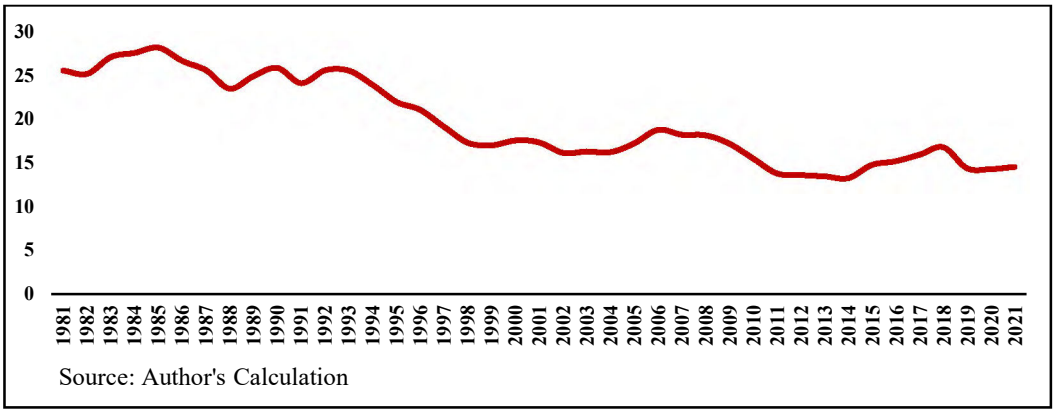



**Fig – B4: Propensity to Investment**

## Monetary Policy Formulation in Pakistan

Since its inception in 1948, the State Bank of Pakistan (SBP) has played a crucial role in strengthening the country's financial system. As the SBP evolved as an institution over time, so did its monetary policy framework to accommodate emergent trends. In the following paragraphs, the evolution of Pakistan's monetary policy framework over time is detailed.

As stated in the SBP Act of 1956, Pakistan's monetary policy seeks to maintain monetary stability and maximize the utilization of the economy's productive resources.

The best method to achieve these objectives is to maintain a stable and low inflation rate. Low and stable inflation creates favorable conditions for long-term economic expansion and job creation. It reduces uncertainty regarding future prices of products and services and enables households and businesses to make economically significant decisions with greater assurance, such as consumption, savings, and investments. This, in turn, facilitates higher growth and creates employment opportunities over the medium term, thereby contributing to the country's overall economic prosperity.

SBP Act, 1956 (as amended up to 28-01-2022) provided the State Bank full and exclusive power to regulate the banking sector, implement an autonomous monetary policy, and establish restrictions on government borrowing from the State Bank of Pakistan. Further, the primary objective of the Bank was to achieve and maintain domestic price stability. Figure – B5 provides historical interest rates.

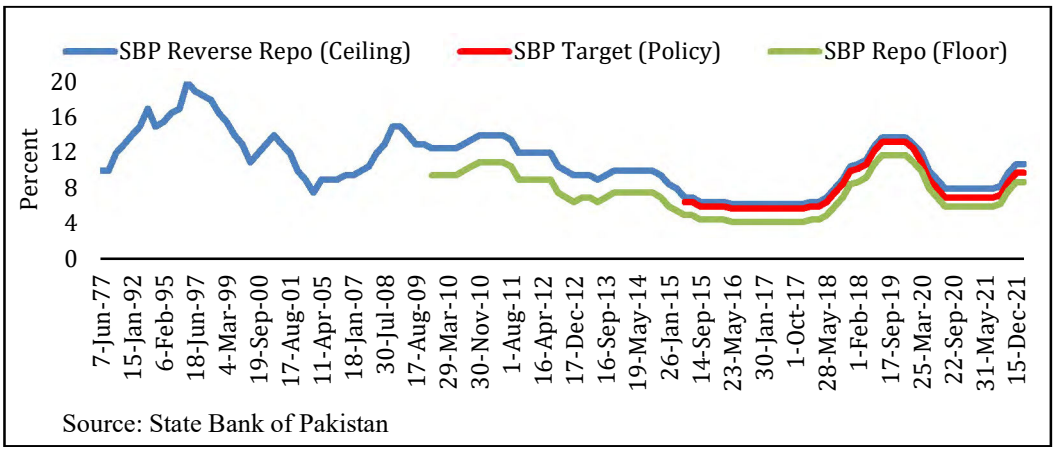
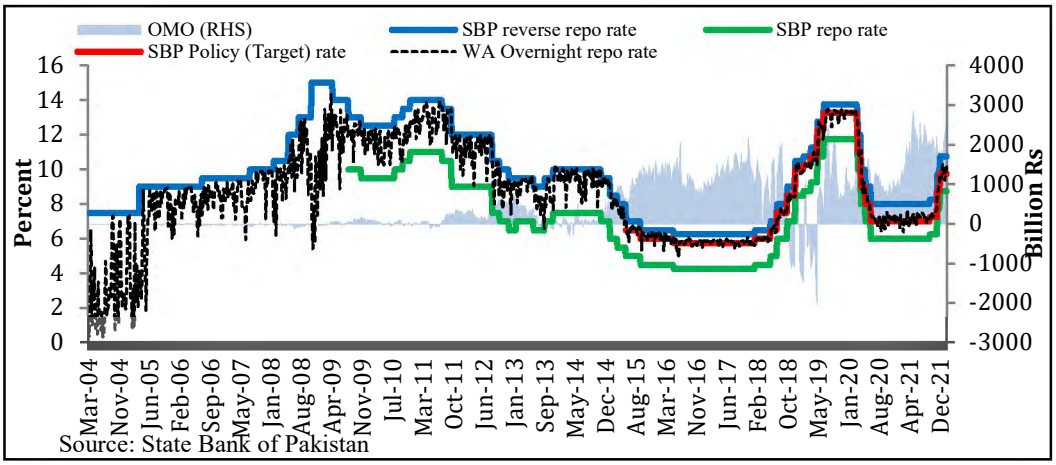



**Fig – B5: Historical Interest Rates**

SBP targeted broad money supply (M2) expansion and reserve money in the 1990s. This rule persisted till the late 2000s. The nominal anchor for monetary policy was monetary aggregates. Due to the deteriorating link between monetary aggregates and the final objective, SBP transitioned from this regime to controlling inflation by influencing aggregate demand relative to productive capacity through short-term interest rate changes. This regime bases policy rate changes on macroeconomic conditions, particularly the near-term inflation trend relative to the proclaimed inflation target. Thus, inflation (and inflation prediction) indirectly anchors Pakistan's monetary policy framework. This monetary policy approach resembles inflation targeting. SBP

implemented the Interest Rate Corridor (IRC) with a 300-basis-point difference between ceiling and floor rates in August 2009. Market conditions prompted further IRC mechanism improvements. February 2013 narrowed the Corridor to 250 bps. In May 2015, the SBP Policy Rate was included as an explicit Target Rate to the Interest Rate Corridor (IRC) framework following international best practices. IRC width was reduced from 250 bps to 200 bps, and the ceiling and floor were established at 50 bps above and 150 bps below the policy (target rate). SBP strengthened this structure in March 2020 by adopting a symmetric IRC with the SBP Policy rate set at the middle of the Corridor, 100 bps from both the floor and ceiling. The symmetric Corridor simplified bank cash flow management incentives and raised savings account minimum rates.



Source: State Bank of Pakistan

**Fig – B6: Monetary Policy Implementation**

## Fiscal Performance

Inadequate implementation of fiscal adjustment policies exacerbated fiscal strains. Due to various factors, revenue collections occasionally fell short of projections. Late in FY 2019, due to losses caused by exchange rate depreciation, the State Bank of Pakistan (SBP) was unable to transfer profits to the budget. This was compounded by delays in renewing telecom licenses and the sale of state assets. Sometimes natural disasters require urgent relief. However, expenditure initiatives (including untargeted subsidies) and delays in the implementation of revenue measures slowed the required fiscal adjustment. In addition, sometimes the current account deficit became unaffordable, necessitating the persistent suppression of imports, which in turn severely eroded the revenue base by harming import-related sales tax and customs duty

revenue, as well as tax revenue in general due to a scarcity-induced decline in economic activity and the closure of various industrial production plants. Occasionally, fiscal slippages were controlled at the expense of the development budget or by implementing a mini-budget.

### Consolidated Fiscal Operations (FY1976-FY2021)

Pakistan's fiscal policy position remained focused on sustained economic growth in unison with declining debt services, alleviating poverty, and investing in physical and human infrastructure. Figure – B7 clearly shows that Pakistan has had its share of good and bad periods over the previous decades concerning its fiscal discipline.

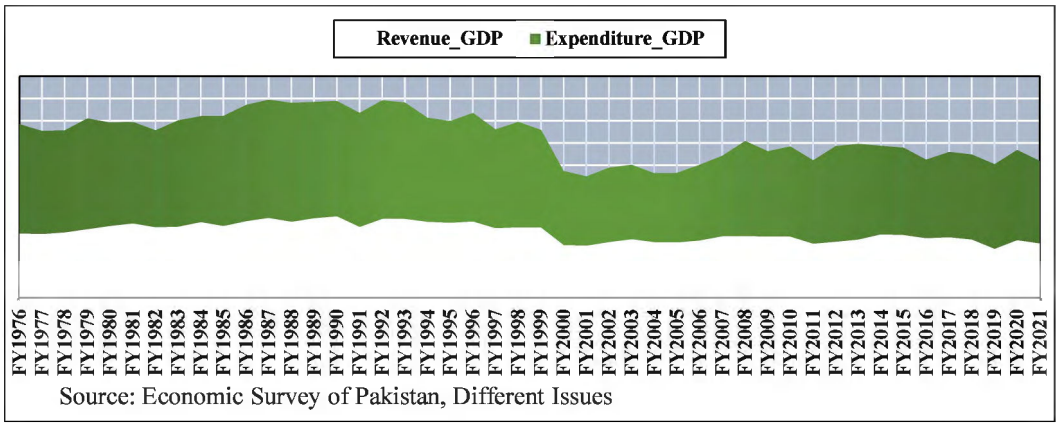



**Fig - B7: Revenue Expenditure Gap (% of GDP)**

### Public Debt Situation in Pakistan

Good debt accrues assets that generate positive returns whereas with excess debt comes angst and worry. Debt itself is not a problem as long as it is utilized for productive sectors. The problem comes when the fiscal policy becomes perpetually financed through debt. In Pakistan, federal govt. has been running fiscal deficits for the last many years. The expenses over and above revenues have to be met through borrowing and over the period, this borrowing has remained elevated. In addition to fiscal deficit, rupee depreciation also adds to public debt i.e., when external debt is reported in PKR. Henceforth, we can say that debt is a result of what is going around in the economy.

## Appendix – C

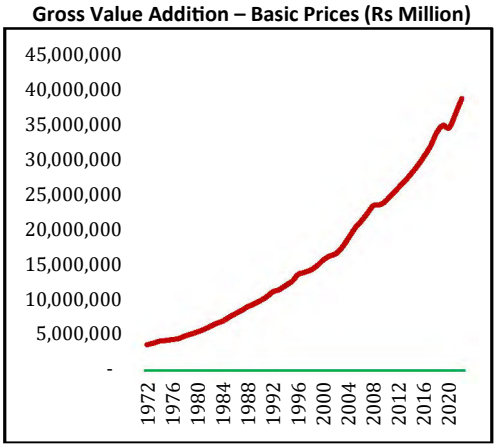
## Variables – Description

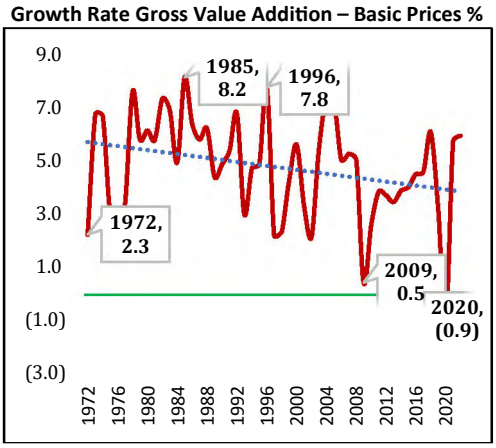
To discuss the desired objectives of the research, the research comprises three analytical chapters. Depending on the requisite objective and the related hypothesis, different variables were used in the analysis. Thus, the following section describes the variables.

### Description of variables

### Gross Value Added - Overall

The measurement quantifies the output contribution of each producer. The calculation involves subtracting the value of goods and services used in production from the total value of output. The GDP is determined by calculating the total value added by all producers, after adjusting for taxes and subsidies. The Gross Value Added at basic prices is calculated by subtracting the Intermediate consumption at purchasers' prices from the Output at basic prices.



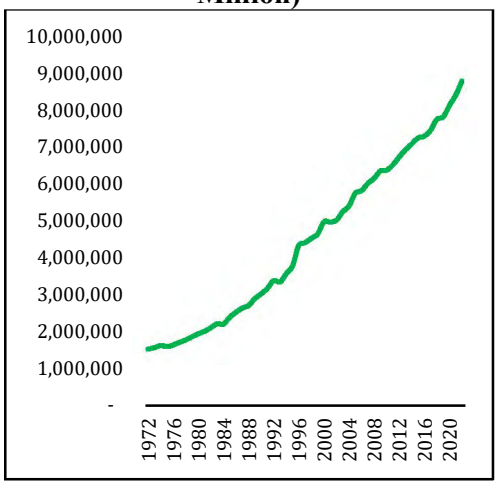




Source: PBS

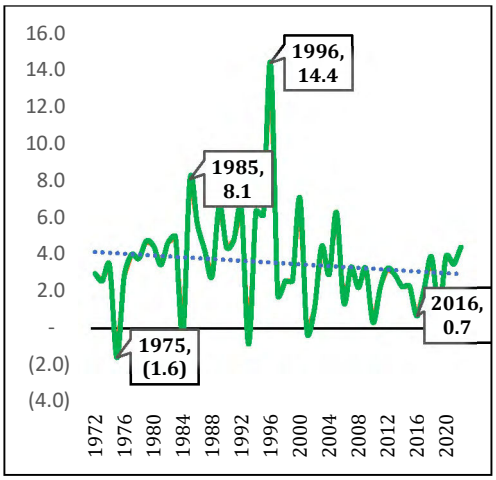
**Gross Value Added - Agriculture**

The agriculture sector consists of Crops, Livestock, Fishing, and Forestry while Crops are further divided into Important Crops, Other Crops, and Cotton ginning.

**Agriculture GVA – Basic Prices (Rs Million)**




**Growth Rate Agriculture GVA – Basic Prices %**

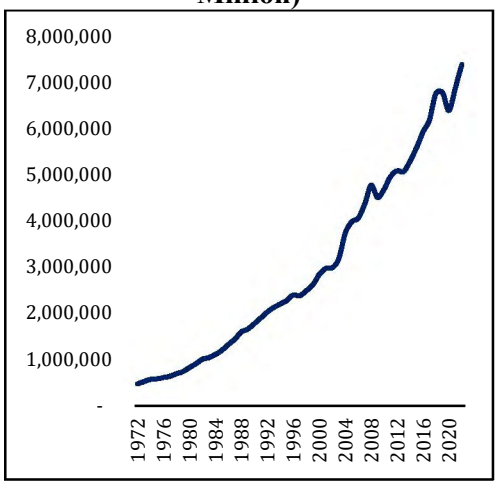



Source: PBS

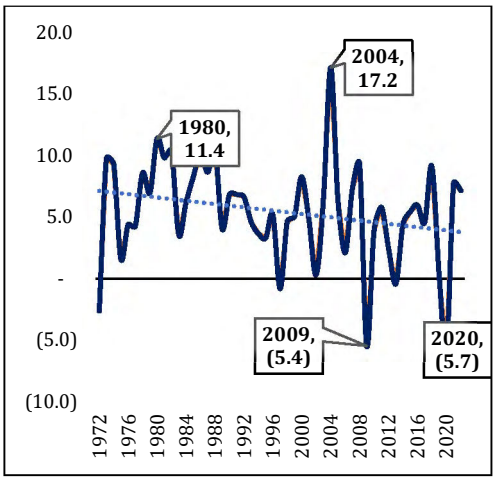
**Gross Value Added - Industry**

The industry sector consists of Mining and Quarrying, Manufacturing, Electricity generation & distribution & Gas distribution, and Construction while Manufacturing consists of Large Scale, Small Scale, and Slaughtering.

**Industry GVA – Basic Prices (Rs Million)**




**Growth Rate Industry GVA – Basic Prices %**

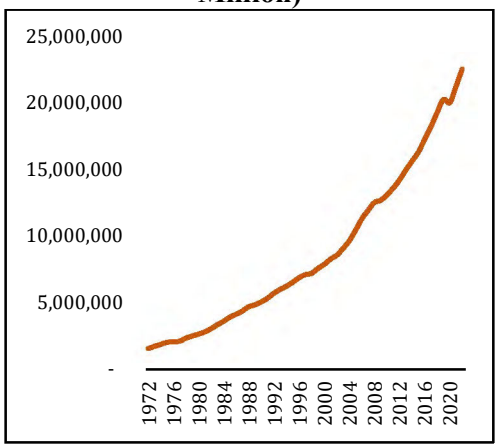



Source: PBS

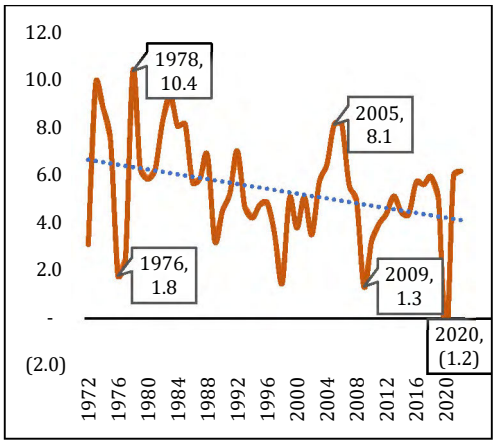
**Gross Value Added - Services**

The services sector consists of Wholesale & Retail Trade, Transport, Storage & Communication, Finance & Insurance, Housing Services (OD), General Government Services, and Other Private Services.

**Services GVA – Basic Prices (Rs Million)**




**Growth Rate Services GVA – Basic Prices %**

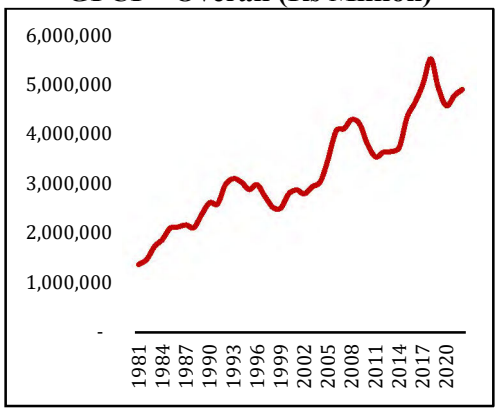



Source: PBS

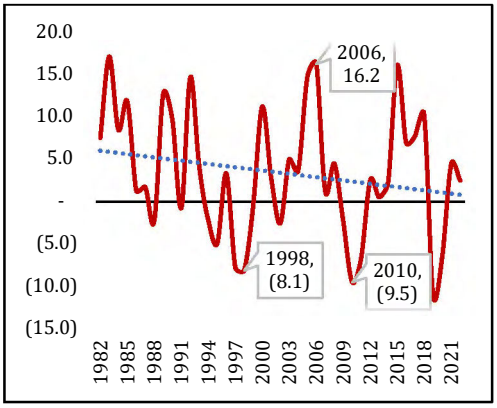
**Gross Fixed Capital Formation (GFCF) - Overall**

As mentioned earlier, the investment is represented by gross fixed capital formation (GFCF), which consists of manufactured fixed assets utilized in manufacturing operations for over a year. It is further categorized as private, general government, and public.

**GFCF - Overall (Rs Million)**




**Growth Rate GFCF – %**

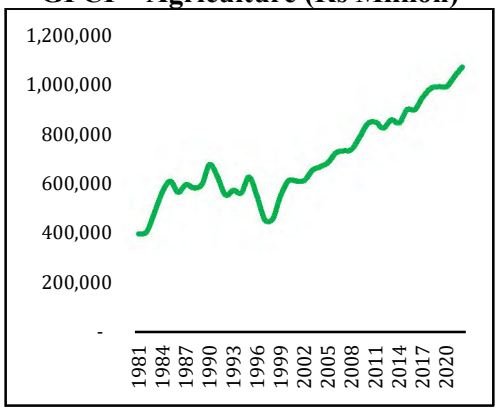



Source: PBS

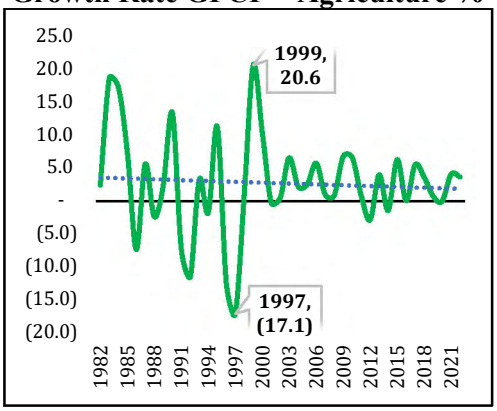
**Gross Fixed Capital Formation (GFCF) - Agriculture**

PBS publishes Gross Fixed Capital Formation (GFCF) in the agricultural sector for the private and public sectors on account of differences in data sources. Private sector gross fixed capital formation (GFCF) in agriculture primarily comprises the following components: land improvement, cultivated assets (including livestock and timber), domestic production and imports of agricultural apparatus, and the installation of tube wells. Farms, structures, wells, farm transportation, waterways, orchards, and non-monetized gross fixed capital formation are all components of rural infrastructure.

**GFCF - Agriculture (Rs Million)**




**Growth Rate GFCF – Agriculture %**

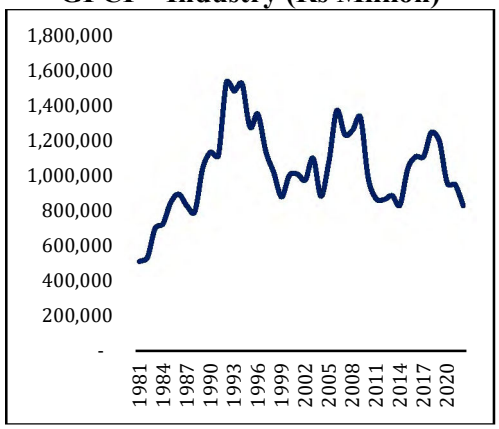



Source: PBS

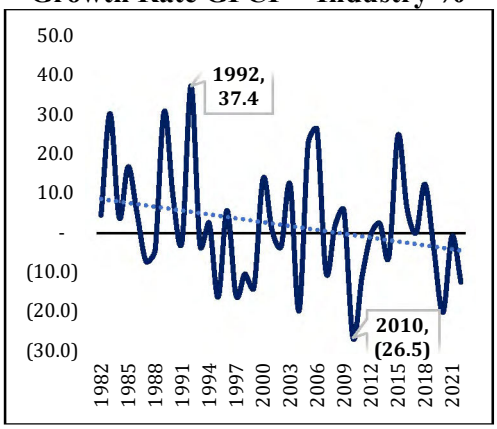
**Gross Fixed Capital Formation (GFCF) - Industry**

PBS provides the Gross Fixed Capital Formation (GFCF) for each industry component, including that of the General Government and the Private and Public Sectors.

**GFCF - Industry (Rs Million)**




**Growth Rate GFCF – Industry %**

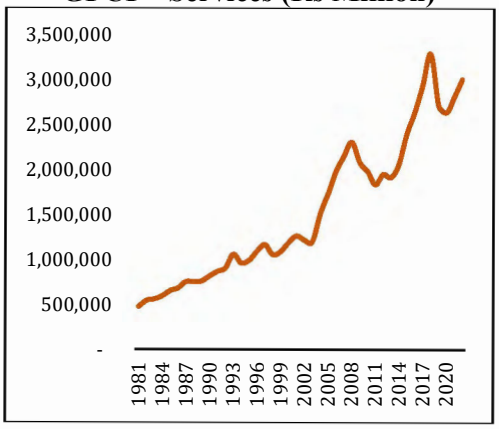



Source: PBS

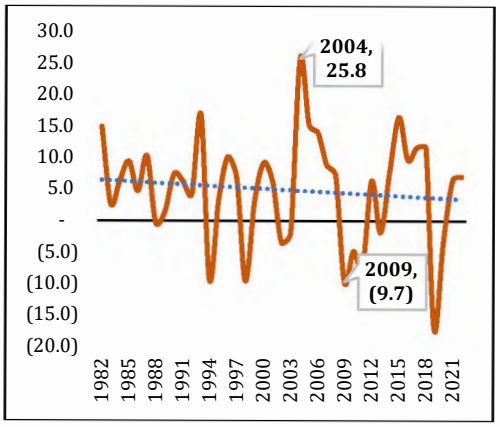
**Gross Fixed Capital Formation (GFCF) - Services**

PBS provides estimates of the Gross Fixed Capital Formation of each component of Services for the Private and Public Sectors as well as the General Government.

**GFCF - Services (Rs Million)**



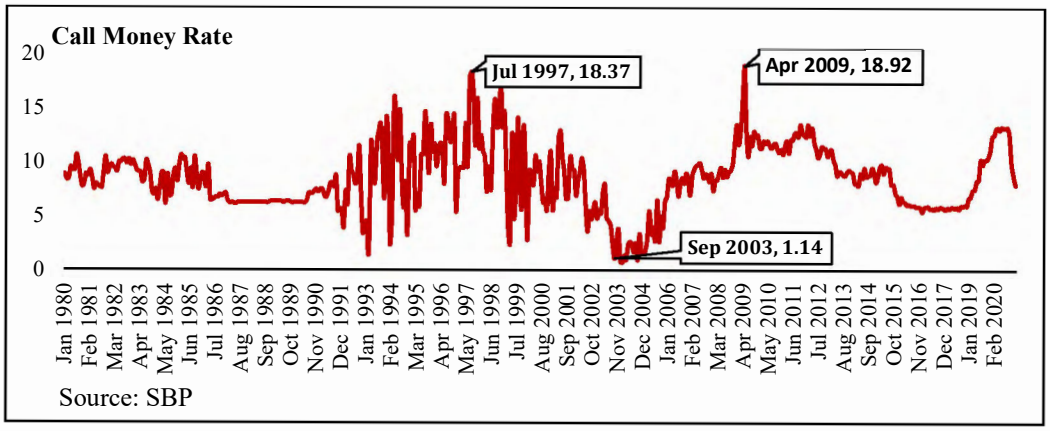

**Growth Rate GFCF – Services %**




Source: PBS

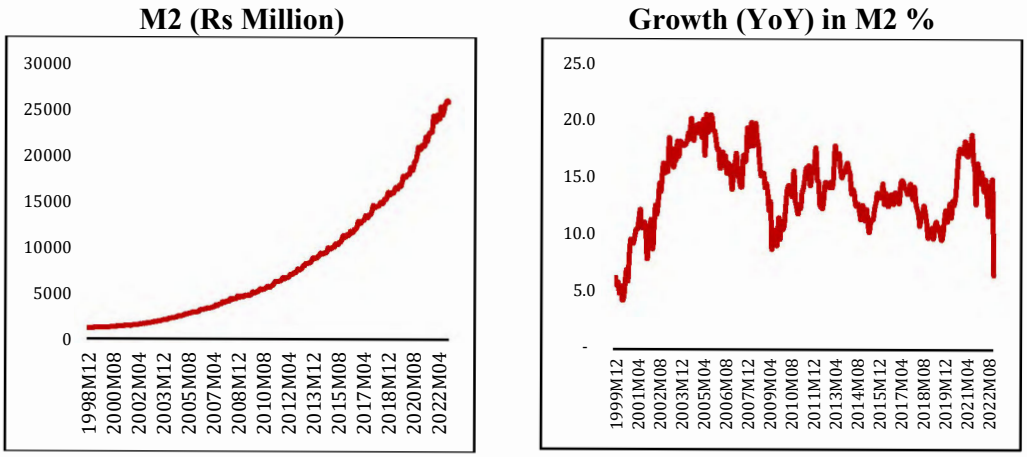
**Interest rate**

Globally, central banks anchor inflation using interest rates. The SBP Act 1956 mandates that the SBP control inflation, promote economic growth, and implement exchange rate policy. In this research, interest rates are included since a strong domestic currency drags on the economy, similar to monetary policy tightening. Further monetary tightening at a time when the domestic currency is strong may attract foreign investors seeking higher-yielding investments, strengthening the currency. Raising interest rates limits aggressive aggregate demand and regulates inflation from the demand side. Interest rate increases can also affect investment and economic activity. The research uses the call money rate (CMR) to estimate the policy rate.




**Money Supply**

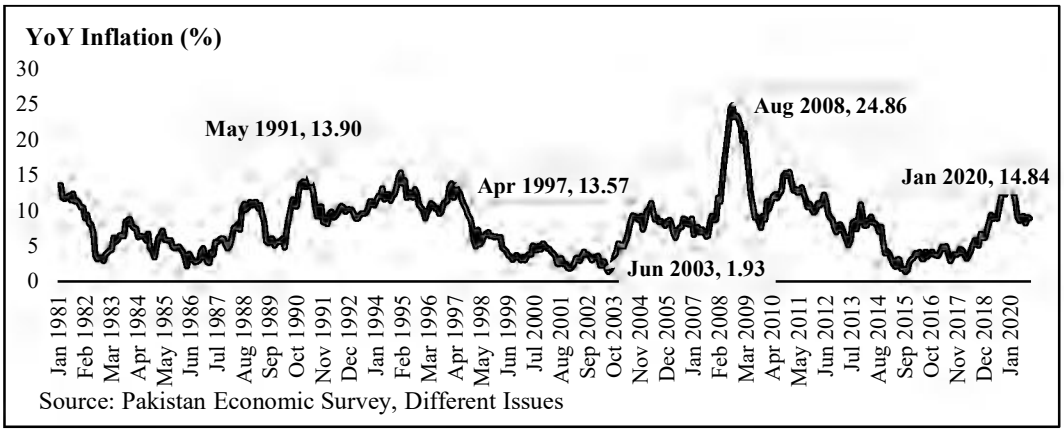
It is the sum of Net Domestic Assets (NDA) and Net Foreign Assets (NFA) published by SBP weekly.




Source: SBP

**Inflation**

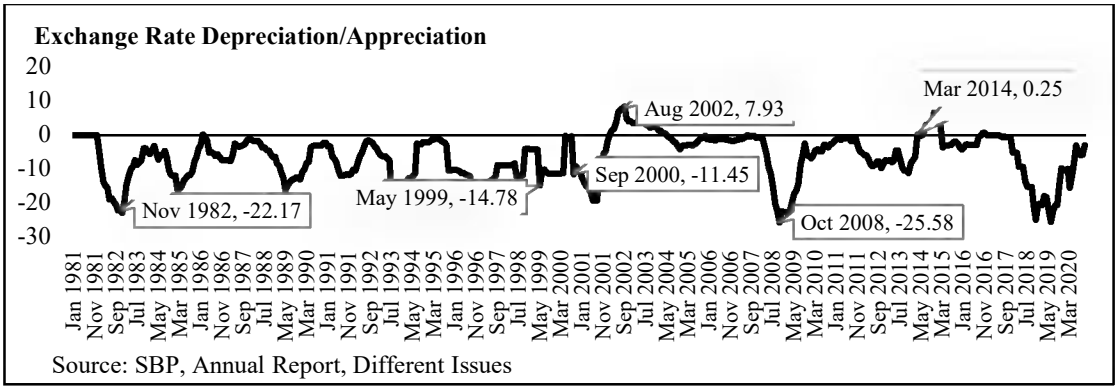
In Pakistan, inflation is measured using CPI, WPI, and GDP deflator. In this study, the inflation rate is measured using the Consumer Price Index (CPI). In Pakistan, the inflation rate is influenced by various factors such as fiscal and monetary policies, international commodity prices, USD exchange rate, seasonal factors, and economic agents' expectations regarding future developments in these indicators. Furthermore, government policies aimed at enhancing market efficiency, particularly in the food sector, are of great significance.



Source: Pakistan Economic Survey, Different Issues

**Exchange rate**

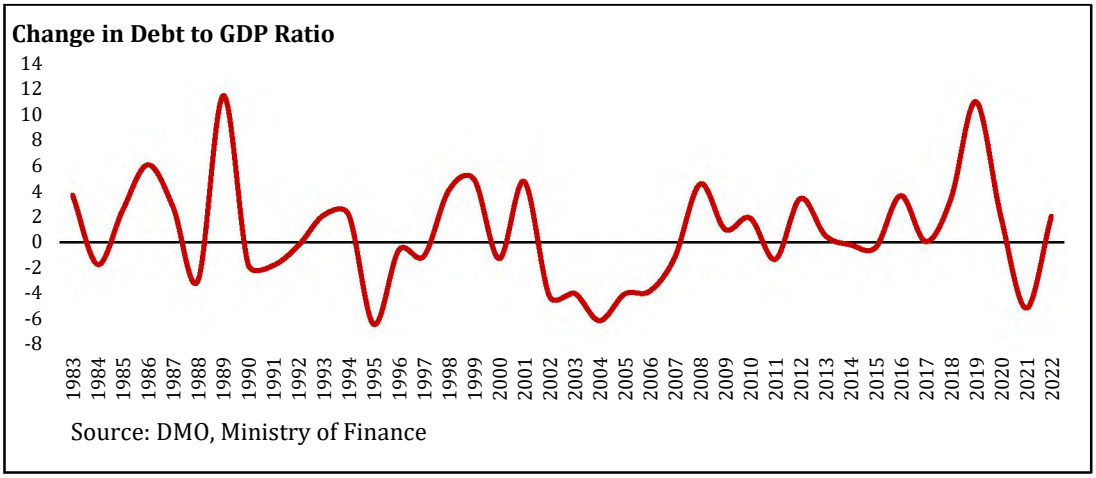
The value of the nation's exchange in terms of other nations' exchange. The valuation of a country's currency relative to the currencies of other countries. True commodity prices that are transacted internationally are influenced by exchange rates. Notwithstanding this, the unpredictability of financial assets and international trade in commodities is reflected in exchange rate volatility. As mentioned in Chapter 4, we measured the exchange rate by $/Rs. However, the graph below is drawn by Rs/$. Thus, in Pakistan, despite the transition from a fixed to a floating exchange rate regime, exchange rate volatility persisted.



Source: SBP, Annual Report, Different Issues

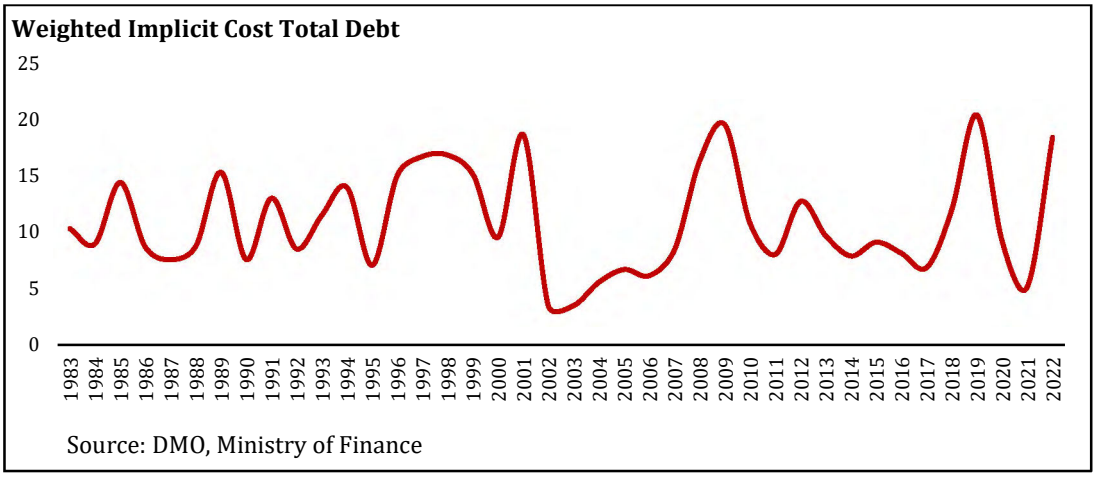
**Change in Debt to GDP Ratio**

It is the nominal value of Debt expressed in Rs divided by GDP at current prices.



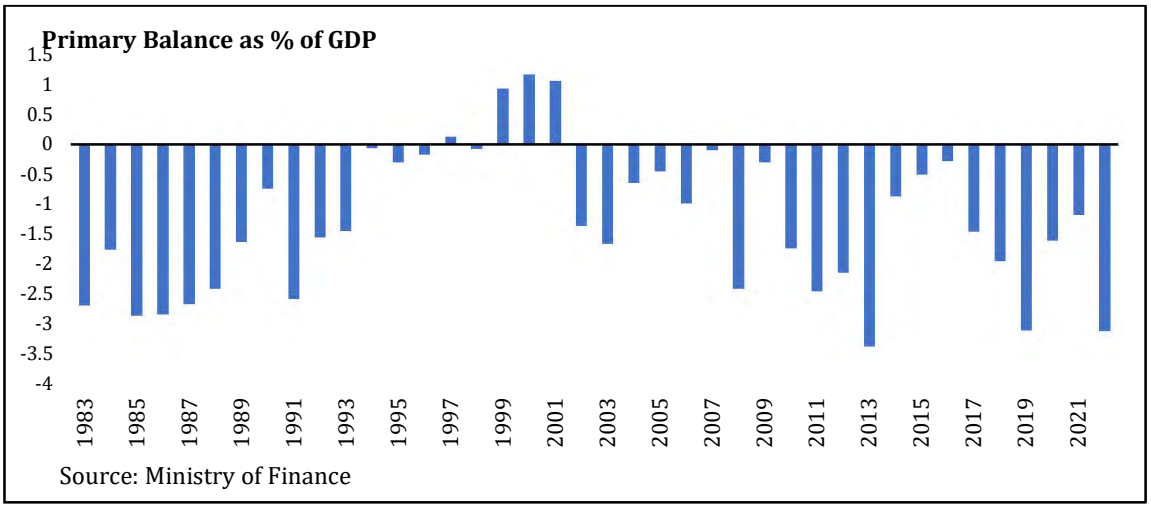

## Weighted Implicit Cost Total Debt

Implicit interest cost on domestic debt by dividing total domestic interest payments as reported in FO by the stock of domestic debt as reported at the end of the previous FY. Likewise implicit cost for foreign debt and then converted into weights as per the ratio of domestic and foreign debt in total debt.




## Primary Balance to GDP Ratio

The primary balance is the fiscal balance minus interest payments. The ratio is obtained by dividing the primary balance by GDP at current prices. Positive primary balance implies surplus and negative primary balance shows deficit.


Primary Balance as % of GDP
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
2017
2019
2021
Source: Ministry of Finance

**Appendix – D**

**Rationale for Using ARDL**

The Autoregressive Distributed Lag (ARDL) test has gained popularity in recent empirical research. Building on the work of Pesaran and Shin (1999) and Pesaran, Shin, and Smith (2001), this technique offers several advantages. Unlike Johansen's approach, which uses a Vector Autoregression (VAR) model, the ARDL test employs a single equation, reducing the number of estimated parameters. Additionally, the ARDL test allows for individualized lag selection for each variable, whereas Johansen's approach imposes uniform lag restrictions. The ARDL approach does not necessitate pre-testing for the order of integration (0 or 1) of the variables employed in the model. Pesaran, Shin, and Smith (PSS 2001) developed a new approach to co-integration testing which is applicable irrespective of whether the regressor variables are I (0), I (1), or mutually co-integrated.

The test begins with a data-generating process, which is a general VAR of order p. This VAR is then transformed into vector ECM form, incorporating a vector z of variables. Their focus is on modeling the dependent scalar variable y conditionally. In order to achieve this, the vector z is divided into the scalar y and vector x, which represent the dependent variables. Assuming no feedback from variable y to variable x, the model can be expressed as a conditional error correction model (ECM) for the change in variable y, denoted as Δy.

$$\Delta y_t = c^{'} w + \pi_{yy} y_{t-1} + \pi_{yx.x} x_{t-1} + \sum_{i=1}^{p-1} \psi_i^{'} \Delta z_{t-i} + \omega^{'} \Delta x_t + u_t \qquad \text{(C - 1)}$$

Where,

$w$ is a set of deterministic variables like the constant term, trend, seasonal dummies, etc.

$c$ is a vector of coefficients of deterministic variables

$u_t$ is the residual term.

To examine the lack of a linear relationship between the variables y and x, a statistical test is employed. This test utilizes either a Wald or F-statistic to assess the hypothesis that all coefficients of the lagged levels in the error correction model (ECM) equation are equal to zero. The PSS method categorizes five cases based on the specification of

deterministic components: (1) no intercepts and no trends, (2) restricted intercepts and no trends, (3) unrestricted intercepts and no trends, (4) unrestricted intercepts and restricted trends, and (5) unrestricted intercepts and unrestricted trends.

The conditional ECMs that emerge can be understood as autoregressive distributed models with orders p, commonly referred to as ARDL (p) models. The publication of tabulated asymptotic critical value bounds for the F-statistic is requested for all five conditional ECM models. If the computed F-statistic for excluding levels in the conditional EMS's exceeds the critical value bounds, the test allows for a definitive inference without requiring knowledge of the integration/co-integration status of the underlying regressors. If the F-statistic is within the specified limits, it is not possible to draw definitive conclusions, and it is necessary to have knowledge of the order of integration of the underlying variables in order to make conclusive inferences. If the calculated F-statistic is less than the lower bound of 0.05, the null hypothesis of no level relationship is not rejected at the 5% significance level. An inconclusive test occurs when the statistic falls within the 0.005 bounds. Conversely, the hypothesis of no level relationship is conclusively rejected when the F-statistic exceeds the upper bound of 0.05.

PSS (Pesaran, Shin, and Smith) provides asymptotic critical value bounds for the t-statistic in testing the significance of the coefficient on the lagged dependent variable in the conditional ECM, in addition to the F-test. PSS recommends the following procedure for utilizing the F and t-statistics. To test the null hypothesis (H0) using the bounds procedure, either the Wald or F-statistic can be employed. If the null hypothesis (H0) is not rejected, further analysis should not be pursued. If the null hypothesis (H0) is rejected, the coefficient of the lagged dependent variables can be tested using the bounds procedure, which relies on the t-statistic. A high value of t indicates the presence of a significant correlation between the variables y and x, suggesting a level relationship between them.

**Appendix – E**

**Assessing Long-Run Relationship - Cointegration Analysis**

In terms of the modeling approach, we follow Pesaran, H. and Y. Shin (1999) and Pesaran, H., Y. Shin, and R. Smith (2001). They designed an alternative to the Engle-Granger co-integration approach and claim that their Auto Regressive Distributed Lag (ARDL) approach encompasses co-integration analysis. In their approach, co-integration testing is not necessary, but they design two alternative bounds tests to evaluate the estimated equation: a Wald test and a t-test. If the equations' F-statistic and if the t-statistic on the level of the lagged dependent variable lay on the right-hand side of the critical bounds published in tables CI and CII with k the number of explanatory variables in Pesaran, H., Y. Shin, and R. Smith (2001), then the null of no levels relationship (equilibrium relationship) can be rejected.

But in terms of the single equations estimated in the thesis, these can also be tested on co-integration by using the Engle-Granger test. This is a unit root test on the residuals of the long-term equilibrium equations. Co-integration is confirmed when the unit root hypothesis on the residuals is the equation is rejected.

***The supply side equations:***

**The aggregate TGVA equation:**

D(D(TGVA))=-0.85*D(TGVA(-1))+0.21*TGFCF(-1)

**F-Statistic:** 10.5 which exceeds the F-test upper bound (3.62 – 4.16) therefore the null hypothesis of no levels relation is rejected.

**T-Statistic:** -4.56 which exceeds the t-test upper bound (-1.95 – -2.60) therefore the null hypothesis of no levels relation is rejected.

The long-run equation:

**D(TGVA) = 0.248*TGFCF**

A unit root test on the residuals of this equation (RESIDDTGVA) reveals that the Null Hypothesis: RESIDDTGVA has a unit root is rejected

**Table A-6-1: Null Hypothesis: RESIDDTGVA has a unit root**
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=9)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -6.129730 | 0.0000 |
| Test critical values: | 1% level | -3.605593 | |
| | 5% level | -2.936942 | |
| | 10% level | -2.606857 | |

**The Agriculture GVA equation:**

D(D(TGVAAGRI))=-1*D(TGVAAGRI(-1))+0.235*TGFCFAGRI(-1)

F and t-statistic under estimation removing the -1 restriction on D(TGVAAGRI(-1)):

**F-Statistic:** 24.5 which exceeds the F-test upper bound (3.62 – 4.16) therefore the null hypothesis of no levels relation is rejected.

**T-Statistc**: -6.97 which exceeds the t-test upper bound (-1.95 – -2.60) therefore the null hypothesis of no levels relation is rejected.

The long-run equation:

**(TGVAAGRI) = 0.228*TGFCFAGRI**

A unit root test on the residuals of this equation (RESIDDTGVAAGRI) reveals that the Null Hypothesis: RESIDDTGVAAGRI has a unit root is rejected

**Table A-6-2: Null Hypothesis: RESIDDTGVAAGRI has a unit root**
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -6.738669 | 0.0000 |
| Test critical values: | 1% level | -3.600987 | |
| | 5% level | -2.935001 | |
| | 10% level | -2.605836 | |

**The Industrial GVA equation:**

D(D(TGVAIND)) =-0.905*D(TGVAIND (-1)) + 0.1283*TGFCFIND(-1)

**F-Statistic**: 14.3 which exceeds the F-test upper bound (3.62 – 4.16) therefore the null hypothesis of no levels relation is rejected.

**T-Statistic**: -5.35 which exceeds the t-test upper bound (-1.95 – -2.60) therefore the null hypothesis of no levels relation is rejected.

The long-run equation:

**D(TGVAIND) = 0.142*TGFCFIND**

A unit root test on the residuals of this equation (RESIDDTGVAIND) reveals that the Null Hypothesis: RESIDDTGVAIND has a unit root is rejected

**Table A-6-3: Null Hypothesis: RESIDDTGVAIND has a unit root**
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=9)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -3.016318 | 0.0421 |
| Test critical values: | 1% level | -3.610453 | |
| | 5% level | -2.938987 | |
| | 10% level | -2.607932 | |

**The Services GVA equation:**

D(D(TGVASER))=-0.986*D(TGVASER(-1))+0.307*TGFCFSER(-1)

**F-Statistic:** 14.6 which exceeds the F-test upper bound (3.62 – 4.16) therefore the null hypothesis of no levels relation is rejected.

**T-Statistic:** -5.36 which exceeds the t-test upper bound (-1.95 – -2.60) therefore the null hypothesis of no levels relation is rejected.

The long-run equation:

**D(TGVASER) = 0.306*TGFCFSER**

A unit root test on the residuals of this equation (RESIDDTGVASER) reveals that the Null Hypothesis: RESIDDTGVASER has a unit root is rejected

**Table A-6-4: Null Hypothesis: RESIDDTGVASER has a unit root**
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -6.147685 | 0.0000 |
| Test critical values: | 1% level | -3.600987 | |
| | 5% level | -2.935001 | |
| | 10% level | -2.605836 | |

**The interest rate equations:**

The ARDL equation:

D(CMR) = -26.701 - 0.210*CMR(-1) - 4.019*(LOG(1000*M2(-1))-LOG(GDPBP_0(-1))) - 0.1750*D(CMR(-1)) - 2.886*D(LOG(1000*M2)-LOG(GDPBP_0)) + 2.528*LOG(GDPBPD_0(-1)) + 2.596*LOG(100*(CPIF(-1)/NEER(-1))) + 31.636*D(LOG(CPI(-1))) + 0.217*D_1 + 0.017*D_2 + 0.370*D_3 + 1.227*D_4 - 0.309*D_5 + 0.061*D_6 + 0.693*D_7 - 0.204*D_8 + 0.143*D_9 + 0.645*D_10 + 0.337*D_11

**T-Statistic:** -5.29 which exceeds the t-test upper bound (-2.86 – -3.78) therefore the null hypothesis of no levels relation is rejected.

The long-run equation:

**CMR = -129.427 - 20.382*(LOG(1000*M2)-LOG(GDPBP_0)) + 16.914*LOG(GDPBPD_0) + 8.197*LOG(100*(CPIF/NEER))**

A unit root test on the residuals of this equation (RESIDCMR) reveals that the Null Hypothesis: RESIDCMR has a unit root that is rejected at the 90% probability level according to Augmented Dickey-Fuller test statistic and rejected at the 95% probability level according to the Phillips-Perron test statistic

**Table A-6-5: Null Hypothesis: RESIDCMR has a unit root**
Exogenous: Constant
Lag Length: 4 (Automatic - based on SIC, maxlag=15)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -2.700152 | 0.0752 |
| Test critical values: | 1% level | -3.453317 | |
| | 5% level | -2.871546 | |
| | 10% level | -2.572174 | |

**Table A-6-6: Null Hypothesis: RESIDCMR has a unit root**
Exogenous: Constant
Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

| | | Adj. t-Stat | Prob.* |
|---|---|---|---|
| Phillips-Perron test statistic | | -6.798976 | 0.0000 |
| Test critical values: | 1% level | -3.452991 | |
| | 5% level | -2.871402 | |
| | 10% level | -2.572097 | |

**The debt equations:**

The ARDL equation:

D(CDR)=-0.308-0.839*CDR(-1)-0.428*GRGDP(-1)+0.456*TDC(-1)+0.839*RES(-1)-0.844*PBR(-1)-0.503*D(GRGDP)+0.546*D(TDC)-0.953*D(PBR)+0.989*D(RES)

**T-Statistic:** -4.2 which exceeds the t-test upper bound (-2.86 – -3.99) therefore the null hypothesis of no levels relation is rejected.

**In this case, variables are not I(1), therefore a co-integration test is not valid.**