



Targeting Debt in Pakistan: A Structural Macro-Econometric Model

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ABSTRACT

Unsustainable debt levels pose serious economic risks, potentially leading to financial instability when repayments become challenging. This paper investigates the intricate dynamics of Pakistan's debt. It aims to assess its sustainability within a broader eclectic and dynamic framework of responsible fiscal management using macro-econometric analysis. A structural macro-econometric model (MEM) based on five blocks has been developed, i.e., Government, Price, Real, Monetary, and External sectors. Moreover, it comprises sixteen behavioral equations along with ten identities. The Generalized Method of Moments (GMM) has been used to estimate the system of behavioral equations and identities to solve the endogeneity problem, while the Gauss-Seidel algorithm is used for model simulation purposes, including dynamic & stochastic simulations. Forecasting has been done from 2023 – 2030. Moreover, three main policy variables, i.e., inflation, exchange rate, and government expenditures, have been given shocks to evaluate their impact on future external borrowing, interest payments along with imports, exports, and net foreign and domestic assets. The results revealed that an effective monetary & fiscal policy must be designed to stabilize the economic conditions to manage external debt and repayments effectively. Moreover, to cope with unsustainable debt conditions, it is required to follow strict fiscal discipline via designing & adhering to a budget that prioritizes inflationary controls and responsible spending practices.



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1. Introduction

Since the inception of the 21st century, hefty indebtedness has been endured as an eminent policy problem for Pakistan. Relying upon the essence of the nation's public policies and economic conditions, external borrowing responds to mold the growth proceedings accordingly. Nations that respond effectively to foreign borrowing by deploying a wide variety of policy perspectives succeed in overcoming the detrimental consequences of debt. Furthermore, it would negatively influence economic growth if the public policies are ineffective in utilizing the acquired loans in development or investment-based projects and are utilized in a way that does not involve profit-making. Likewise, nations who are unable to fulfill their debt

compulsions face drastic macroeconomic imbalances like major fiscal inconsistencies, worsening of foreign exchange hoardings (accumulation or building up of foreign currency kept by government or central bank), lower investment, exchange rate uncertainties, and continuous deterioration in credit ratings, as per international agencies. This implies that when fund seekers are unable to use the obtained money efficiently, that maximum revenues could generate, leading to increased development, then they have to face negative consequences in the form of inability of debt servicing and also face obstacles in the way to sustainable growth and progress (Abdelaziz, Rim, & Majdi, 2019; Akram, 2014; Government of Pakistan, (2007-2008)). Hence, borrowed funds must be used in profit-making projects to gain maximum advantages rather than bearing detrimental effects.

A load of unsustainable foreign debt significantly compromises any developing nation's economic well-being and development. If the debt cannot be obligated via the nation's foreign exchange reserves, in such cases, the nation either defaults or prefers borrowing to repay the loans at hefty terms. Moreover, if debt dues are delayed via fresh loans or rescheduling, it increases costs, including intensive compromise on nations' economic and political sovereignty. Furthermore, there is a need for high and sustainable economic progress along with massive foreign earnings to attain sustainable debt servicing (Ishfaq, Chaudhary, & us Saqib, 1999; Sayeed & Rashid, 2003).

During the Cold War (1980s), Pakistan obtained massive foreign aid and a huge sum of remittances from abroad, keeping the broadening debt in check. Noticeably, debt conditions in the '90s were terrible in Pakistan's history following the persistent BOP and budget deficits, which reduced the range of fiscal choices left to economic managers. After that, a huge part of government revenues was utilized to service debts, and development activities decreased. Consequently, public health, social well-being, and educational expenses decrease even in absolute. Political distress and external sanctions imposed in 1998 after the nuclear test further deteriorated Pakistan's economic status and was about to default (Bilquees, 2003; Khan, 1997).

In fiscal discrepancies (situation where organizations' financial records do not align) , evaluating debt sustainability is necessary to formulate provident macroeconomic policies for an economy. Financial impediments and extremely indebted nations need to become more eminent, where the basic cause of macroeconomic instabilities is highly associated with increasing debt levels. In this regard, debt sustainability becomes a key requirement for the stability of macroeconomic conditions in those economic systems as capital formation and economic progress deteriorate on account of the increased rate of public debt (Checherita-Westphal & Rother, 2012). Moreover, developing and fragile nations usually suffer from this difficulty, while financially stable nations can wisely manage to meet their debt obligations. Hence, analyzing debt sustainability for nations that face consistent budget discrepancies and hefty debt burdens would be very important in designing prudent and efficient macro policies for such states. Therefore, for a country like Pakistan, it is necessary to pay attention to the idea of debt sustainability as its debt burden is increasing daily, imposing serious consequences on economic stability.

Pakistan is grappling with immense debt burden issues both externally and domestically, with external debt increasing rapidly without adequately contributing to production. Pakistan's weaker economic situation has hindered its ability to manage its external debt obligations, a significant issue for any developing economy, primarily due exchange rate. Foreign debt in Pakistan has significantly increased since 1990, reaching \$12.9 billion in 1990, reaching \$60.9 billion in 2013, \$73.1 billion in 2016, \$96 billion in 2018, and \$109 billion in 2021 (Kausar, Ali, & Khan, 2022). In the fiscal year 2021 and 2022, Pakistan's total debt reached 44,336 billion, accounting for 71.3% of GDP, resulting in the country's ranking in foreign debt (Baloch, Shahzad, Ahmed, & Tariq, 2024).

Government authorities worldwide strive to ensure the sustainability of debt and economic progress to fix macroeconomic measures. However, they forgo investment activities while saddled with increasing debt burdens, thus redirecting substantial resources to meet debt obligations at the cost of employment opportunities & economic development. Increasing and unserviceable loans push nations into debt distress, leading them to gain assistance and bailout deals. Hence, such conditions lead to unsustainability, which results in incapability to fulfill financial obligations and enhances the chances of default. For a long time, Pakistan has been confronting such traditional issues because of the ballooning fiscal deficits accompanied by the maturity of the nation's external debt. Pakistan's fiscal deficit (government expenditure exceeds its revenue) reached 8.1 percent of GDP in 2020 compared with 6.5 percent in 2011. Such huge current & fiscal discrepancies enhance reliance on external borrowing (Islam, Ahmed, & Faraz, 2023; Kemal, 2001). Referring to past economic distress, there is a shortage of research on their sole interrelations and consequences or providing their projections. This paper tends to make additions by presenting a dynamic, structural macro-econometric model of Pakistan's economy to replicate imputations of assembled debt variations on GDP along with other growth indicators and to assess the debt sustainability analysis for the period (1973-2022). The framework of the study comprised five (5) macroeconomic blocks analyzing the consequences of debt on National Income (NI) and other economic measures. Our research provides several suggestions for monetary (MP) and fiscal policy (FP).

The main objective of the study is to develop and empirically estimate the dynamic structural macro-econometric model of Pakistan's economy to study the debt sustainability analysis. Further by using different econometric techniques to simulate accumulated debt variations on GDP and other macroeconomic indicators, particularly to address the problem of endogeneity and lastly the study aims to provide sound macroeconomic policies for debt sustainability and debt management considering various scenarios.

The key research question of the given study is:

How do fiscal variables behave, using the macro-econometric framework, to explain debt sustainability and management in Pakistan?

The rest of the study is organized as follows: Section 2 explains the literature review, Part 3 deals with methodology, providing the identities and behavioral equations implied to design the required blocks of structural macroeconomic frameworks and enumeration of variables employed in the study, following part 4 which explains the results and discussions, where fifth and last part provides conclusions and policy suggestions.

2. Literature Review

There is an interesting history behind MEM (Macro econometric modeling) for over a century. Firstly, macro-econometric models were formed to execute the general theory of Keynes. However, with time, different paradigms, like monetarist, new-classical, and new Keynesians, have been included in macro-econometric models. Tinbergen is known as a pioneer of this domain, as before WWII, the first macro model was formed by him for the Dutch economy. The model was particularly constructed to assist the planning bureau in designing appropriate economic policies (Bodkin, Klein, & Marwah, 1991; Bodkin, (1986a)).

Moreover, the 1960s observed the development of macro-econometric modeling on a large scale. Models were largely based on monthly or quarterly data to keep models updated for commercial benefits. It was widely believed that such models substantially contributed to increasing economic understanding and also assisted in dealing with real-world economic issues (Fair, 1987; Sowe & Hargreaves, 1991). Furthermore, Garratt, Lee, Hashem Pesaran, and Shin (2003) built a quarterly small macro model for the UK's economy (1965q1 to 1999q4), followed by a structural VAR technique to determine long-run relationships among

nine main variables. The paper aimed to build a consolidated theoretical and practical base and to target the monetary shocks.

Similarly, Arestis and Sawyer (2002) constructed the BOE (Bank of England) model consisting of 18 equations; 10 are behavioral equations, while 8 are identities. The models are estimated to specify SR and LR dynamics following the error correction model by adopting an endogenous view of money. The model mainly aims to identify monetary policy mechanisms and assess their relevant effect on the economic system.

The case of developing a macro model was first formed for India by (Narasimham, 1956). The consistent economic issues in developing regions, like the budget deficit, stagflation, trade, and heavy indebtedness, enhance the need for developing countries to utilize macro models. Kannapiran (2003) established a macro-econometric model referring to Mundell Fleming and IS-LM for developing nations. Quarterly data was analyzed, with SEM (simultaneous equation model) and error corrections estimated through the 2SLS-core technique. The model will be reliable for developing countries to conduct multiple policy analyses.

Furthermore, Ra and Rhee (2005) presented a medium-sized macro-econometric framework based on a Keynesian model for the Nepalese economic system. The model comprised five blocks: demand, credit & money, prices, BOP, and Government. Moreover, within and out-sample forecasting has also been evaluated. The forecasting outcome depicts that the influx of foreign borrowings and political stability are core factors in governing the long-term growth prospects of the Nepalese economic system. Likewise, Bhat and Kamaiah (2021) concluded that developing strong coordination among monetary and fiscal policies is required, which would help handle inflation and improve the current account deficit.

If one finds the history of Pakistan regarding macro econometric modeling, there were very few attempts at forming macroeconomic models. Islam (1965) was the first to form a small-size Pakistan macroeconomic model to assess the effects of MP (monetary policy) via simulations and forecasting. The framework comprised seventeen equations, including eleven behavioral equations, whereas the remaining are either definitional equations or identities. The estimation OLS technique has been employed for the estimation of behavioral equations. The findings of policy simulations also provided to quantify the effect of shocks on multiple exogenous variables. Similarly, Chishti, Hasan, and Mahmud (1992) constructed a macroeconomic framework for Pakistan, and the VAR technique has been used to estimate the defined models. The findings indicate that MP and FP variables, real external resources, and remittances are entirely exogenous and not impacted by other explanatory variables. Real GDP is firmly affected by expected policies and remittances, where the influence of external resources is strongly insignificant. Moreover, Ahmed, Rafiq, and Iqbal (1993) also specified a model referring to the Keynesian framework to identify the dynamic stability conditions and to study the significance of policy instruments. A model comprised of 5 behavioral equations and three identities. It was found that the public expenses and MS (money supply) are effective in stimulating GNP, but their influence might become mild with an increment of time lag.

Similarly, Haque, Lahiri, and Montiel (1990) presented a small macroeconomic framework for 31 developing nations. The model is based on the Mundell-flaming model by identifying certain characteristics of the economic systems of developing nations. For the estimation, the GLS technique is applied, and the findings articulate that, on average, sampled countries depicted a high rate of capital movement. Padda, Safdar, and Khan (2022) also studied the macroeconomic consequences of FP tools by employing time series data from Pakistan from 1975 to 2020. The structural VAR technique measures the effects via shocks produced by public revenues and expenses. The findings indicate that spending shock was found to have an increasing influence on imbalances in output, whereas the decreasing effect on unemployment while positive tax shock negatively affects output, inflation & output. The

study recommends that it is required to widen the tax base rather than increase the tax rate. Likewise, Naqvi, Kemal, and Aziz (1981) built a dynamic macroeconomic model comprised of ninety-seven equations, among which forty-five are behavioral. The model is split into four sub-models: expenditure, investment, foreign trade, and labor market blocks. The 2SLS technique has been employed to estimate the whole model. Moreover, simulations have been done with historical evaluation techniques & ex-post forecasting methods. Similarly, Hanif, Hyder, Lodhi, and Batool (2008) and Khan (1988) also constructed a macroeconomic model to anticipate the consequences of MP with simulations and forecasting.

Other than general macroeconomic modeling, few studies specified macroeconomic models to study the phenomenon of debt sustainability. Debt sustainability is observed as mandatory for any indebted nation's economic progress and macroeconomic security. Different studies have evaluated government debt sustainability rates because of their importance for the economic system. For Pakistan, a study by Mahmood et al. (2010) covered multiple debt ratios to examine debt sustainability, stating that total debt diverged from sustainable levels for about three decades. Further, they explained that the main cause of unsustainable debt was a current account disbalance along with a primary fiscal deficit. Similarly, Jafri (2008) studied Pakistan's debt with the DSA (Debt Sustainability assessment) technique. The findings indicate that as a consequence of mild individual shocks to principal components of debt evolution like real GDP, external debt ratio to GDP, and current account non-interest balance to GDP will rise though, but at the same time, it would still be within safe ranges. Further, thirty to forty percent of significant deterioration of the exchange rate holds the potential to affect the debt-GDP ratio to violate the debt threshold rate found for Pakistan. Lastly, a massive collective shock to the variables under study will also require another external debt rescheduling. Moreover, Raghbendra (2001) considered a few aspects of the consequences of fiscal policy (FP) on macroeconomic adaptations in developing nations. The findings indicate that macroeconomic indicators deteriorate in response to an increase in the budget deficit. For Pakistan, managing the primary balance to entangle herself out of the debt burden has become crucial. In contrast, an increase in internal or external real debt at the national level is generally privileged for those present at that period but puts a burden on those living beyond that period through reducing private capital with a reduction of goods and services (Modigliani, 1961).

In another study, Archibald and Greenidge (2003) examined adjustment policies of Barbados related to finance and debt management. Two approaches are applied to gauge debt sustainability: the accounting method and budget constraint, estimated with the cointegration approach. The results of sustainable testing confirmed that FP has remained sustainable since its independence. In contrast, Wilcox (1989) argued that the discounted debt series was stationary at zero means but could not establish a sustainable level of debt. Thus, fiscal policy was not sustainable in the US.

Furthermore, Ejaz and Hyder (2019) identified the paths of the sum of debt to GDP from 2019-2025 medium term. Future projections are also made, and uncertainties related to the following projections are identified by calculating probabilistic forecasts. The main finding states that foreign debt is somewhat sustainable, but the overall condition of debt is shocking. It is suggested that there is a dire need to design policies that focus on resource mobilization and priority must be given to adopting fiscal austerity programs. Similarly, Nizami, Ihsan, and Hasan (2020) also studied the debt sustainability phenomenon by fan chart approach for the coming eight years. The given fan charts define the intensity of risk, and unknown economic conditions, along with the endogenous response of FP via diagrammatic presentations of vast samples of debt trajectories. The findings concluded that the level of debt is unsustainable in Pakistan. The heavy reliance on debt is observed by Anwer (2000), who reported that it is due to high dependency on the IMF and World Bank. High reliance on debt to correct the current account deficit makes it not sustainable and only increases financial vulnerability and recession

that ultimately tends to reschedule debt. For Pakistan, it is essential to promote fiscal policies for effective debt sustainability and management.

Moreover, Araj, Hlasny, Mansour Ichrakieh, and Intini (2019) built a debt macroeconomic model for the Lebanese economy to measure the influence of debt variations on GDP and other economic measures. Five macroeconomic blocks have been included: sixteen behavioral equations with ten identities. Simulations anticipated that added fiscal deficits and increased debt accumulation will hinder growth. Whereas fiscal consolidation employing an external stream of revenues would help pay public debt and growth promoting. Seemingly, different studies concluded that lesser foreign reserves, volatile exchange rates, budget deficit, current account discrepancies, and rising government expenses are the main reasons behind the increasing debt burden leading to debt unsustainability (Bhanumurthy, Bose, & Chakravarti, 2018; Bhat & Kamaiah, 2021; Chandia & Javid, 2013; Hussain & Idrees, 2019; Mirza & Mushtaq, 2015; Ramzan, Saleem, & Butt, 2013).

3. Methodology

3.1. Framework of Macroeconomic Modelling

Contemporary macroeconomic models are based on the evaluation of behavioral equations employing data and the simulations of selected policy variables to provide policy suggestions. Over the past 80 years, new classical, Keynesian, and new Keynesians have concentrated on examining output variations, price, and employment levels via changes in fiscal and monetary factors. As Hicks and Keynes advocated IS-LM (Investment saving-liquidity preference MS) to link multiple aspects of the economy in a distinct framework. New classical like Goodhart, Tobin, and Phelps provided microeconomic foundations to the framework of money, inflation, demand, and employment, focusing on the strategic linkages between economic agents and policymakers.

The given macro-econometric model for Pakistan is developed in line with the Mundell-Fleming IS-LM BoP model for developing open economies following market-based flexible exchange rates, including five macroeconomic blocks: government, price, financial sector, macroeconomic and external accounts. The blocks include estimable equations and identity relations explaining theoretical interdependence among variables for imputing missing variables, along with bound model forecasts. The overall model comprises of sixteen behavioral equations and 10 identities. The commonly used rule in analyzing macro-econometric models is to employ at least thirty observations and to derive the ratio of the number of observations to given covariates not lesser than 6 ratio 1 but must be at least 10 ratio 1 on average.

3.1.1. Government Block

Government Block traces the development of public expenditures, revenues, claims on government authorities, and budget deficits. The total government revenues (TR_t) are the aggregate of tax revenues ($TREV_t$) and non-tax receipts ($NTRV_t$).

$$TR_t = TREV_t + NTRV_t \quad (1)$$

Ricardo's theory of public debt suggests that utilizing communities and industries with abundant financial resources can potentially finance public spending and reduce inequality. Further, the study argued that prioritizing one sector over another in allocating public spending, despite high taxes and public debt, negatively impacts economic growth (Ricardo, 1819). Okoye (2013) argues that governments need to take on productive debt to increase economic growth, as paying interest on debt extorts significant income to the economy.

Tax revenues ($TREV_t$) are modeled as linked to aggregate private consumption ($LRPCE_t$) and government expenditures (LGE_t) (Kharka & Kongcharoen, 2016; Tendengu, Kapingura, & Tsegaye, 2022). Private consumption and government expenditures are key drivers of economic activities that directly and indirectly influence the tax base (Fan, Li, Wang, & Li, 2020).

$$TREV_t = f(LRPCE_t, LGE_t) \quad (2)$$

Because of the heavy debt burden, the government has to pay hefty interest payments. Interest payments (IRD_t) can be taken as a function of debt stock (GDS_t). The inclusion of debt stock as interest payment determinant offer comprehensive overview of the borrowing's fiscal implications, considering market sustainability and dynamics, level of debt burden and cost of borrowing (Gamber & Seliski, 2019).

$$IRD_t = f(GDS_t) \quad (3)$$

External debt (ED_t) is taken as a function of official exchange rate ($OEXR_t$) & budget deficit ($BDEF_t$) lagged by one year i-e t-1. The impact of $OEXR$ is pivotal in this regression. As devaluation affects the ability of external borrowing (Awan, Asghar, & Rehman, 2011; Cahyadin & Ratwianingsih, 2020). This relationship between (ED_t) and ($OEXR_t$) play crucial role in management of external financial risks. In addition, increase in fluctuation in external borrowing and exchange rate significantly influence external debt.

$$LED_t = f(OEXR_{t-1}, BDEF_{t-1}) \quad (4)$$

Lastly, Claims on Central Government (CCG_t) adds all loans to public institutions' net deposits. The lag of both CCG and Budget $BDEF$ will be used (Diamond & Dybvig, 1986; Shetta & Kamaly, 2014).

$$LCCG_t = f(LCCG_{t-1}, BDEF_{t-1}) \quad (5)$$

3.1.2. Prices Block

Modeling prices is a significant facet that Central Banks (CBs) and economic agents use to determine their expectations about the monetary policy and state of the economic system. The present analysis derives the prices, implicitly employing one identity and behavioral equation. The identity for GDP deflator (PD) develops by dividing NGDP (nominal) by RGDPFC (Real)

$$PD_t = \text{NDGP}_t / \text{RGDPFC}_t \quad (6)$$

Identity (6) is crucial as it connects the supply and demand side. To complete this block, inflation (CPI) is modeled as a function of last year's inflation and expenditures. Private consumption expenses ($RPCE$) are used as a proxy to determine all inflation factors (Fornell, Rust, & Dekimpe, 2010). To capture the ratchet effect and adaptative expectations lag, CPI is added (Brown, 1952).

$$CPI_t = f(CPI_{t-1}, LRPCE_t) \quad (7)$$

3.1.3. Financial Sector & Monetary Block

This block modeled the Money demand and supply, foreign and domestic assets possession, and the private sector claims as a proxy of sector indebtedness. The analysis takes liquid or narrow money as exogenous. Moreover, the effective demand rate for quasi-money

(MQ) considered to rely on foreign and domestic assets is modeled as a function of nominal GDP, foreign assets, and lending rate, lagged by one year. M2 is expected to positively associate with NFA and aggregate output (Nguyen, 2015).

$$LM2_t = f(LGDP_{t-1}, NFA_t) \tag{8}$$

Furthermore, NFA is modeled as a function of RGDP (Acaravcı & Çalim, 2013).

$$NFA_t = f(LRGDP_t) \tag{9}$$

Eq (10) will estimate MQ as the difference between M2 and M1.

$$MQ_t = (M2_t - M1_t) \tag{10}$$

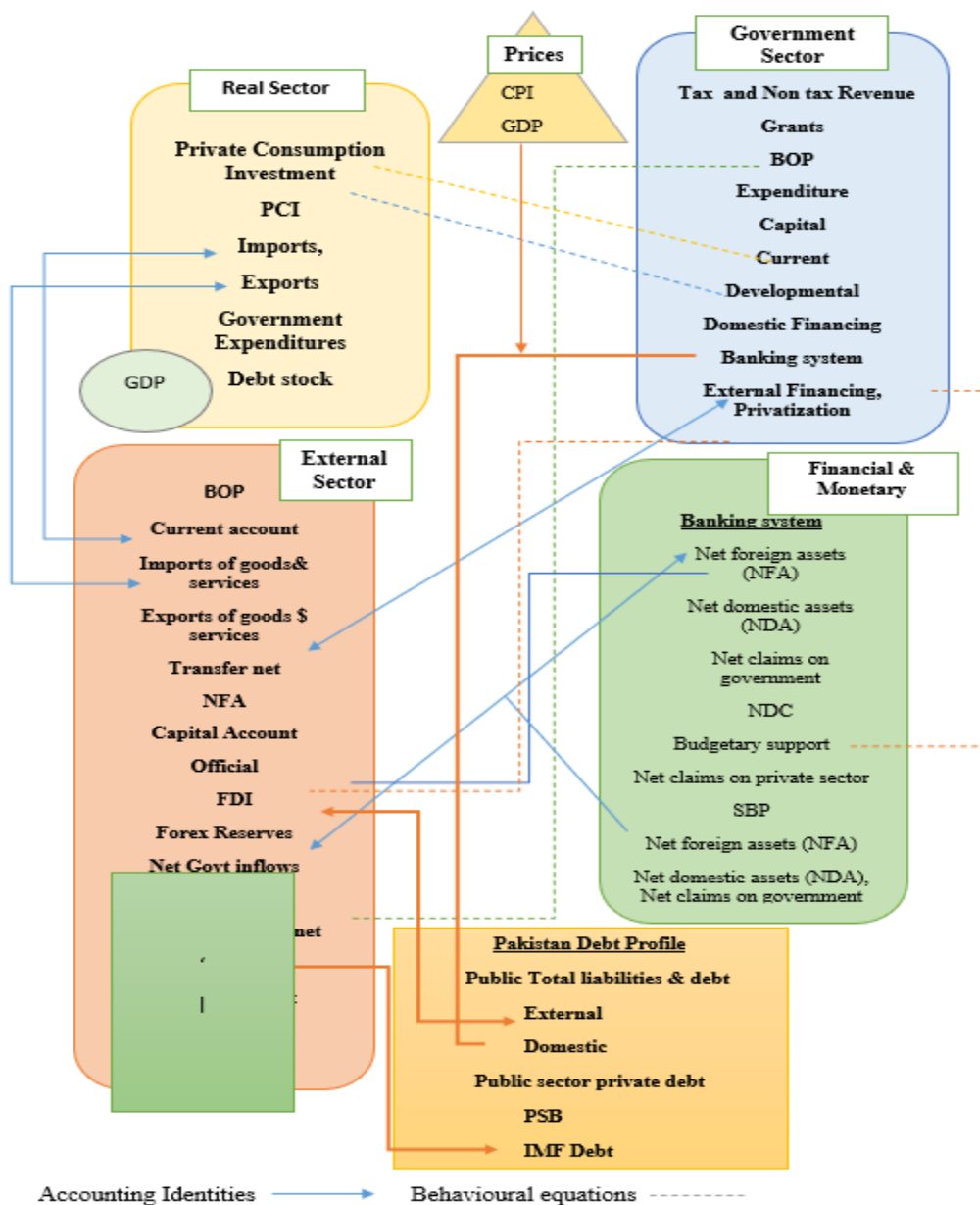


Figure 1: Macro Econometric Framework

The lending interest rate (LR) is modeled as a function of lags of total debt. The lending rate is used as 1(0) rather than I(1) and also in non-log form (Gamber & Seliski, 2019).

$$LR_t = f(LGDS_{t-1}, LGDS_{t-2}) \quad (11)$$

Private-sector claims are modeled as their two lags (Christ, 1968).

$$LCPSt = f(LCPS_{t-2}) \quad (12)$$

Lastly, Net domestic credit (NDC) functioned as its lag and government debt stock (GDS) (Ndikumana & Boyce, 2003).

$$LNDC_t = f(LNDC_{t-1}, LGDS_t) \quad (13)$$

3.1.4. Macroeconomic Block

Macroeconomic block traces the performance level of the aggregate economy. The block is comprised of 4 behavioral equations. Private consumption, investment, wealth, and aggregate supply. The 1st equation is for private consumption modeled as a function of wealth lending rate (Di Maggio et al., 2017; Li & Zhang, 2021).

$$LC_t = f(WH_t, LR_t) \quad (14)$$

Private investment is modeled as a function of the lending rate (Chhibber, Van Wijnbergen, & Mundial, 1988).

$$LRPI_t = f(LR_t) \quad (15)$$

The wealth equation is modeled as the one government debt stock. Wealth is assumed to have an inverse association with debt stock. The decreasing effect of high debt on wealth is rooted in the Ricardian equivalence hypothesis (Seater, 1993). It is perceived that consumers will assume rising debt rates as future taxes.

$$WH_t = (LGDS_{t-1}) \quad (16)$$

Unemployment (UE) is modeled as RGDP in the last year, fragility index (SFI), and year 2019 as an indicator for a year of the outbreak of covid 19 (Akinbobola* & Saibu, 2004; Gharehgozli, Nayebvali, Gharehgozli, & Zamanian, 2020)

$$UE_t = f(RGDP_{t-1}, SFI_t, D_{19}) \quad (17)$$

The macro-block further includes different identities. Eq (17) is an identity obtaining RGDP from NGDP utilizing the deflator method:

$$RGDP_t = \frac{NGDP_t}{DEF} \quad (18)$$

Real GDP is also linked to its components as an aggregate of net exports, private consumption, and investment & government expenditures.

$$RGDP_{t-1} = (RX_t - RM_t + RPCE_t + RPI_t + GE_t) \quad (19)$$

Real output growth can be given as:

$$\frac{RGDP_t}{RGDP_{t-1}} = 100 * \left(\frac{RGDP_t}{RGDP_{t-1}} \right) \quad (20)$$

As RGDPt/RGDPt-1 depicts growth rate. Whereas GNI (gross national income) is defined as the aggregate of GDP & Net factor income.

$$GNI_t = GDP_t + RNFI_t \tag{21}$$

3.1.5. External Block

The external block shows the state of the nation's real trade with partners, capital account, and trade balance. The import (RM) model is a function of public debt (PD) and the exchange rate (OEXR). As imports are perceived to depend on the exchange rate (Bhanumurthy et al., 2018).

$$RM_t = f(PD_t, OEXR_t) \tag{22}$$

Similarly, RX (exports) are modeled as a function of import with a 1-year lag to add a time delay as a consequence of the import of intermediate goods and resources before the export of value-added goods and gross fixed capital formation (GFCF).(Rajni, 2013).

$$RX_t = f(RM_{t-1}, GFCF_t) \tag{23}$$

Furthermore, the capital account (CAC) is given as a sum of net factor income (NFI) & trade balance (TB) (Meng, Gao, Ye, Zhang, & Xing, 2022).

$$CAC_t = (NFI_t + TB_t) \tag{24}$$

Moreover, to link imports & exports, the given identities are intended to associate external accounts with the remaining macroeconomic blocks.

$$TB_t = |RX_t - RM_t| \tag{25}$$

$$BP_t = (NFA_t - NFA_{t-1}) \tag{26}$$

3.2. Data

Variables are selected according to their theoretical and statistical properties. Annual data from 1973-2022 will be used. Most data is retrieved from PES (Pakistan Economic Survey), handbook of statistics, WDI, and Econ-stats.

Table 1
Variable Description

Variables	Abbreviation	Measurement Unit	Description of Variables
Unemployment rate	UNEMP	Rate	Total unemployment
Nominal GDP	NGDP	Rs Million	GDP at nominal values
RGDP factor cost	RGDPFC	Rs Million	Real productivity at total factor cost
Real private consumption	RPCE	% of GDP	Final consumption expenses, market value of all goods & services.
Real private investment	RPI	% of GDP	Rate of investment in the private sector
Gross Fixed Capital Formation	GFCF	% of GDP	Total capital formation percentage of GDP
The Gross national income	GNI	LCU	Total income derived from domestic sources
Real net factor income	RNFI	percent	Income gained by abroad residents- income of non-residents in domestic nation
Wealth	WH	unit	net foreign assets (NFA) + currency in circulation (cc) - (db)domestic debt
Total Tax revenue	TREV	RS Million	Government total revenues

Total Govt revenues	TR	%GDP	Total government revenue
Non-tax revenues	NTRV	RS Million	Public revenue other than taxes
T-bills	TBILLS	Rs Billion	Treasury bills
Claims on central government	CCG	annual growth as % of (BM) broad money	Included the provision of loans to the central govt
Govt expenditures	GE	Rs Million	Government Total Expenditures
Budget deficit	BDEF	RS Million	Govt rev-govt exp
Govt total debt stock %	GDS	% of GDP	It is owed to foreigners & payable in currency services & goods. Moreover, it is the aggregate of publicly guaranteed goods and short-term and long-term debt. The GDP deflator is the ratio of GDP in current domestic currency to GDP in fixed domestic currency.
GDP implicit deflator	GDPIMP	An index	It shows the per annum % variation in the cost to the average user of gaining a basket of services & goods that may be determined or changed at particular intervals, like per year (the Laspeyres formula is mostly used).
Consumer Price Index	CPI	Annual %	
M2	M2	Rs Million	M2 Quasi Broad money
Broad money growth	M3	(annual %)	Broad money growth
Net domestic assets	NDA	Rs Million	Domestic assets holding less domestic liabilities
Net foreign assets, LCU (WDI)	NFA	Rs Million	The aggregate of FA owned by monetary authorities & deposit money banks minus foreign liabilities
Lending rate	LR	Annual %	Bank rate that meets the financing requirements of the private sector
State fragile index	SFI	Index	The index determines the vulnerability in post, pre, and active conflict conditions. It is made up of 12 risk indicators. Higher value depicts that the country is more fragile.
Trade balance	TB	Percent Growth rate	Total trade balance
Real imports.	RM	Rs Million	Exports of goods & services
Real exports	RX	Rs Million	Exports of goods & services
Interest payment on debt	IRD	%expenses	Interest payment including interest payment on Govt debt, loans & debt instruments
Official exchange rate	OEXR	(LCU per US\$, period average)	Exchange Rate of Pakistan RS in terms of US\$
Quasi Liquid money	Mq	Rs Million	Quasi Liquid money

Sources: Pakistan Economic Survey, International Monetary Fund, WDI, State Bank pk, Econ-stats

Data sample from 1973-2022 have been used in the study. Values that were missing are completed by extrapolation and other techniques. Further, a backward extension of the sample was possible but this sample period has been covered due to strong sources. As an innovation, no study has been conducted on this big model and has not utilized data like in the present study. It is the first-time work has been done on very big data. As far as limitation is concerned, with the availability of time, this analysis can be further extended by collecting data from the State Bank and others. The variables description is given in Table 1 below. The Five blocks include fiscal variables relating to BOP, prices, and monetary and national accounts variables.

3.3. Model construction and estimation background

After the model's specification and data completion, the next important step is identifying an estimation technique that enables us to measure the validity of unknown model parameters. The section provided the individual blocks of models and their respective estimable behavioral equations alongside identities. The equations across all blocks are estimated using the Generalized Method of Moments (GMM) technique. The method and the specific functional forms of equations have been selected to estimate the true data-generating process (DGP) behind the macroeconomic relations of variables, keeping in view the data availability of variables. Hansen (1982) presented the Generalized Method of Moments (GMM method), particularly with the stationarity applications of time series in mind. In this method, a group of population moments criteria is determined on the regression errors. These conditions specified the errors' expected values and also the expected estimates of the product of the error along with exogenous instruments by setting them equal to zero. The model's parameters could be derived by replacing sample moments with population ones. Depending on the number of instruments, equations may be over, exactly, or under-identified. Thus, the moment conditions in the specific equation may be greater, less, or equal to the number of parameters to be determined. GMM holds multiple significant characteristics to justify its preference over other techniques. It properly deals with the endogeneity problem. It utilizes a weighting matrix allowing it to deal with heteroskedasticity & serial correlation for non-linearities and unknown forms. Its estimates are asymptotically normal and also consistent. Parameter consistency and efficiency are the specific goals. To these ends, all model variables were checked for non-stationarity, strong dependence, and theoretical violations of sequential exogeneity ($E(u_t|x_s)=0$ for all $t>s$) (Engle, Hendry, & Richard, 1983).

The model construction is started by examining the variable's properties to formulate regression equations to estimate. The variables have been transformed to natural logarithmic form. ADF test reveals that all of the variables were found to be stationary at levels other than Unempt, GDPt, LRPI, LGE, LGDPIMP, CPIt, TBt, LRXt, LRMt, IRDt, BDEFI, LGDPIMP, LGDS and OEXRt which were non-stationary at $I(0)$ and found stationary at $I(1)$. Thus, the presence of non-stationarity voids various standard inference methods incorporating usual GMM and provides spurious regression. Hence, a technique called FM-GMM is used to measure the parameters of an equation comprising of stationary & non-stationary variables (Kitamura & Phillips, 1997). Moreover, Hsiao (1997) added that this particular technique, FM-GMM, is suitable for time-series regression models. He stated that the usual 2SLS method provides a consistent output of the model rather than a non-stationary series provided the presence of cointegration.

Thus, before the application of system GMM, cointegration has been examined in all behavioral equations. Cointegration theory relies on linear interrelation. All equations of the analysis possess linear linkages; thus, cointegration may occur. Furthermore, structural equations are based on appropriate macroeconomic theories. Consequently, cointegration is found in most conditions. After testing cointegrating relationships for all the equations in the next step system-GMM technique has been applied to estimate the parameters of the equation.

3.4. Block Linkages

Coefficients for each equation have once been defined. Each endogenous variable will be solved via simulation. Referring to initial statistics, interlinkages between variables are repeated across blocks till the equilibrium for an economy is identified in the system. Thus, it is vital to know how variables are associated with each other within the system.

The government block is important for defining the final demand level. Particularly, Private investment and public investment are strongly influenced by public expenditures. Where, the rate of interest from the monetary block describes private investment. Imports and exports from the macroeconomic block and are directly associated with the external block via

bridging equations. Price blocks also influence final demand by changing nominal values to real values.

Price block is mostly exogenous as prices are mainly defined by exogenous values. In Pakistan, prices are usually determined by a combination of both internal and external factors. External factors like fluctuations in the exchange rate, global price level, and trade policies. Whereas internal factors like demand and supply, fiscal & monetary policies, and government regulations.

The monetary & financial block is associated with monetary, government, and external blocks. Aggregate M2 is the sum of the Government and public credits and NFA. Nominal GDP from the macroblock defines variation in domestic credit. The change in NFA is defined by the overall balance from BOP in an external block. The government block is directly associated with the monetary block. This block consists of mainly policy-related variables like expenditures, tax revenues & borrowing.

The BoP or external block is interlinked to the monetary & government block. Imports are usually defined by nominal GDP, External debt, and capital grants are linked to variables in financial blocks. To do the debt analysis, main debt variables are given in different blocks according to their respective linkages. The impact of exchange rate fluctuations, economic productivity, government expenditures, and capital & current account behavior determines the debt stock, public, and external debt.

4. Results and discussion

This section deals with the main findings of the analysis. Estimated parameters, J-stats, standard error regression, wald test, and also Durbin Watson (DW) 1st order autocorrelation of residuals are given. Secondly, variables of interest projected in line with different policy scenarios are given in the table below in appendix and also provided with a graphical analysis.

4.1. Discussion of Macroeconomic Blocks

4.1.1. Government Block

The findings of equation 1 listed in the government block provide that government tax revenues are positively associated with a change in private consumption expenditures instigated as revenues from individuals' VAT (value-added taxes) and are considered one of the principal components of public revenues. Moreover, findings also report that revenues are negatively influenced by increasing government expenditures. With the increase in consumption, tax revenue increase by 0.25 % and are significant at a one percent significance level, whereas they tend to decrease by -5.54% and are also significant at a one percent significance level. As government expenses increase, it becomes essential for them to borrow more, resulting in a higher interest rate and hence crowding out private spending. As a consequence, economic activity deteriorates, resulting in decreasing tax revenue. On the other hand, in Pakistan, high inflation deteriorates money's purchasing power, decreasing tax returns in real terms. Equation two modeled debt interest payment as a function of debt stock. The findings state that an increase in debt stock increases interest payments by 2.61% and is significant at a one percent significance level. As increased debt stock raises the borrowing rate which in turn also increases the debt obligations and the government is required to pay more interest on added debt including existing debt payments. Whenever the debt stock increases, interest payments also tend to increase, which creates challenges for a public budget to allocate a major portion of its income to meet debt service requirements, hence the government is left with fewer resources to fulfill its other public investments & services.

Equation 3 provides that an increase in exchange rate tends to increase external debt by 0.02% and is significant at a 1% level of significance, depending on multiple factors and the

nation's economic system. An increase in the exchange rate directly influences Pakistan's external debt as it is denominated in foreign currency. When the exchange rate increases or the country's currency appreciates, the sum of debt rises when reverted into domestic currency. This states that the nation has to spend more money to pay back the same amount of debt denominated in foreign currency, resulting in an increased debt burden domestically. Furthermore, central banks may react to exchange rate variations by adjusting interest rates. In such cases, authorities might increase policy rates to halt the excessive appreciation of the currency, which consequently affects the borrowing cost and debt dynamics, respectively.

Moreover, the trade balance was found to have a positive association with external debt as in the case of Pakistan, the trade balance remained negative, providing that imports exceed exports, leading to an increase in its external debt. As Pakistan faces a trade deficit, it requires more foreign currency than export earnings to finance this. Thus, increased borrowing to fill this gap results in higher external debt. Equation four found that government claims are negatively associated with its lag, but the coefficient is insignificant and also found a negative association with a lag of budget deficit. A budget deficit hinders the government's ability to launch new programs or expand the existing ones.

4.1.2. Price Block

Equation 5 depicted that variation in CPI is linked to its lagged variations and also with variation in aggregate consumption level as per macroeconomic theory. According to the results, a change in lagged CPI increases the current inflation by 1.01%. It is also significant at a one percent level and shows that an increase in consumption tends to raise CPI by 0.53% and is significant at a 5 percent significance level. Consumption is the main component of Aggregate Demand (AD), as demand tends to increase more than the provision of goods & services, resulting in demand-pull inflation. On the other hand, when supply exceeds demand, it results in cost-push inflation.

4.1.3. Financial Sector & Monetary Block

Equation 6, as anticipated, change in M2 (broad-money) is estimated to have a positive association with lagged variation in aggregate output. It tends to have a positive association with net foreign assets. M2 increases by 4.41% with one percent increase in net foreign assets and is significant at 1% significance level. Similarly, it also increases by 1.15% with an increase in aggregate output and also significant at a 1% level of significance. With the expansion in economic activity and demand for funds, money supply is increased to fulfill investment demands and transactions. Lending by monetary authorities also increases, resulting in a higher money supply.

Moreover, an increase in net foreign assets depicts that foreign assets exceed liabilities. To prevent the home currency to appreciate significantly (because of high demand in response to the high inflow of reserves), the Central Bank (CB) chose to participate in the forex market. This action deliberately injects an equal amount of domestic currency into the economic system, increasing the money supply. Equation eight shows that there lies a positive association between net foreign assets (NFA) and real GDP. NFA tends to increase by 9.68% with a 1 percent increase in aggregate output found to be significant. Increased economic growth can influence NFA in multiple ways, as increased production promotes exports, results in foreign exchange earnings, and adds to the nation's foreign reserves—Equation 8 models Lending rate (LR) as a 2nd-order distributed lag of public debt stock. Lending rate findings show a positive link with contemporaneous variation in debt stock to its 2nd lag but found negative insignificant for 1st lag. With increased borrowing rates, lending also tends to increase. Equation 9 shows a positive significant association between variations of CPS (claims in the Private sector) and their 2nd lag, but the impact is smaller. A 1%-point increment in prior

private claims is anticipated to raise future claims by 1 %, suggesting rapid repayment. The final model of this block i-e equation 10 depicts that variation in NDC (net domestic credit) is positively associated with its lag, stating that it increases by 2.79 percent and is significant at a 5% significance level. Moreover, it is also found that credit increases by 7.3 percent with an increase in debt stock

4.1.4. Macro-economic Block

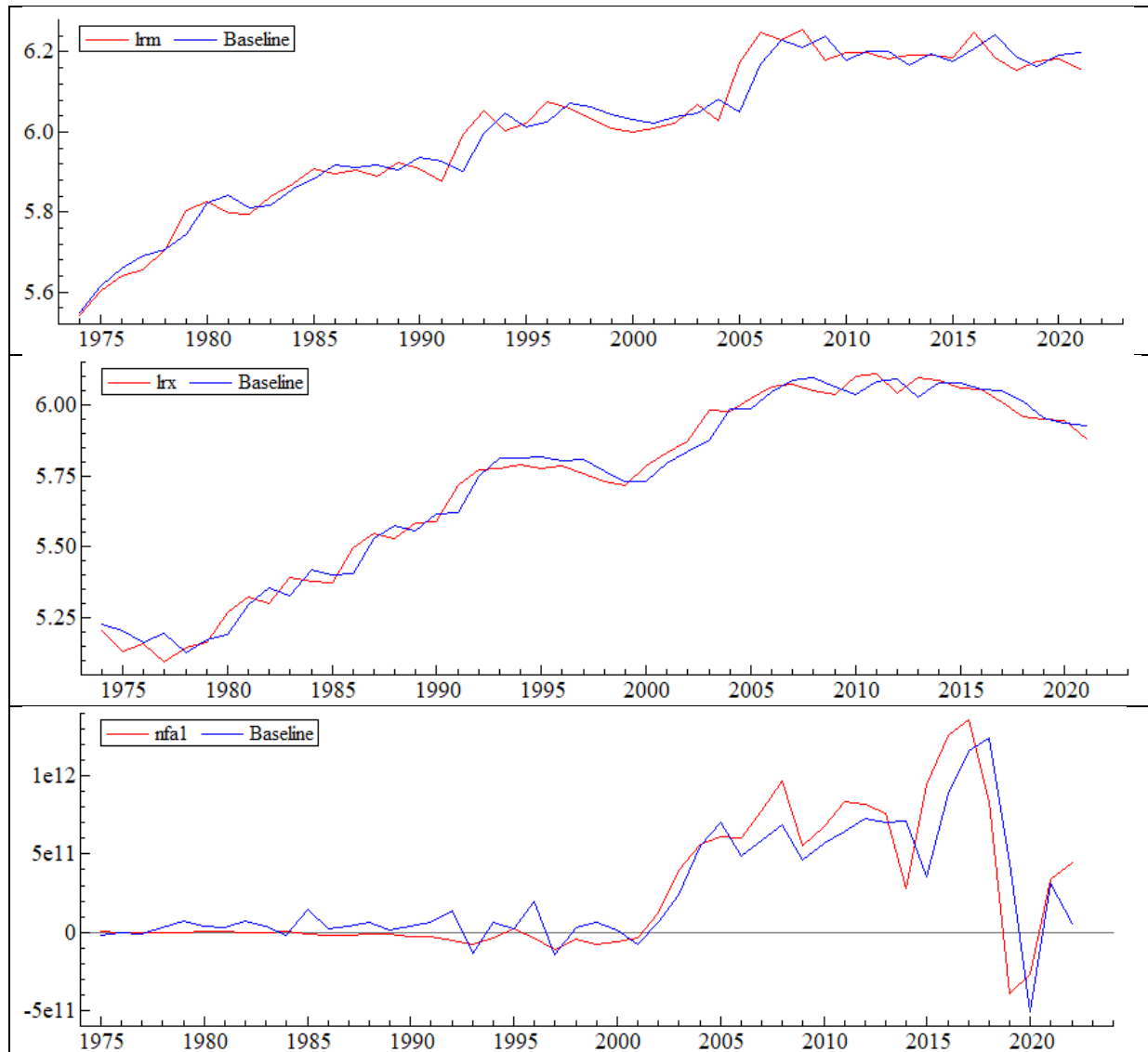
Equation 11 of this block depicts that the rate of consumption tends to have a positive link with the rate of wealth while negatively related to the lending rate. It is found to be positive but insignificant. Consumption increases by 0.25 percent with an increase in wealth and is significant at a one percent significance level. As per the wealth effect, with an increased wealth rate, consumers maximize their consumption spending. Moreover, in countries like Pakistan, high consumption levels are attributed to remittances or accumulated wealth. Equation 12 states that the investment rate is inversely associated with the lending rate. With an increase in lending rate, investment significantly decreases by 0.02% at a 1 percent significance level. An increase in lending rate raises the borrowing cost, consequently affecting investors' borrowing capacity. A higher interest rate also increases the cost of servicing the present debt, decreasing business gains, which limits the availability of funds for investment. Equation 13 states the impact of change in debt stock on the rate of wealth. The findings state that an increase in debt stock results in a decrease in the rate of wealth by 10.4% and is significant at 1 percent. Debt is accompanied by interest payments and obligations. Higher debt increases debt expenses. The prolonged duration of debt servicing with no corresponding earnings can halt wealth accumulation. Equation 14 indicates that an increased rate of GDP negatively influences the rate of unemployment. The coefficient of GDP is positive but insignificant. Moreover, the State fragility index was found to positively impact the unemployment rate, showing that unemployment increases by 0.05% and is significant at 1 percent. Similarly, Dummy for 2019 was also found to have an increasing impact on the unemployment rate; due to the lockdown imposed during COVID-19, massive people have lost their jobs and become unemployed.

4.1.5. External Block

Equation 15, models imports as a function of public debt and exchange rate. The findings state that imports have an increasing relationship with public debt while negatively associated with the exchange rate. Imports were found to increase by 1.22% with an increase in public debt, while decreased by 0.05% with an increase in the exchange rate. When government authorities increase the debt rate to finance multiple projects, social schemes, and infrastructure development it can boost economic activity. Higher public spending generates higher demand in the economic system promoting an increased rate of investment and consumption which tends to enhance demand for imports, particularly if domestic industries cannot meet excessive demands. Moreover, due to the high exchange rate, imported goods become expensive domestically, whereas domestic items become cheaper for foreign consumers. In this case, imported items are marked as less competitive in a domestic market system, resulting in a reduced rate of imports. Equation 16 depicts that imports are vital determinants of exports. The findings are anticipated and point towards a lagged effect in exports of finished items to import of manufacturing materials. Moreover, capital formation was also found to have an increasing impact on exports, as exports rose by 0.04% with an increase in the rate of capital formation. J-stats for all the equations are greater than 0.05, favoring the acceptance of null to validate the overidentified restrictions, providing that selected instruments are valid, meet orthogonality conditions, and are exogenous.

4.2. Dynamic Simulation (Within Sample Performance)

After the specification of the model, it is solved for ex-ante & ex-post simulation. For the provision of uncertainty measures, stochastic simulations have been employed. Contrary to a deterministic process where residuals are set for expected estimates, which are 0, from which stochastic simulation randomly picked values to get error terms (Fair, 2018). The model's ability to repeat the dynamics of actual endogenous variables is analyzed based on ex-post simulation for a given sample. Simulations have been done for the following variables i-e Debt interest payments, External debt, imports, exports, Net domestic assets, and net foreign assets. Blue lines show baseline values, while red lines represent actual values. The simulation analysis shows the models' accuracy in tracking the real dynamics of concerned endogenous variables. The graphical representation of predicted and actual estimates of selected variables, confirms that the deterministic dynamic solution of the given model closely traces the actual time horizons of the selected variables as shown in Figure 2.



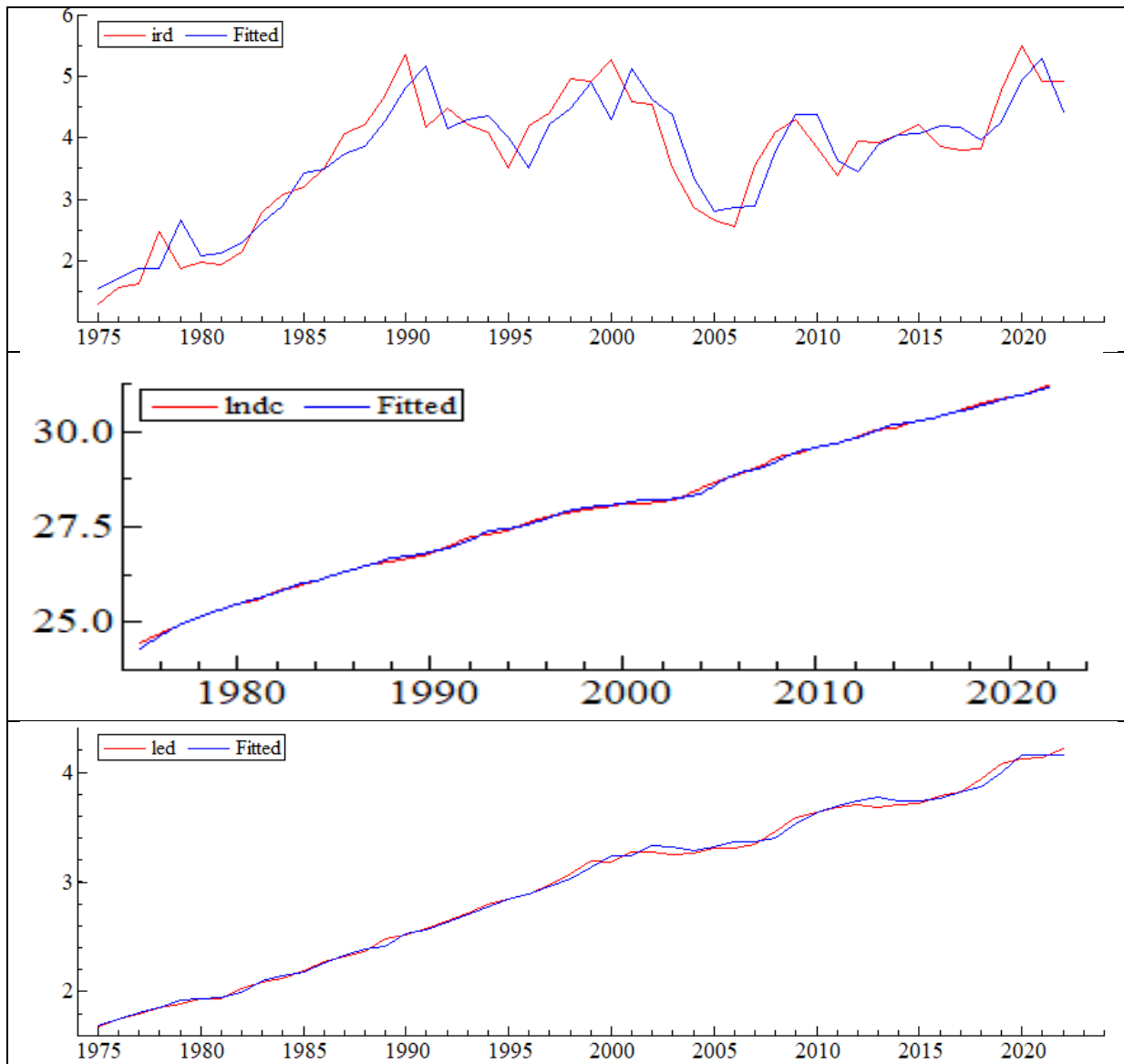


Figure 2: Simulation Graphs Red lines show the actual & blue line shows the baseline.

Forecast evaluation measures have been used for the evaluation of ex-post simulations. The commonly known forecast evaluation criteria are Theil's coefficient (u), MAPE (Mean Absolute Percentage Error), MAE (Mean Absolute Error), and RMSE (Root Mean Square Error). The formulas to determine forecast evaluation criteria are given below

$$u = \frac{\sqrt{\frac{1}{T} \sum_{t=1}^T (\hat{y}_t - y_t)^2}}{\sqrt{\frac{1}{T} \sum_{t=1}^T (\hat{y}_t)^2} \sqrt{1/t(y)^2}}$$

$$MAPE = \frac{1}{T} \sum_{t=1}^T \left| \frac{\hat{y}_t - y_t}{y_t} \right|$$

$$AE = \frac{1}{T} \sum_{t=1}^T |\hat{y}_t - y_t|$$

$$RMSE = \sqrt{\frac{1}{T} \sum_{t=1}^T (\hat{y}_t - y_t)^2}$$

Where, T represents sample range, simulated value in period "t" is represented by \hat{y}_t and actual values are depicted by y_t (Pindyck & Rubinfeld, 1991).

Table 2 provides forecast evaluating measures for selected variables. The estimates reveal that solved and actual values are closely related. As most of the values are near zero. Whereas, some larger values belong to the added identities. The estimates validate that historical data is well-tracked with a smaller error margin.

Table 2
Measures of Forecast Evaluation

Variables	MAPE	u	RMSE	MAE
Debt Interest Payments	4.76	0.02	0.67	0.28
External debt	7.62	0.03	0.22	0.18
Imports	1.23	0.00	0.09	0.07
Exports	2.21	0.012	0.14	0.12
Net Foreign Assets	3.14	0.25	4.54	3.51
Net Domestic Assets	0.88	0.05	0.07	0.05

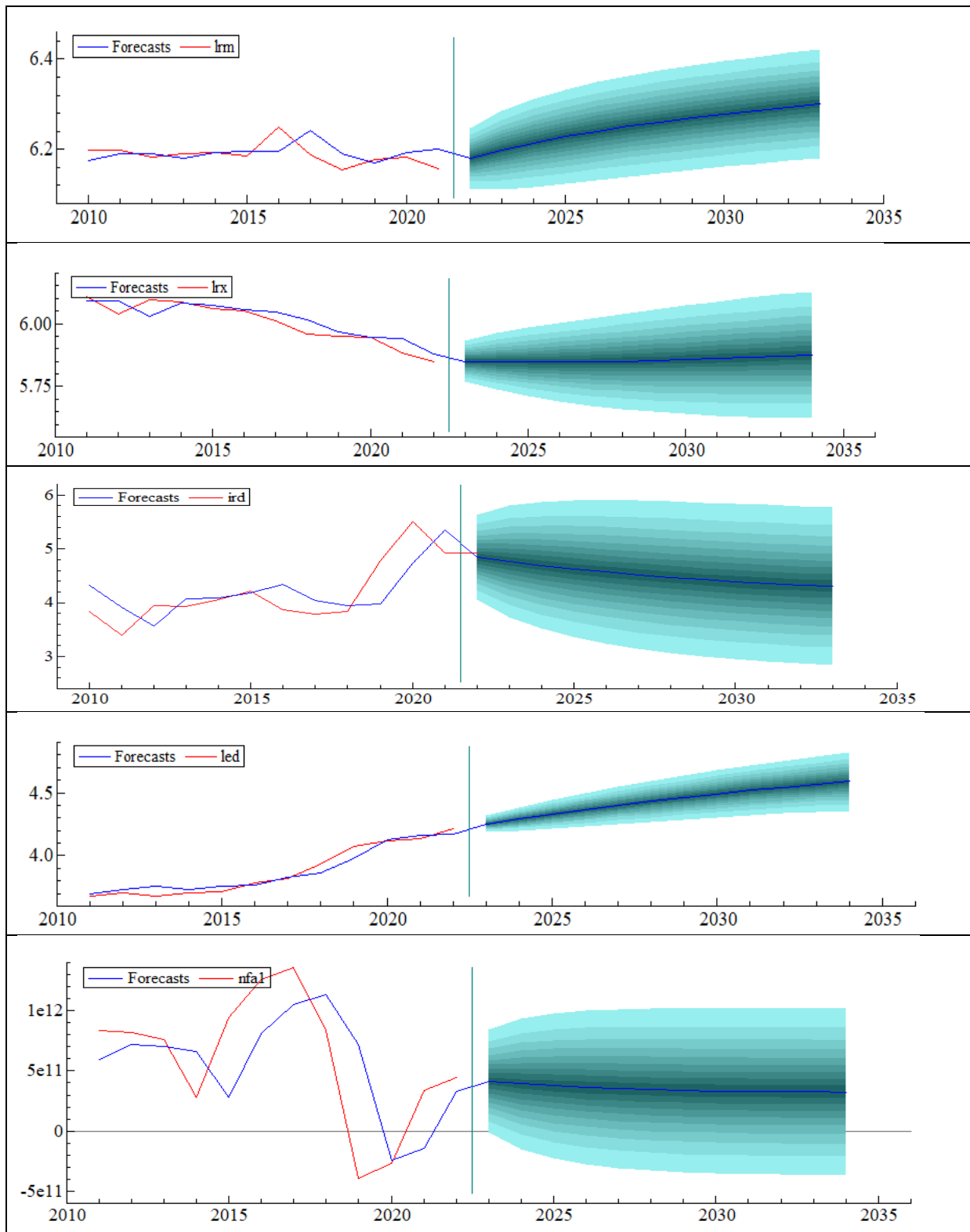
4.3. Shock Analysis and Ex-ante Simulations

The additional benefit of this model is that it can gauge the impact of multiple shocks. The graphical projections of different shocks are shown in Table 3. which depicts the difference among endogenous variables concerning baseline and different scenarios. In, this regard, the Gauss-Seidel technique has been used to solve the model to conduct various experiments.

4.4. Stochastic Simulations

If the model is found to reasonably fit, in ex-post simulations, it is used for forecasting examination. Assumptions have been made to track the future projections of the concerned variables. Pakistan is facing higher inflation, currency devaluation, massive debt burden, and also trade and fiscal deficit. In the present time, Pakistan has to cope with these major problems to overcome their detrimental consequences on future economic progress. Thus, this section deals with the analysis of different scenarios like increased exchange rates, Government expenses, and inflation to gauge its impact on the behavior of concerned variables like debt payments, external debt, imports, exports, and net domestic and foreign assets. The values are reported in Table 3 in appendix where median estimates are derived from stochastic simulations. The forecast period ranges from 2023 to 2030 under multiple scenarios. On average with an increase in exchange rate, interest payments tend to be 4.6 till 2030, while external debt remained at 4.4 with an increasing rate, imports are also anticipated to exceed exports further, and net domestic assets are expected to increase till 2030 in response to an increment in the rate of exchange. For government expenditures, interest payments tend to be 4.0 and are expected to decrease till 2030 whereas external debt is shown to have the same consistency imports are expected to decrease as increased government spending promotes good economic growth and domestic businesses. Moreover, exports are expected to raise as also net domestic assets as compared to foreign assets. In case of an increase in inflation, the interest payments and debt rates are expected to grow on an average of 4.6 and 4.48 percent. Imports are also anticipated to rise as compared to exports. Net domestic assets are expected to grow more than foreign assets.

Fan charts depict a range of reasonable outcomes with respective confidence bands. The darkest tone illustrates a 60 percent confidence level while the 95% level is depicted by the darkest area. Whereas, the median forecast is represented via a solid line in the forecast region.



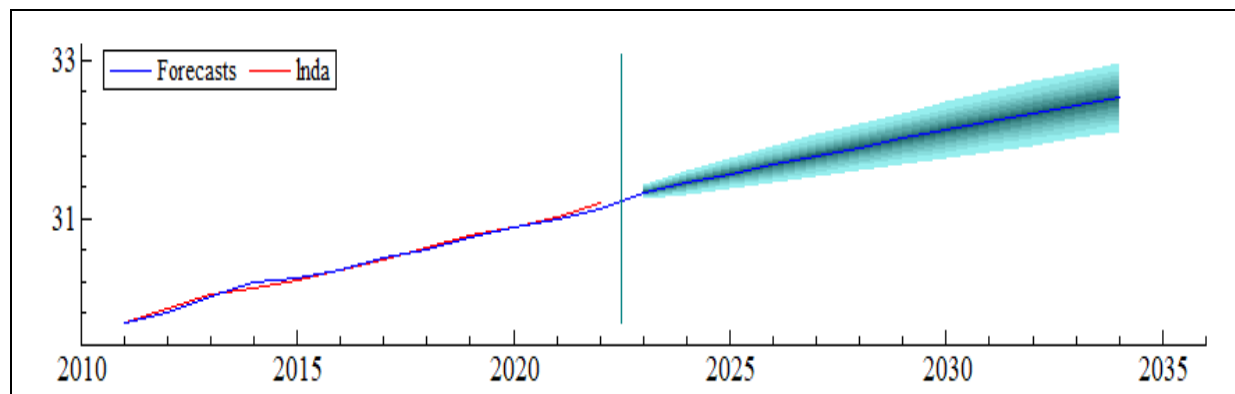


Figure 3: Fan Charts show forecasted values (2023-2035)

i. 5% increase in Exchange Rate

As shown in Table 3, given in the appendix the effect of an increased exchange rate tends to increase debt interest payments and external debt of Pakistan in the future. Due to the high exchange rate, it becomes more expensive to service foreign debt in terms of local currencies. As Pakistan possesses high debt denominated in foreign currency, weaker currency leads to high principal amounts and also high-interest payments. This could impose strain on the public finances and resultantly raise debt sustainability concerns. The high exchange rate also exacerbates the nation's current account deficit, as projected that imports tend to grow more as compared to exports in response to the high exchange rate by 2030.

ii. 10% increase in Government Expenditures

An increase in government expenses has an increasing impact on debt payments and external debt. If increased fiscal costs are not used for productive purposes, more spending on non-productive affairs may pose a threat to the long-term sustainability of public finances. Moreover, when public expenses are funded via extensive borrowing, it results in massive debt, making it challenging for government authorities to service the debt, which might result in debt crises.

iii. 5% Increase in Inflation

Increasing inflation is the most significant issue Pakistan faces and has severe consequences. Rising inflation results in economic inefficiencies as businesses and individuals allocate more time and resources to manage the inflation risk despite paying attention to productive activities. Moreover, the high inflation rate also sabotages the government's ability to cope with its debt burden efficiently. It also results in higher interest payments, enhancing fiscal pressure and creating difficulties in debt servicing. In addition, inflation also exerts pressure on BoP by influencing the cost of imports. If increased inflation outpaces export progress, the trade deficit might expand, leading to a strain on forex reserves.

5. Conclusion

This paper outlined the macro-econometric model to target the debt burden of Pakistan. A small macro-econometric model has been formulated comprised of sixteen behavioral equations and ten identities explaining theoretical dependency between variables to impute missing observations & also bound model forecast. The model consists of 5 blocks: government, price, monetary & financial, macroeconomic, and external account blocks, and for estimation, a sample has been selected from 1973-2022. At first, the stationarity of the variables was tested by employing the ADF test, some variables were found to be stationary at a level while some were found stationary at 1st difference. The system of equations have been

estimated jointly using the Generalized Method of Moments. To assess macro-econometric issues multiple test statistics have been utilized like J-stats for assessment of validity of restrictions along with instruments exogeneity. While the Wald test has been used to evaluate the issue of autocorrelation. The estimation findings depict that most of the signs are as per expectation and also justified as the parameters were statistically significant. Almost all the behavioral equations depicted that there lies no issue of endogeneity. The government block shows that tax revenues tend to have positive association with private consumption while negatively impacting government expenses. Moreover, debt interest payments also found to have positive relation with government debt stock. Likewise, external debt was also found to have an increasing relation with exchange rate & trade balance. Whereas claims on government depicted a negative relation with its lag and lag of budget deficit.

In the price block inflation is found to have an increasing relation with its lag and also with real private consumption. In 3rd financial sector & monetary block, money supply depicted to have positive association with net foreign assets and lag of GDP. Moreover, net factor assets found to have a direct relation with Real GDP. The lending rate is found to have a positive relation with debt stock. Further, claims on private sector shown to have an increasing relation with 2nd lag of claims on the private sector. Net domestic credit shown to have positive association with its lag and also government debt stock. In macro-economic block aggregate consumption is found to have increasing link with wealth and also with lending rate. On the other hand, real private investment found to have decreasing relation with rising lending rate. Likewise, wealth is found to have a decreasing association with increasing debt stock. Last, equation of this block of unemployment is found to have a negative relation with the state fragility index while for GDP it is found positive & insignificant. The last and the 5th external account block provides that imports have an increasing relation with public debt while negatively related to exchange rate. Furthermore, exports found to have positive link with lag of imports and capital formation.

After, completion of estimation of the model, simulation exercise has been done to determine validity of the model. The model is solved deterministically via Gauss-Seidel and dynamic simulation method. It is evident that the actual and predicted estimates are close with each other as analyzed by values of their inequality, RMSE, and MAPE. Furthermore, it is also shown by the graphical analysis that model is capable to catch the actual paths & turning points in the economy. Moreover, the simulation experiments were conducted by employing the forecast period 2023-2030 as after Covid 2019, the economic condition of the country further deteriorated and negatively impacted the growth rates. Forecasting has been done by giving shocks like to analyze the impact of an increase in the exchange rate, government expenditures, and inflation on future rate of external debt, interest payments, current and capital accounts. It is found that increase in exchange rate, government expenditures, and inflation stimulate the rate of external debt, and interest payments by 2030. So, these are the serious issues that Pakistan has to deal with in order to manage heavy debt burden. It is required to formulate efficient monetary and fiscal policies and stabilize both sides simultaneously to attain an equilibrium state in the economic system.

5.1. Policy Implications

It is a great challenge for Pakistan to manage the external debt burden and interest payments accompanied by increasing inflation, exchange rate & government expenditures. Here are few policy suggestions based on findings that could be followed:

- On Fiscal side it is necessary to increase development expenditures and should avoid wasteful spending's to prioritize fiscal discipline. Referring to the empirical finding, government block shows that tax revenues tend to have positive association with private consumption support that tax base should be expanded and promote efficient tax reforms to increase revenue collection. Moreover, it is required to implement

medium-term framework to define clear targets for debt sustainability & deficit reduction.

- On monetary side, the positive relationship between inflation and real private consumption necessitate the need for careful management of inflation, to line up and ensure stability of objectives it is vital to promote coordination among monetary and fiscal policies. Attention must be paid on interest rate adjustment to stabilize inflation while also analyzing its influence on investment & borrowing costs.
- In order to reduce volatility and its influence on external debt servicing, effective measures must be adopted to ensure exchange rate management. Moreover, to deal with exchange rate volatility foreign exchange reserves must be consider strategically.
- A comprehensive debt management strategy must be developed in order to minimize borrowing costs and directing debt maturity profiles. Diversification of sources of financing must be promoted in order to rely on a single source of external borrowing. Concessional borrowing must be prioritized to minimize interest payments.
- Structural reforms must be implemented to increase productivity to enhance growth and also enhance exports earnings is supported by an increasing correlation between wealth, aggregate consumption, and lending rate. Opportunities for investments must be increased in order to attract FDI and forex exchange flows.
- More importantly, it is necessary to promote transparency in debt reporting, public spendings, and fiscal management to develop investor's credibility & confidence. Long term development plans must be developed that stresses on promotion of sustainable economic development, improvement in economic resilience and also to reduce dependency on external borrowing.

5.2. Limitation of the Study

Data constraint is one of the potential limitations of the study.

5.3. Future Research Direction

To help future scholars, the study includes future research directions. The study can be expended by adding more blocks and variables to a macro-economic model which will enable to examine a more comprehensive overview of the economic interdependencies. In addition, the influence of various variables can be evaluated by targeting policy-specific variables. Furthermore, analysis can also be done by introducing shocks to the key variables. Furthermore, analysis can also be done by introducing shocks to the key variables.

Author's Contribution:

Ambreen Fatemah: Data collection, Data analysis, writeup of Paper.

Ahsan ul Haq: Guidance and Supervision.

Conflict of interest/ Disclosures:

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Appendix**Estimation Results****Government Block**

$$TREV_t = 1.94***LRPCE_t - 5.54***\Delta LGE_t + 0.15*** \quad \text{Eq 1}$$

(0.205) (1.09) (0.10)

$$\Delta IRD_t = 2.61***\Delta LGDS_t \quad \text{Eq 2}$$

(0.66)

j-stats=4.9 D-W=0.17 S.E= 1.29 Wald= 5.5

$$\Delta LED_t = 0.02***\Delta OEXR_t + 4.37**\Delta TB_t \quad \text{Eq 3}$$

(0.005) (1.93)

j-stats=0.25 D-W=0.30 S.E= 0.88 Wald= 11.8

$$LCCG_t = -0.018L1CCG_t - 0.14***\Delta L1BDEFI_t \quad \text{Eq 4}$$

(0.01) (0.03)

j-stats=0.25 D-W=1.07 S.E= 0.56 Wald= 1.82

Price Block

$$\Delta CPI_t = 1.01***\Delta L1CPI_t + 0.53**LRPCE_t \quad \text{Eq 5}$$

(0.02) (0.24)

j-stats=3.5 D-W=2.27 S.E= 12.3 Wald= 1.97

Financial Sector & Monetary Block

$$LM2_t = 4.41***NFA_t - 1.15***\Delta L1GDP_t \quad \text{Eq 6}$$

(7.19) (0.19)

$$NFA_t = 9.68***LRGDP_t - 6.42 \quad \text{Eq 7}$$

(5.68) (3.83)

j-stats=3.02 D-W=0.45 S.E= 8.47 Wald= 1.87

$$LR_t = -18.7\Delta L1LGDS_t + 22.07**\Delta L2LGDS_t \quad \text{Eq 8}$$

(11.28) (11.48)

$$LCCPS_t = 1.00***L2LCPS_t - 2.53 \quad \text{Eq 9}$$

(3.61) (3.61)

j-stats=0.24 D-W=2.06 S.E= 2.17 Wald= 2.77

$$NDC_t = 2.79**L1LNDC_t + 7.37***\Delta LGDS_t \quad \text{Eq 10}$$

(1.42) (1.02)

j-stats=0.33 D-W=1.38 S.E= 3.12 Wald= 1.16

Macro-Economic Block

$$LC_t = 0.25***LWH_t + 0.004LR_t + 3.77*** \quad \text{Eq 11}$$

(0.02) (0.006) (0.23)

$$\Delta LRPI_t = -0.02***LR_t + 6.23*** \quad \text{Eq 12}$$

(0.00) (0.14)

j-stats=4.98 D-W=0.96 S.E= 0.36 Wald= 4.35

$$LWH_t = -10.4***\Delta LGDS_t + 27.2*** \quad \text{Eq 13}$$

(1.64) (2.53)

j-stats=1.79 D-W=0.59 S.E= 0.73 Wald= 10.7

$$\Delta UE_t = 0.07***\Delta LGDP_t + 0.05***SFI_t + 1.55***D19 \quad \text{Eq 14}$$

(0.10) (0.005) (0.56)

j-stats=2.59 D-W=0.99 S.E= 0.34 Wald= 30.9

External Accounts Block

$$\text{LRM}_t = 1.22 \text{ *** } \Delta \text{LPD}_t - 0.05 \text{ *** } \Delta \text{LOEXR}_t \quad \text{Eq 15}$$

(0.06) (0.01)

j-stats=8.9 D-W=0.09 S.E = 0.93 Wald= 17.8

$$\Delta \text{LRX}_t = 1.83 \text{ *** } \text{L1LRM}_t + 0.04 \text{ *** } \text{GFCF}_t - 5.96 \text{ **}$$

(0.17) (0.01) (1.23)

j-stats=6.17 D-W=0.58 S.E = 0.153 Wald= 2.76

Eq 16

Table 3
Ex-ante Forecasts Under Different Scenarios on Economic Variables.

Variables	2023	2024	2025	2026	2027	2028	2029	2030	Average
Scenario 1: 5% increase in Exchange rate									
Interest Payments	4.841	4.776	4.719	4.668	4.624	4.58	4.55	4.52	4.660
External Debt	4.3467	4.3958	4.4431	4.4892	4.5347	4.5797	4.6241	4.6681	4.4876
Imports	6.1853	6.2063	6.2247	6.2395	6.2513	6.2609	6.2690	6.2824	6.2399
Exports	5.8603	5.8391	5.8149	5.7894	5.7636	5.7378	5.7123	5.6870	5.6622
NFA	-3.850	4.2332	4.1220	5.4884	6.6423	7.8741	9.0059	1.0092	4.3155
NDA	7.4425	7.4933	7.5433	7.5346	7.6400	7.6869	7.7330	7.7784	7.6137
Scenario 2: 10% increase in Government Expenditures									
Interest Payments	4.1203	4.0406	4.0021	3.9868	3.9830	3.9839	3.9864	3.9890	4.0115
External Debt	4.3628	4.4260	4.4898	4.5544	4.6199	4.6862	4.7534	4.8216	4.3628
Imports	1.4130	1.402	1.3941	1.3884	1.3848	1.382	1.382	1.3832	1.3911
Exports	5.9586	5.9612	5.9638	5.9664	5.9690	5.9714	5.9737	5.9759	5.9675
NFA	3.4328	3.9010	4.118	4.1948	4.2006	4.1774	4.146	4.118	4.0360
ND	3.0815	3.0815	4.0943	4.7190	5.4394	6.2703	7.2287	8.3342	5.2811
Scenario 3: 5% increase in inflation									
Interest Payments	4.2003	4.148	4.1273	4.119	4.1181	4.1181	4.1184	4.1187	4.1337
External Debt	4.2863	4.3297	4.3798	4.4335	4.4878	4.5414	4.5939	4.6458	4.4623
Imports	6.2728	6.2838	6.2932	6.3019	6.3100	6.3179	6.3256	6.3332	6.3048
Exports	5.8965	5.6234	5.5463	5.432	5.7234	5.687	5.9654	5.7654	5.7049
NFA	7.5889	3.1388	4.4618	8.9688	1.1822	1.0939	8.1875	6.6600	5.1602
NDA	7.4670	7.5181	7.5687	7.6191	7.6691	7.7189	7.768	7.817	7.6432