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Articles

Economic and Political Drivers of External Debt: Insights from
Developing and Transitioning Economies in Asia
**Muhammad Dawood, Zhao Rui Feng, Tamoor Azam,
and Fayaz Hussain Tunio**

Technocratic Dreams, Political Realities:
Evaluating Full Reserve Banking for Pakistan
Asad Zaman

Field-Based Yield Gap Analysis of Basmati Rice: A Case Study of Two
Districts in Central Punjab, Pakistan
Zartasha Zafar, Faisal Jamil and Iftikhar Hussain Adil

Family Size and Nutritional Outcomes in Children:
Lessons from Pakistan
Filza Ayaz

Climate Vulnerability and Debt: How Energy and Road
Access Shape Household Coping in Pakistan
Saima Nawaz

Book Review

Our Dollar, Your Problem: An Insider's View of Seven
Turbulent Decades of Global Finance, and the Road Ahead
Muhammad Naveed Tahir



C O N T E N T S

	<i>Pages</i>
ARTICLES	
Muhammad Dawood, Zhao Rui Feng, Tamoor Azam, and Fayaz Hussain Tunio Economic and Political Drivers of External Debt: Insights from Developing and Transitioning Economies in Asia	131
Asad Zaman Technocratic Dreams, Political Realities: Evaluating Full Reserve Banking for Pakistan	153
Zartasha Zafar, Faisal Jamil and Iftikhar Hussain Adil Field-Based Yield Gap Analysis of Basmati Rice: A Case Study of Two Districts in Central Punjab, Pakistan	175
Filza Ayaz Family Size and Nutritional Outcomes in Children: Lessons from Pakistan	193
Saima Nawaz Climate Vulnerability and Debt: How Energy and Road Access Shape Household Coping in Pakistan	215
BOOK REVIEW	
Kenneth Rogoff Our Dollar, Your Problem: An Insider's View of Seven Turbulent Decades of Global Finance, and the Road Ahead <i>Muhammad Naveed Tahir</i>	237

Economic and Political Drivers of External Debt: Insights from Developing and Transitioning Economies in Asia

MUHAMMAD DAWOOD, ZHAO RUI FENG, TAMOOR AZAM, and
FAYAZ HUSSAIN TUNIO

This study explores the economic and political determinants of external debt in 37 Asian developing and transition economies (ADTEs) over the period 1997-2020. Controlling for endogeneity and dynamic panel bias using fixed effects (LSDV), bias corrected LSDVC and Generalised Method of Moments (GMM) estimators, we find that economic growth, national savings, trade balance and strong institutional quality significantly reduce external debt. However, debt levels are exacerbated by investment, government consumption, inflation, interest rate, exchange rate, debt servicing and international reserves. The study underscores the importance of institutional quality in the pattern of borrowing, providing useful insights for policy-makers for sustainable debt management and long-term economic development.

Keywords: External Debt, Economic Growth, GMM, Institutional Quality, Asia

1. INTRODUCTION

Since the early 1970s, developing economies have faced a series of recurring economic shocks that have had a profound impact on their growth paths. These include the oil crises of the 1970s, the global recession of the early 1980s, the Asian financial crisis of 1997, the global financial crisis of 2008 and most recently the disruptions caused by the COVID-19 pandemic. Such shocks have resulted in persistent macroeconomic imbalances, high inflation and increasing dependence on external borrowing to maintain economic stability and development (Dawood, et al. 2025; Chudik, et al. 2017; Mensah, et al. 2019). External debt has been considered as a vital fiscal device for enhancing domestic savings and promoting investment particularly in resource constrained economies (Siddique, et al. 2015). However, the rising debt servicing burden has become a structural problem for many developing countries as evidenced by rising interest rates, falling capital inflows, falling domestic productivity, and limited access to modern technology (Baidoo, et al. 2021; Ofori-Abebrese, et al. 2021; World Bank, 2023).

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In Asia, developing economies have borrowed heavily externally to cover balance-of-payments deficits, support economic growth, reduce unemployment and fight poverty (Harsono, Kusumawati & Nirwana, 2024). But they have been unable to use these funds effectively because of repeated global and local shocks. The average debt-to-GDP ratio of Asian emerging and developing economies has risen significantly from 56 percent in 2019 to 75 percent in 2022, largely due to the economic impact of the pandemic (IMF, 2022; Gaspar, et al. 2021). The World Bank (2022) also reported that South Asia's external debt stock grew by 10.2 percent in 2021 to US\$900 billion, with India, Bangladesh and Pakistan leading the increase. In contrast, debt accumulation in East Asia and the Pacific, excluding China, slowed to 3.5 percent, reflecting both pandemic and climate-related challenges.

The existing literature has been largely focused on the macroeconomic impacts of external debt, with little consideration given to the economic and political factors that contribute to the accumulation of external debt (Dawood, et al. 2024; Beyene & Kotosz, 2020; Harold, 2019). Most studies have used country-specific time series approaches (Wahyuni, et al. 2019; Mahara & Dhakal, 2020; Ayesha & Emon, 2022; Baniata, et al. 2023), but only a few have used panel data analyses that allow for broader generalisation (Mijiyawa, 2023; İlhan, 2023; Gulcemal, 2022). The empirical evidence in the Asian context, however, is still limited to small panels of ASEAN countries (Rindi, et al. 2023) or to some sub-regions (Dawood, et al. 2021).

Based on this theoretical background, the present study puts external debt in a broader context of savings, investment and foreign financing. According to the Harrod-Domar (1939, 1946) model, sustained growth requires an important and necessary element of capital accumulation. Chenery and Strout's (1966) Dual-Gap Theory points to the savings-investment and foreign exchange constraints that developing economies frequently face, which compel them to borrow from abroad. Finally, Bacha's (1989) Three-Gap Model extends this framework by introducing fiscal constraints and argues that poor domestic resources, along with budgetary and trade imbalances, force countries to seek external financing. Taken together, the models provide a conceptual framework for the study of the impact of economic structures and institutional conditions on the debt accumulation of developing countries. The present study broadens the existing literature that has largely focused on macroeconomic variables by incorporating institutional and political governance indicators to the debt-growth framework.

Methodologically, the study employs a set of robust panel estimators, namely Least Squares Dummy Variable (LSDV), bias-corrected LSDVC and dynamic system Generalised Method of Moments (GMM) for consistency, controlling for endogeneity and capturing dynamic interactions. This holistic analytical approach is expected to give deeper insight into the joint effect of governance quality, political stability and economic fundamentals on external debt dynamics. This combination not only improves the theoretical understanding of debt accumulation, but also gives practical policy recommendations for sustainable debt management and economic stability in the Asian region.

The rest of this study is organised as follows. Section 2 reviews the literature on determinants of external debt; Section 3 provides details about data and methodology; Section 4 shows the empirical results and discussion; Section 5 concludes with key policy implications and directions for future research.

2. LITERATURE REVIEW

2.1. Theoretical Framework

The Three-Gap Model developed by Bacha (1989) is a useful framework for analysing the dynamics of external debt financing in developing countries as it emphasises three critical gaps that have a significant impact on a country's borrowing requirements: The savings-investment gap, the fiscal gap and the exchange gap. This model is built upon the basic ideas of Chenery and Strout (1966) in their Dual Gap Model, who first identified the savings-investment gap and the foreign-exchange gap as the main constraints in developing economies. The Three-Gap Model embeds the fiscal gap into the analysis, which provides a more comprehensive analysis of the economic determinants of external debt.

2.1.1. Saving-Investment Gap

The imbalance between savings and investment lies at the heart of the dynamics of external debt. Developing countries need external financing because they generally do not have enough domestic savings to meet the investment requirements for sustainable growth. This gap is defined as the difference between gross capital formation and national savings. Where national savings are not enough, governments have to look to the world market for external debt to finance investments necessary for economic growth. According to theoretical foundations, higher rates of investment tend to lead to higher productivity and growth and hence to an increase in the country's ability to service its debt in the long run (Rindi, et al. 2023). The saving-investment gap can be written as:

$$\Delta D_{ext}^{S-I} = I - S \quad (1)$$

where I is the level of investment, S is the level of domestic savings, and ΔD_{ext}^{S-I} represents the change in external debt due to the saving-investment gap. This equation indicates that the higher the investment-to-savings ratio, the higher the external debt. In this context savings are the difference between private income and consumption. This may be defined as home savings:

$$S = Y - C \quad (2)$$

where S for domestic savings, Y presents national income, and C stands for consumption.

2.1.2. Foreign Exchange Gap

The foreign exchange gap is the difference between a country's exports and imports, which necessitates buying foreign currency to cover trade deficits. This is the gap that is represented by the trade balance, and on which the exchange rate and international reserves have their influence (Mijiyawa, 2023). When a country has a negative trade balance, it has to borrow from abroad to pay for its imports, and this can lead to an increase in its external debt. International reserves act as a buffer against currency fluctuations and as a safety net to manage debt repayments (Waheed, 2017). The theoretical motivation for this gap stresses the importance of trade balance in the determination of external financing needs, countries with large trade deficits are more vulnerable to external shocks. The foreign exchange gap is given by:

$$\Delta D_{ext}^{FX} = M - X \quad (3)$$

where ΔD_{ext}^{FX} is the change in the external debt due to the foreign exchange gap, M is imports and X is exports. Growth in external debt results from an excess of imports over exports.

2.1.3. Fiscal Gap

The fiscal gap is the difference between government revenue and government expenditure. The fiscal gap is further augmented by the requirement to service the debt already owed. It is a measure of the extent of excess of government expenditure over revenue and the need for external borrowing to meet the deficit (Shaharuddin & Edris, 2021). High levels of debt service, the periodic payment of interest and principal on existing debt, can severely limit a government's fiscal space, limiting its ability to invest in development and social programs (Sagdic & Yildiz, 2020). The fiscal gap is thus an important indicator of the financial health of a country, affecting its dependence on external debt to meet the budgetary needs of the economy and to retain economic stability. The fiscal-constraint gap is expressed as:

$$\Delta D_{ext}^{Fiscal} = G - T \quad (4)$$

where ΔD_{ext}^{Fiscal} refers to the change in external debt due to the fiscal gap, G is government expenditure and T is government revenue. Fiscal deficit is when expenditure exceeds revenue and it results in borrowing from external sources which in turn increases the external debt. The overall external debt equation is determined by the combined gaps:

$$\Delta D_{ext} = \Delta D_{ext}^{S-I} + \Delta D_{ext}^{FX} + \Delta D_{ext}^{Fiscal} \quad (5)$$

This expands to:

$$\Delta D_{ext} = (I - S) + (M - X) + (G - T) \quad (6)$$

2.1.4. Institutional Quality

Besides economic models, political determinants like the quality of institutions, governance structures and policy decisions also play a vital role in external debt dynamics (Chiminya, et al. 2018; Harold, 2019; Azolibe, 2020; Ibrahim, 2021). Recent studies have found that institutional quality and governance are key determinants of foreign debt accumulation. Besley & Persson (2018) emphasise the importance of good governance structures in improving creditor confidence and decreasing the costs of borrowing. They also stress the importance of state capacity in enabling sound borrowing practices. Dreher & Gassebner (2020) stress the significance of robust institutional safeguards in mitigating default risk and ensuring access to external financing, in their study on the impact of sovereign defaults on access to international financial markets. Hasan & Hossain (2021) provide a global perspective on governance and foreign debt and explain the complex interrelations between debt sustainability, fiscal management strategies and quality of governance. Together these studies underscore the significance of governance and institutional quality in determining borrowing conditions, debt management, and economic stability in an increasingly integrated global financial environment.

Economic growth increases the capacity of an economy to generate revenue and pay its debts as faster growth usually leads to increased investment opportunities and higher national savings which in turn reduces dependence on borrowing from external sources (Waheed & Abbas, 2021). In addition, good economic performance can attract foreign direct investment which can provide alternative sources of financing. On the other hand, high inflation reduces the real value of debt and makes it more difficult to manage

and service the debt (Dawood, et al. 2021) while high interest rates increase the cost of borrowing which could discourage investments and worsen fiscal deficits. These macroeconomic factors as a whole point to the interrelatedness of economic stability and external debt dynamics, and their significant impact on a nation's financial health.

We base our empirical model on the Three-Gap Framework (Bacha, 1989) and specify the following relationship. The savings-investment gap is proxied by investment (PFIN) and national savings (PSAV); the foreign-exchange gap by the trade balance (TDRA), the exchange rate (XRPD) and international reserves (IRGDP); and the fiscal gap by government consumption (PGCE) and debt servicing (TSPY). We supplement this core specification with standard macroeconomic controls—economic growth (RYPH), inflation (DCPI) and interest rates (EFIR). Most importantly, we augment the model with institutional quality (IQ) that we hypothesise to be a cross-cutting determinant that influences the magnitude of all three gaps. Our complete specification, illustrated in our conceptual framework (Figure 1), enables us to test whether superior governance moderates external borrowing needs after controlling for fundamental macro-economic pressures. We write the relationship to include economic and political determinants that affect the dynamics of external debt as:

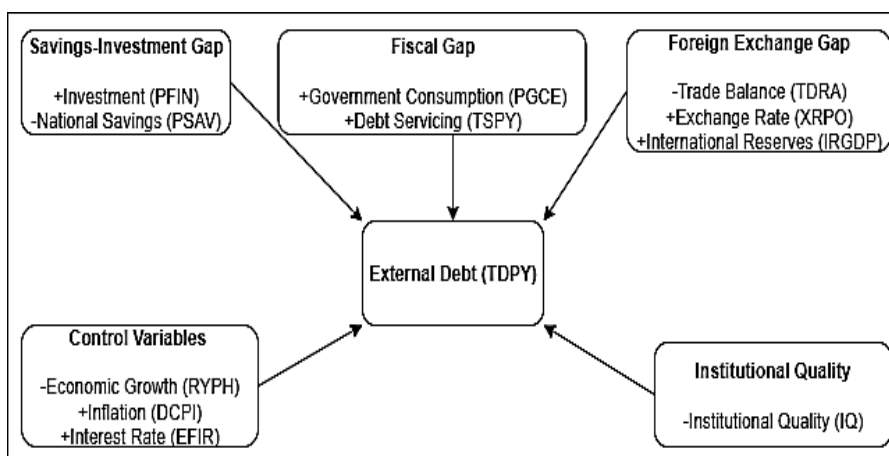
$$\Delta D_{ext} = f(I, S, M, X, G, T, IQ, EG, Inf, IR, DS, ER, InR) \quad (7)$$

where IQ is institutional quality, EG is economic growth, Inf is inflation, IR is interest rate, DS indicates debt service, ER denotes exchange rate, and InR represents international reserves and f is a function that takes into account the complex relationship of these variables with external debt. A general equation of the effects of economic and political factors is:

$$\Delta D_{ext} = \alpha + \beta_1 IQ + \beta_2 EG + \beta_3 Inf + \beta_4 IR + \beta_5 DS + \beta_6 ER + \beta_7 InR + \beta_8 (I - S) + \beta_9 (M - X) + \beta_{10} (G - T) + \varepsilon \quad (8)$$

Where α is a constant, β are coefficients attached to each variable and ε is the error term.

Fig. 1. Conceptual Framework: The Three-Gap Model and Institutional Quality.



2.2. Empirical Literature

External debt is an important factor in the economic development of the countries. But the factors that determine the external debt are still a subject of debate

among economists and policy makers. An understanding of the causes and determinants of external debt is essential for the establishment of effective fiscal policies and the promotion of sustainable economic growth. The empirical work is largely concerned with the complex dynamics of external debt accumulation, and it is mainly economic. But the interplay of political and institutional factors has been paid comparatively less attention in the extensive literature on this subject. The majority of existing studies have focused on the determinants of external debt for individual countries using time-series analysis, but there is little research using panel data. Panel studies allow for more generalisable inferences to be made across multiple countries and therefore facilitate the development of generalised policy frameworks (Wooldridge, 2015).

Waheed (2017) in his study on macroeconomic factors affecting external debt, performed panel analysis of 12 oil exporting and 12 oil importing countries. The results showed that economic growth and reserves help to reduce the levels of external debt while deficits, inflation and investments tend to increase it. Similarly, Mensah, et al. (2017) used the VAR estimator and found that domestic borrowing, public investment and consumption expenditure are important determinants that lead to the increase in external debt among 24 African countries while economic growth, inflation and tax revenue have a diminishing impact on the levels of external debt. Furthermore, Abbas & Wizarat (2018) discovered that military spending is a factor in the external debt using the fixed-effect model, while domestic investment and trade have a mitigating effect.

Moreover, Sagdic & Yildiz (2020) by using the PCSE estimation method find that higher public expenditure and debt servicing increase external debt in the economies of Central Asia and the Caucasus. On the other hand, a positive current account balance, low inflation and high domestic savings are related to a decrease in external debt. Waheed & Abbas (2021) investigated the economic determinants of external debt in one oil-exporting and nine oil-importing countries. In oil-exporting countries, external debt levels are mitigated by factors such as economic growth, government revenue, foreign direct investment (FDI) and population size. On the contrary, government spending, trade openness, inflation and current account balance tend to worsen it. However, for oil importing countries, economic growth, government revenue, current account balance, domestic investment and labour force participation are associated with a decrease in external debt. Whereas, FDI and foreign exchange reserves are found to be positively related with external debt.

Dawood, et al. (2021) studied 32 Asian countries for the time period 1995-2019. From the GMM method, the authors found that inflation and economic growth are associated with a decrease in external debt, while trade, government expenditures and exchange rates are associated with an increase in external debt. Similarly, Shaharuddin & Edris (2021) used the Autoregressive Distributed Lag (ARDL) technique to investigate the determinants of external debt from 1870 to 1913 and found that economic growth has a negative impact on external debt while government expenditure positively contributes to the buildup of external debt. Gülcemal (2022) used several dynamic panel methods and found that total external debt is negatively related to economic growth. However, trade openness and the Consumer Price Index (CPI) are positively correlated with the accumulation of long-term foreign debt in six emerging market economies (EMEs) over the period 1990-2019.

Ilhan (2023) investigated the factors of external debt in emerging markets from the first quarter of 2005 to the first quarter of 2020 by applying a panel augmented mean group (AMG). The findings suggest that economic growth reduces external debt while trade openness, inflation and domestic credit increase external debt. Also, Mijiyawa

(2023) used fixed-effect and GMM models and found that economic growth, remittances, and the nominal exchange rate had a significant negative effect on external debt, while fiscal deficits, trade openness, and foreign direct investment were statistically insignificant. Furthermore, Rindi, et al. (2023) estimated a fixed effect model and reported that, across six ASEAN countries from 1997 to 2021, economic growth, inflation, and the exchange rate negatively affect external debt. In contrast, investment and capital withdrawal have a significant positive effect on external debt levels.

A growing body of literature, however, underscores the significance of non-economic factors influencing external debt, including political stability, the quality of institutions, and relationships with creditors. Chiminya, et al. (2018) examine economic and political determinants of external debt of the sub-Saharan African countries, with the focus of trade, economic growth and investment. Their results indicate that democratic regimes tend to accumulate higher debt levels than autocratic ones. This suggests that there is a relationship between the political regime type and debt accumulation. Similarly, the study of Harold (2019) used OLS and MRA regression models. He showed that democracy, political stability, control of corruption and quality of legal frameworks are key factors in determining the dynamics of external debt, especially in African countries in the Franc Zone.

The effect of debt servicing, import levels and growth rates of advanced economies in exacerbating external debt while exports play a mitigating role is explained by Beyene & Kotosz (2020). They also stress the importance of foreign direct investment and political stability in the context of reducing external debt burdens, especially in the case of Heavily Indebted Poor Countries (HIPC)s. Azolibe (2020) investigates the economic and political determinants of external debt in heavily indebted poor countries (HIPC)s. The study examines the main drivers of external indebtedness using static and panel fully modified ordinary least squares (OLS) models on data for 39 HIPC)s over the period 1996-2018. The findings reveal that corruption, dependence on foreign aid, government expenditure, population growth and unemployment rate are the drivers for increase in external debt. Conversely, external reserves and economic growth (GDP growth) hurt debt levels. In a related analysis, Harsono, et al. (2024) look at the determinants of external debt in developing countries in the ASEAN region. Their findings indicate that variables such as the inflation rate, interest rate, and institutional quality exert a negative influence on external debt. In contrast, the exchange rate and trade openness exert a positive influence. Amoh, et al. (2024) used a panel quantile regression analysis on data from 30 Sub-Saharan African economies (2000-2021). They revealed heterogeneous effects across the debt distribution. Increased foreign direct investment (FDI) inflows and trade openness were associated with a rise in external debt. Conversely, corruption exhibited an inverse correlation with debt from the 10th to the 80th quantiles, whereas gross fixed capital formation similarly exerted a debt-reducing influence.

The literature on external debt dynamics has mainly focused on economic determinants, such as growth, fiscal balance, trade and inflation. At the same time, political and institutional dimensions have been relatively under-studied empirically. This narrow focus limits a more holistic understanding of the processes of debt accumulation, especially in contexts where the quality of governance, institutional capacity and political stability have a significant influence on fiscal behaviour and borrowing patterns. Moreover, the bulk of the previous work has been done on African economies, creating a geographical imbalance that ignores the different structural and institutional features of Asian developing and transition economies. With the rapid economic changes, fiscal

decentralisation efforts and changing governance frameworks in Asia, there is a critical need to extend empirical inquiry into the region.

3. RESEARCH METHODOLOGY

This study examines the determinants of external indebtedness using a panel data of 37 Asian developing and transitioning economies (ADTEs) for the period 1997–2020. The sample selection is consistent with the Three-Gap framework (Bacha, 1989) in theory, as these economies usually face savings-investment, foreign-exchange and fiscal gaps that lead to external borrowing. Although the study period was determined by data availability, it fortuitously covers the three major global shocks discussed above, providing natural variation in debt stress. Moreover, the large heterogeneity of the institutional quality of these countries (Harsono, et al. 2024; World Bank, 2024) provides a strong test for governance as an important determinant of debt accumulation. This full sample, constituting 90 percent of developing economies in the region (Appendix Table A1), in turn, provides a robust context in which to investigate external debt in settings where it is structural as opposed to discretionary to development.

The economic determinants were taken from the Economist Intelligence Unit (EIU) country database (2020) and the political and institutional determinants were taken from the Worldwide Governance Indicators (2021). Six variables were used to build a composite index of institutional quality, namely voice and accountability, control of corruption, regulatory quality, political stability, government effectiveness and rule of law. The composite index was derived from principal component factor analysis (PCA) and standardised to a range of –2.5 to 2.5 for ease of comparison. Higher higher scores on this index indicate better institutional quality and lower scores indicate worse institutional quality.

3.1. Model Specification

The study used a panel model to estimate the economic and political determinants of external debt in ADTE as follows:

$$TDPY_{it} = \pi_0 + \pi_1 X_{it} + \eta_i + \lambda_t + \mu_{it} \quad (9)$$

In this framework, TDPY refers to the external debt-to-GDP ratio and is the main dependent variable. X_{it} is the vector of explanatory variables, η_i captures country-specific effects, λ_t represents time-specific effects, and μ_{it} is the idiosyncratic error term that has zero mean and constant variance. The coefficients $\pi_1, \pi_2, \dots, \pi_{11}$ capture the effect of each explanatory variable on external debt, while π_0 is the intercept term. The indices i and t represent, respectively, between 1 and N (countries) and 1 and T (time periods).

$$TDPY_{it} = \pi_0 + \pi_1 RYPH_{it} + \pi_2 PFIN_{it} + \pi_3 PSAV_{it} + \pi_4 PGCE_{it} + \pi_5 TDRA_{it} + \pi_6 XRPD_{it} + \pi_7 DCPI_{it} + \pi_8 EFIR_{it} + \pi_9 TSPY_{it} + \pi_{10} IRGDP_{it} + \pi_{11} IQ_{it} + \eta_i + \lambda_t + \mu_{it} \quad (10)$$

The model above identifies ten economic factors attached to external debt, and they are mainly analysed by empirical research. RYPH is the proxy for economic growth and is defined as real GDP per capita. PFIN shows at the same time the gross fixed capital formation in percent of GDP, which is an indicator of investment. PSAV is Gross National Savings as a percentage of GDP, and PGCE is Government Expenditure as a percentage

of GDP. TDRA represents the trade balance as a share of GDP, and XRPD shows the exchange rate (national currency per US dollar, averaged over the period). DCPI measures the change in the general price level of goods and services in an economy over a period of time and is a proxy of inflation. EFIR, on the other hand, is a proxy for interest rates and measures the actual interest rate charged on loans or earned on investments, including the effect of compounding and other fees. TSPY is the ratio between the external debt service and the country's GDP. IRGDP is the ratio of a country's foreign exchange reserves to its GDP and shows its ability to meet external debt obligations. Finally, IQ is a summary index of political and institutional factors based on governance indicators such as voice and accountability, control of corruption, regulatory quality, political stability, government effectiveness and rule of law.

3.2. Estimation Strategy

The Fixed Effects (LSDV) and bias-corrected Least Squares Dummy Variable Corrected (LSDVC) estimators are commonly used in recent empirical studies addressing the economic and political determinants of public debt because they account for unobserved heterogeneity and dynamic panel bias. The results from these studies suggest the relationship between public debt and sovereign bond yields is non-linear; the cost of borrowing increases sharply once the debt-to-GDP ratio crosses a critical threshold. Moreover, independent fiscal institutions are important for reducing debt risk premiums by encouraging fiscal discipline and market confidence (Pappas & Kostakis, 2020). The quality of governance matters as well for the debt-growth nexus. While high public debt is likely to impair economic growth, good governance mechanisms can mitigate or even reverse this negative impact if the quality of institutions is above a certain threshold (Abbas, et al. 2021). In particular, the LSDVC estimator is useful for dynamic panels with a small number of time periods, since it corrects the small-sample bias of the usual fixed-effects estimators. Previous applications have validated its robustness in evaluating the negative impact of household debt on growth (Samad, et al. 2020), the effect of liquidity on bank lending (Dahir, et al. 2018) and the positive relationship between bank profitability and economic performance in West Africa (Koffi, 2024). In general, the estimators offer robust and unbiased views of the complex interrelationships between debt, governance and macroeconomic stability (Nwakuya & Ijomah, 2017).

Panel data regression models are widely adopted to evaluate the influence of variables like government revenue, expenditure, GDP growth, inflation and debt-to-GDP ratios on fiscal deficits and debt sustainability across countries and time (Mahmood, et al. 2025). To solve the endogeneity problems and simulate the effects of policy shocks, like fiscal expansion, exchange rate volatility and inflation on debt dynamics and macroeconomic stability, many structural macro econometric models with several behavioural equations are estimated with Generalised Method of Moments (GMM) (Fatimah & Haq, 2024). Nonlinear methods like Smooth Transition and Self-Exciting Threshold Autoregressive (SETAR) models are used to evaluate asymmetric responses of debt to macroeconomic fluctuations (Andrić, et al. 2024). Similarly, vector autoregression (VAR) models are employed to examine causal relationships between debt, inflation, and economic growth (Zhuravka, et al. 2023; Li, 2020). Bayesian Model Averaging (BMA) techniques further boost robustness by identifying the most influential political and institutional predictors of debt accumulation (Nagou, et al. 2021). Recent developments also include grouped fixed effects (GFE) and multinomial logit models that allow for heterogeneity in governance structures and regime types, offering a nuanced

understanding of how economic and political dynamics jointly determine public debt sustainability (Gómez-Puig, et al. 2022).

In order to ensure a robust identification, and to address possible econometric problems, we employ a battery of complementary estimators. To account for unobserved time-invariant country characteristics, we first estimate a static panel model using the Fixed Effects (LSDV) estimator, as supported by a significant Hausman test ($\chi^2 = 43.44$, $p\text{-value} = 0.0000$). To correct for potential small-sample bias of this estimator, we apply the bias-corrected LSDV (LSDVC) method developed by Bruno (2005). Moreover, given the persistence of external debt and the possible endogeneity of some regressors, we employ the two-step System GMM estimator (Blundell & Bond, 1998). This dynamic model uses internal instruments, namely the lagged levels from period $t-2$ and earlier for the differenced equation, and the lagged differences for the level's equation. To avoid overfitting we use a collapsed instrument matrix. The validity of these instruments is verified by the Hansen J test ($p = 0.588$), and the absence of second-order serial correlation is supported by the AR(2) test ($p = 0.500$). This multi-pronged approach guarantees the robustness of our findings to estimation techniques and that the estimated determinants of external indebtedness are reliable. The GMM estimator also accommodates heteroscedasticity and autocorrelation in the error structure through a consistent estimator and the inclusion of lagged internal instruments. In this study, instrumental variables are the year dummies with lags (up to 1 or 2 lags) and the lag of the dependent variable of the model in the sample.

4. RESULTS AND DISCUSSIONS

4.1. Descriptive Analysis

Table 1 shows the descriptive statistics of the variables used in the empirical analysis. The average external debt to GDP ratio (TDPY) for the sample is 52.97 percent, implying a large aggregate debt burden. The average values of the main economic variables are investment (PFIN) at 24.76 percent of GDP, national savings (PSAV) at 25.43 percent of GDP, and a marginally negative trade balance (TDRA) of -1.26 percent of GDP. The average of the index of institutional quality (IQ) is negative (-0.43), which is indicative of the governance challenges faced by many developing and transition economies. The high standard deviations and the broad ranges (minimum and maximum values) for most variables highlight the major heterogeneity across the sampled economies and over time. This applies in particular to the exchange rate (XRPD) and the external debt itself (TDPY) from 0.1 percent to 367.67 percent. This large variation is useful for panel data estimation as it enables the identification of the determinants of external debt in different macroeconomic environments.

4.2. Correlation Analysis

One of the most popular statistical measures is the Pearson correlation coefficient. It measures the strength of the relationship between two or more variables, whether that relationship is positive or negative. A correlation coefficient near $+1$ or -1 indicates a strong positive or negative relationship respectively and a coefficient near 0 indicates a weak relationship between the variables. A correlation of 0 means there is no relationship between the variables. The correlation matrix for the variables used in the

model estimation of this section is given in Table 2. In data analysis, it is important to avoid high collinearity between variables to ensure that statistical inferences are unbiased and accurate (Moreno-Brieva, et al. 2019). The matrix indicates that some variables are positively correlated with external debt and others are negatively correlated. Specifically, public consumption, government consumption, effective exchange rate, effective interest rate, and debt servicing ratio are positively related to external debt, while the five determinants of external debt are negatively related to external debt.

Table 1
Definitions and Descriptive Statistics

Variables	Symbol	Definitions	Sources	Mean	Std. Dev.	Min	Max
External Debt	TDPY	Total external debt as % of GDP	EIU	52.97	48.68	0.1	367.67
Economic Growth	RYPH	Real GDP per capita in \$USD	EIU	5.06	4.97	-30.9	34.47
Investment	PFIN	Gross Fixed Capital Formation as % of GDP	EIU	24.76	8.84	1.4	69.67
National Savings	PSAV	Gross national savings as % of GDP	EIU	25.43	13.16	-11.9	66.03
Government Expenditure	PGCE	Government expenditure as % of GDP	EIU	13.98	5.25	3.46	31.75
Trade Balance	TDRA	Trade balance as a % of GDP	EIU	-1.263	19.9	-58.82	54.81
Exchange rate	XRPD	Exchange rate as national currency per US\$, period average	EIU	1641	4586	0.27	42000
Inflation	DCPI	Annual %	EIU	6.94	7.92	-18.97	57.07
Interest Rate	EFIR	Effective interest rate % paid on external debt	EIU	3.29	2.31	0.02	26.1
Debt Service	TSPY	External debt servicing as a % of GDP	EIU	5.71	8.21	0.041	61.54
International Reserves	IRGDP	International reserves as a % of GDP	EIU	21.07	21.49	1.08	132.03
Institutional Quality	IQ	Institutional quality index	WGI	-0.43	0.6	-2	0.94

Source: EIU: Economist Intelligence Unit country database, WGI: World Governance Indicators.

Table 2
Correlation Matrix

Variables	RYPH	PFIN	PSAV	PGCE	TDRA	XRPD	DCPI	EFIR	TSPY	IRGDP	IQ
RYPH	1.000										
PFIN	0.227	1.000									
PSAV	0.163	0.426	1.000								
PGCE	-0.159	0.086	-0.010	1.000							
TDRA	0.066	-0.088	0.586	0.060	1.000						
XRPD	-0.009	0.007	0.077	-0.102	-0.005	1.000					
DCPI	-0.147	-0.144	-0.163	-0.168	-0.109	0.131	1.000				
EFIR	-0.043	0.048	0.153	0.252	0.258	-0.113	-0.132	1.000			
TSPY	-0.041	-0.055	-0.075	0.069	0.078	-0.088	-0.137	0.370	1.000		
IRGDP	-0.039	0.126	0.002	-0.020	-0.020	-0.024	0.125	0.098	0.047	1.000	
IQ	-0.014	0.256	0.398	0.294	0.296	-0.071	-0.474	0.322	0.155	-0.083	1.000

4.3. Estimation and Discussion

A static panel fixed effects (LSDV) methodology is applied in this analysis. We have examined the determinants of external debt in ADTE economies following Hausman test. Abbas, et al. (2021) and Bittencourt (2015) support this approach as the most reliable and efficient estimator among static panel models to estimate the equation 10. The results in Table 3 provide useful insights from the panel fixed effects (LSDV) and the bias-corrected LSDVC estimates. Our analysis shows a significant relationship between economic growth (RYPH) and external indebtedness which is in line with established economic theories. In particular, developing countries with high income or rapid economic growth tend to have higher national saving and investment. These countries have high income levels and can invest their savings, so they are better able to meet their external debt obligations. This shows the crucial role of economic activity in reducing external debt ratios and so allowing the rate of accumulation of external debt to be reduced. For instance, the static panel FE (LSDV) and LSDVC models imply that an increase of one dollar in economic growth is associated with annual decreases of 0.13 percent and 0.21 percent in external debt, respectively. The analysis of the growth model also shows that the interaction of consumption and income can give rise to two different outcomes. In the first case when income is greater than consumption savings increase, this means that savings can be invested or used for consumption later and this increases the ability to service debt and reduces dependence on external borrowing. On the contrary, high consumption and low income leads to low savings. In this situation, the country may have to depend on external financing or aid. The results of our study are in line with the findings of Shaharuddin & Edris (2021); Dawood, et al. (2021); Mijiyawa (2022); Gulcemal (2022) and Ilhan (2023) that economic growth has a negative impact on the accumulation of external debt.

Investment and savings are key determinants of external debt and their variations greatly affect external debt levels. The difference between investment and savings may result in an increase or decrease in the accumulation of external debt. If there are excess domestic savings in the economy, it can finance investment without recourse to foreign funding and hence avoid the build-up of external debt. Or, when the desire to invest is greater than the available domestic savings, economies may resort to borrowing from abroad to fill the gap. Empirical evidence from the Fixed Effects (LSDV) and LSDVC models provides that developing economies are likely to resort to external financing in the event of a savings shortfall. The analysis shows that for every 1 percent increase in

investment, the external debt increases by 2.1 percent and 0.25 percent. In contrast, a 1 percent increase in savings is associated with a 0.12 percent and a 0.21 percent reduction in external debt. Sagdic & Yildiz (2020) have found similar results on the negative impacts of domestic savings on external debt. Rindi, et al. (2023) have found similar results as well showing a positive relationship between investment and external debt. The dynamics of external debt accumulation, and in particular the interaction of savings and foreign exchange constraints, is better understood in comparison with the dual gap model of Chenery & Strout (1966). The model argues that borrowing is warranted when there is a difference between domestic savings and investment. The savings-investment gap theory posits that in the absence of adequate savings, economies can resort to borrowing to meet investment needs and spur growth. Economies are often left with no other option but to borrow from abroad in case of imbalances in domestic savings-investment gap. Developing economies, in general, tend to have limited capacity to finance the investments required to achieve targeted rates of growth out of domestic savings. The absence of domestic savings, often forces these economies to seek external financing, thus helping to increase the level of debt.

One of the most important determinants of external debt is government expenditure. If the government increases its spending without a similar increase in revenue, it will run a budget deficit. This means that the government will be forced to look for external sources of finance to cover its budget deficit and other short-term financial needs. The coefficient attached to government consumption has a positive association with external debt. That is, a 1 percent increase in government consumption respectively leads to 0.86 percent and 0.086 percent increase in external debt. Empirical studies have consistently shown a positive relationship between government expenditure and external debt, supporting our findings (Waheed, 2017; Adamu, 2019; Beyene & Kotosz, 2020; Mahara & Dhakal, 2020).

The trade balance, the difference between a country's imports and exports, is a critical factor in external debt accumulation. If we take the trade balance as a percentage of Gross Domestic Product (GDP), an increase in this ratio means less external debt. Moreover, a trade surplus leads to large inflows of foreign currency, particularly dollars, boosting domestic capital and savings and thus reducing dependence on foreign financing. Conversely, a trade deficit, which is characterised by low exports, forces an economy to seek external financing to pay for its imports, as high imports require more currency. Table 3 shows that the trade balance coefficient suggests that a 1 percent increase in the trade balance leads to a decrease of 0.12 and 0.10 percent in the accumulation of external debt, respectively. These results are consistent with the work of Butkus & Seputience (2018) and Beyene & Kotosz (2020). Even though other studies have found trade openness to be a determinant (Amoh, et al. 2024), it is worth noting that the trade-to-GDP ratio is an effective measure of how this gap contributes to external debt accumulation, in line with gap models.

Differential in exchange rate between the local currency and the US dollar (USD) is important in affecting the level of external debt. If the domestic currency appreciates relative to the USD, then the external debt ratio falls. A depreciation of the domestic currency (an increase in the exchange rate) means that the external debt ratio rises. This is due to the fact that the gross domestic product (GDP) is calculated in local currency and then converted into USD at the current rate. So if the exchange rate goes up, the GDP in USD decreases, while the external debt is still in USD. Hence, the relationship between exchange rate and external debt ratio is significantly positive with the positive coefficient of exchange rate. Ozata (2017) and Dawood, et al. (2021) researches support

a positive relationship, as a 1 percent increase in the exchange rate leads to an increase in external debt by 4.66 percent and 0.22 percent.

There are several factors influencing the relation between the inflation rates and the external debt. Moderate inflation can help local economic growth, which can in turn help reduce the foreign debt as the economy grows. On the other hand, high inflation rates may impede economic growth, leading to insolvency, a fall in real GDP and a drop in the standard of living, all of which may reduce the capacity to service foreign debt. Holders of external debt usually want to be paid in a stable currency (e.g., the US dollar). Thus, countries have to increase their export activity, attract foreign direct investment, or both. The relationship between inflation and external debt also depends on the currency denomination of the debt, which is frequently the US dollar. If domestic inflation and the purchasing power parity (PPP) principle are at play, countries may have higher domestic-currency costs for interest payments and debt repayment. The case establishes a positive correlation between inflation and external debt as evidenced by the positive coefficient of inflation. The LSDV model indicates that an increase of 1 percentage point in inflation is associated with an increase of 4.74 percentage points in the external debt. In addition, inflation has a significant impact on external debt in large-scale debt-vulnerable countries (LSDVC), where a one percentage point increase in inflation leads to a 0.03 percentage point rise in external debt. The positive relationship between inflation and external debt is particularly significant in economies operating under fixed exchange rate regimes (Waheed, 2017). Under these conditions, increasing inflation exerts pressure on the exchange rate and necessitates the need for foreign exchange to keep rates fixed. This can only be done by taking foreign loans, thus leading to the build-up of external debt.

In gap models, the effective interest rate is a key factor affecting external debt, and it is a measure of the cost of external borrowing. In developing countries, it is the standard to borrow in U.S. dollars, which are subject to swings in international capital markets. Higher interest rates mean higher costs of debt, thus there is a positive relationship between the effective interest rate and the level of external debt. The coefficient attached to the interest rate is positive so that a change of one percentage point in the effective interest rate is associated with an increase in the external debt of 0.96 and 0.83 percentage points respectively. This correlation is empirically supported by Vighneswara (2015). Harsono, et al. (2024) find a negative relationship between interest rates and external debt accumulation.

Debt service, consisting of principal and interest payments due at maturity, exerts a substantial influence on external debt in developing economies. Such economies generally have difficulties in servicing their debts and pay more in debt service than they can afford. In some cases they may even resort to taking on additional debt to service existing debt thereby creating a positive correlation between debt servicing and the accumulation of external debt. The analysis shows that a 1 percent increase in debt servicing is associated with 3.65 percent and 0.02 percent increase in external debt accumulation respectively. This finding is in agreement with the findings of Beyene & Kotosz (2020) and Sagdic & Yildiz (2020).

Moreover, even though they are incorporated into the theoretical framework, international exchange reserves are a crucial variable that scholars often ignore in the analysis of the determinants of external debt. The present study confirms the results of Wahyuni, et al. (2019) that international reserves and external debt accumulation have a positive relationship. In particular, the coefficient on reserves is positive, implying that a 1 percent increase in international reserves is associated with an increase in external debt accumulation of 1.80 and 0.01 percent, respectively. These results were in line with the

results of Waheed & Abbas (2021) but were not in line with the results of Waheed (2017); Azolibe (2020) and Chiminya, et al. (2018).

The results show that institutional quality has a significant negative impact on external debt accumulation, implying that an improvement in institutional quality is associated with a decline in external borrowing. In particular, economies with low levels of corruption, political stability and effective governance are better able to channel the resources they have to productive sectors, thus reducing the need for more debt. The results show that one unit increase in the institutional quality is associated with a decrease in external indebtedness by 0.5 percent and 0.4 percent from the LSDV and LSDVC estimation respectively. The results are in line with the studies of Harold (2019); Beyene & Kotosz (2020); Harsono, et al. (2024) and Amoh, et al. (2024).

Table 3
Least Squares Dummy Variable and Bias-Corrected LSDV

Variables	Fixed Effect (LSDV)			Bias-Corrected (LSDVC)		
	Coef.	Std. Err.	Sign	Coef.	Std. Err.	Sign
ln-TDPY	-	-	-	0.953	0.016	***
RYPH	-0.128	0.080	**	-0.207	0.086	***
PFIN	2.080	1.882	**	0.249	0.023	***
PSAV	-0.119	0.064	**	-0.206	0.076	**
PGCE	0.855	0.259	**	0.086	0.165	**
TDRA	-0.131	0.061	**	-0.033	0.026	**
XRPD	4.747	1.657	***	0.027	0.008	***
DCPI	0.248	0.068	***	0.236	0.087	***
EFIR	0.964	0.250	***	0.834	0.221	***
TSPY	3.648	0.920	***	0.017	0.016	*
IRGDP	1.802	0.685	**	0.001	0.001	***
IQ	-0.468	0.724	**	-0.383	0.541	**
Constant	-13.503	5.681	***	-	-	-
Hausman test. chi2(6)	43.44			Prob>chi2=		
=				0.0000		
R-squared	0.549			Number of obs		
F-test	7.736			851.000		
				Prob > F		
				0.000		

Note: Dependent variable TDPY: Total external debt to GDP; LTDPY: Lag of TDPY; *, **, and *** represent significance at 10 percent, 5 percent, and 1 percent, respectively.

4.4. Diagnostic Tests and Robustness Check

The study employs a two-step generalised method of moments (GMM) to ensure robustness of its empirical findings. As shown in Table 4, the GMM estimates are consistent with the fixed-effects model (LSDV) and the LSDVC in terms of the direction and statistical significance of the coefficients. However, the GMM coefficients are generally larger than those obtained from the LSDV model. The analysis also reveals a significant positive coefficient for the lagged dependent variable (external debt), indicating that external debt is persistent among the selected developing and transitioning economies in Asia. Results also reveal a significant negative relationship between economic growth and external debt at 1 percent level of significance which implies that increase in economic growth leads to decrease in external debt. In particular, a 1 percent increase in economic growth causes a 0.40 percent reduction in external debt as also identified by previous studies (e.g., Waheed & Abbas, 2021; Dawood, et al. 2021; Azolib, 2022; Ilhan, 2023). The coefficients of investment and savings also have opposite signs as expected in the context of the savings-investment gap. Higher savings reduce external debt, while higher investment leads to its accumulation. These results corroborate those

reported in Table 4 and are in agreement with previous studies by Waheed (2017), Chiminya, et al. (2018); Sagdic & Yildiz (2020); Waheed & Abbas (2021) and Amoh, et al. (2024).

The GMM results show a strong positive relationship between external debt and government expenditure. The regression coefficient indicates that 1 percent increase in government expenditure results to 9.81 percent increase in external debt other things being equal. This result indicates that increased government spending without proper financing will lead to increased borrowing which will worsen the level of external debt. On the contrary, the results reveal a significant negative relationship between the trade balance and external debt revealing that an increase in trade to GDP ratio reduces the accumulation of external debt. In more specific terms, a one percentage point improvement in the trade balance results in a 0.20 percentage point reduction in external debt. This is logical as a trade surplus, where exports exceed imports, enables the spending gap to be financed by export earnings rather than borrowing. These results are consistent with Chiminya, et al. (2018) but contradict the findings of Vighneswara (2015) and Belguith & Omrane (2017).

The results indicate a positive statistically significant Relationship between the exchange rate and external debt. The coefficient indicates that 1 percent increase in exchange rate results in 6.07 percent increase in external debt. This result shows higher exchange rates mean a weaker domestic currency and that more local currency is needed to service foreign debt. Importantly, this result from the Generalised Method of Moments (GMM) analysis is consistent with the results of the baseline model. This evidence supports the earlier work of Harsono, et al. (2024) but disagrees with the work of Mijiyawa (2023) and Rindi, et al. (2023) and highlights the challenges that external debt presents to developing economies, especially those that have floating exchange rate regimes, open capital accounts and more involvement in global financial markets. As foreign currency borrowers, such economies have historically been vulnerable to external shocks. For example, in the event of commodity price collapses, external debt obligations are generally serviced from export revenues or other income flows. However, the influence of exchange rate fluctuations on export performance and external debt burdens may be inconsistent. The depreciation of the local currency against major currencies can increase export earnings if the volume of exports is sufficient to offset the decrease in local prices in dollar terms. But it also raises the local value of foreign-currency-denominated debt.

The empirical results reveal a significant positive relationship between inflation and the external debt as indicated by the LSDV and LSDVC coefficients. For example, a 1 percent rise in inflation is linked to a 0.15 percent increase in external debt. The effective interest rate is another important determinant, and it has a positive coefficient in the main estimator, implying that a one percentage point increase in the effective interest rate results in an increase of 1.53 percentage points in external debt. Moreover, the study finds debt servicing to be an important factor. The result shows that the more the borrowing, the more the debt servicing obligation, thus contributing to the rise in external debt. Moreover, positive coefficients on international reserves indicate that a 1 percent increase in reserves leads to a 3.11 percent increase in external debt. Also worth noting are the outcomes of the Generalised Method of Moments (GMM) estimation which corroborate

the findings of the LSDV and LSDVC models further strengthening the robustness of the analysis.

Table 4
Generalised Method of Moments Results

Variables	System GMM		
	Coef.	St.Err	Sign
TDPY	0.987	0.018	***
ln-TDPY	-0.397	0.043	***
RYPH	8.224	1.845	***
PFIN	-0.075	0.069	**
PSAV	9.810	4.291	***
PGCE	-0.199	0.064	***
TDRA	6.065	1.866	***
XRPD	0.149	0.035	***
DCPI	1.528	0.147	***
EFIR	3.160	0.470	***
TSPY	3.112	0.638	***
IRGDP	-0.435	0.457	**
IQ	-51.989	13.045	***
Constant			
Number of obs 851 No. Of the 37 countries. of instr 36 AR (2) [Pr0] 0.500 Hensen [Pro] 0.588			

Note: Dependent variable TDPY: Total external debt to GDP; LTDPY: Lag of TDPY; *, **, and *** represent significance at 10 percent, 5 percent, and 1 percent, respectively.

Moreover, the robust estimator results for institutional quality are consistent with the main estimation results. However, the credibility and consistency of the generalised method of moments (GMM) results are based on the validity of the used instruments and the absence of second-order autocorrelation (AR[2]). The tests used to check these assumptions are provided in the result section of Table 4 and suggest that the model is free of higher order autocorrelation and the instruments are valid. The p-values of the AR(2) test and Hansen J test for instrument validity are also above the conventional 5 percent significance level, which further indicates the robustness of the model. Thus, the results of the study are robust and can be used to inform policy-making. We conducted a battery of diagnostic tests to check the validity of our empirical strategy. Heteroskedasticity (Modified Wald test: $\chi^2 = 357.42$, $p < 0.001$) and cross-sectional dependence (Pesaran's test: $CD = 2.34$, $p = 0.019$) were found to be present in the data, which justified the use of robust estimation techniques. The Shapiro-Wilk test rejected normality of residuals ($W = 0.89$, $p < 0.01$), but our large sample size guarantees the asymptotic validity of our estimators. Variance Inflation Factors (mean $VIF = 2.17$) ruled out multicollinearity. Finally, Ramsey's RESET test ($F=1.24$, $p=0.292$) provided no evidence of model misspecification.

5. CONCLUSION AND POLICY IMPLICATIONS

This study investigates the economic and political determinants of external debt of Asian developing and transitioning economies (ATDE) for the period 1997–2020. This work adopts a mixed-method approach by combining panel fixed-effects (LSDV), bias-corrected LSDV and system GMM estimations to capture short- and long-term dynamics.

The bias-corrected LSDV estimator improves the efficiency of the estimation by correcting for the small sample bias that is present in the standard fixed effects models. At the same time, the system GMM approach further confirms the robustness of the results by alleviating the potential endogeneity and dynamic panel bias. Empirical evidence suggests that higher economic growth, higher national savings, favourable trade balances and stronger institutional quality are associated with lower external debt ratios. This highlights the ability of emerging economies with sound governance systems to mobilise internal resources, to enhance fiscal discipline and to reduce reliance on external financing.

Higher levels of external debt, on the other hand, are associated with increased investment, higher government consumption, inflationary pressures, exchange rate volatility and increased debt servicing costs. Such factors are pointers to the inherent weaknesses in fiscal management and macroeconomic stability. It implies that where domestic fiscal capacity is weak, the government resorts to external borrowing to fund both developmental and recurrent expenditures. External debt is also positively correlated with interest rates, reflecting the burden of debt servicing that can crowd out productive spending and slow long-term growth. The findings highlight the importance of macroeconomic stability, institutional integrity, prudent fiscal governance and policies for domestic resource mobilisation and external sector competitiveness for sustainable debt management. External financing is crucial to foster growth in developing economies. However, excessive dependence on foreign debt may result in crises associated with debt servicing, economic instability, risks of sovereign default, macroeconomic imbalances and long-term social and financial consequences. Driven by historical crises such as oil shocks, financial crises and the disruptions caused by the COVID-19 pandemic, these economies have become more dependent on external resources and have renewed the scholarly focus on the sustainability of external debt.

The policy implications of this study suggest that sustainable debt management in Asian developing and transition economies would require a balanced focus on economic and political determinants of external indebtedness. The findings highlight that fiscal and macroeconomic reforms will not be sufficient if institutional weaknesses and governance challenges and political instability keep eroding fiscal discipline. Thus policy-makers need to follow a comprehensive strategy for increasing national savings, promoting export diversification and enhancing fiscal transparency. These measures can help countries reduce their reliance on external borrowing by improving the efficiency of public spending, broadening the domestic revenue base and enhancing accountability in debt management institutions. Furthermore, fiscal expansion in the post-COVID-19 recovery needs to be balanced with long-term debt sustainability by prioritising productive investments in infrastructure, education and digital capacity that deliver economic returns. Strengthening governance frameworks and tackling politically motivated borrowing are equally important to avoid debt-driven vulnerabilities. Institutional reforms that promote transparency, rule-based fiscal policies, and independent debt oversight mechanisms can increase investor confidence and lower risk premiums. Hence, addressing structural and governance-related constraints can assist countries in developing a more resilient fiscal framework that can help them to manage external liabilities and support inclusive and sustainable economic growth in line with the core objectives of the study.

Table A1

List of Asian Economies

Transitioning Economies	Developing Economies		
Azerbaijan	Bahrain	Malaysia	Sri Lanka
Kazakhstan	Bangladesh	Maldives	Thailand
Kyrgyz Republic	Bhutan	Myanmar	United Arab Emirates
Tajikistan	Fiji	Nepal	Yemen
Turkmenistan	India	Oman	
Uzbekistan	Indonesia	Pakistan	
Cambodia	Iran	Papua New Guinea	
China	Jordan	Philippines	
Laos	Korea	Qatar	
Mongolia	Kuwait	Saudi Arabia	
Vietnam	Lebanon	Syria	

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Technocratic Dreams, Political Realities: Evaluating Full Reserve Banking for Pakistan

ASAD ZAMAN

This paper critically examines a recent proposal advocating full-reserve banking in Pakistan, inspired by modern revivals of the Chicago Plan. While such proposals are motivated by legitimate concerns about financial instability, excessive debt creation, and the social consequences of private money creation, the paper argues that they are best understood as institutional power-sharing arrangements rather than purely technical reforms. Using a historical–institutional methodology, the analysis examines the causal mechanisms through which monetary systems evolve and the political constraints shaping reform feasibility. Drawing on historical experience in Pakistan and international cases—including Japan’s window guidance system and China’s state-led financial institutions—the paper shows that proposals such as full reserve banking typically require a rare balance of power between governments, financial institutions, and external actors. In Pakistan’s current institutional context, where domestic financial interests and IMF programmes constrain monetary sovereignty, such conditions are unlikely to emerge. The paper therefore proposes a set of more feasible reform pathways, including credit guidance, development of finance mechanisms, and greater transparency in credit allocation. It also argues that deeper reforms may gain political traction when framed within Pakistan’s constitutional commitment to Islamic finance, which provides a powerful source of social legitimacy for monetary reform. More broadly, the paper illustrates how historical and institutional analysis can be used to evaluate counterfactual policy proposals that cannot be analysed using conventional data-driven empirical methods.

JEL Classification: E42, E58, P16, B41, O17.

Keywords: Full Reserve Banking, Monetary Sovereignty, IMF Conditionality, Political Economy of Finance, Pakistan.

1. INTRODUCTION

In response to the persistent economic instability afflicting Pakistan—inflation, public debt, financial exclusion, and repeated banking crises—Qanit Khaleelullah & Sohaib Umar (2026) have proposed the adoption of a full reserve banking system. Their proposal—referenced as QK-SU hereafter—is rooted in a desire for financial justice and macroeconomic stability. It draws upon modern revivals of the Chicago Plan, a 1930s-era blueprint that sought to eliminate private banks’ ability to create money and assign this role solely to the state (Phillips, 1995). The proposal reignites an important debate about sovereign monetary authority, central to broader global explorations of reform in the aftermath of the 2008 Global Financial Crisis (GFC).

Far from being an isolated or uniquely local intervention, QK-SU’s proposal sits at the tail end of a global wave of interest in sovereign money systems. This renewed

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interest was sparked by the systemic failures of financial deregulation exposed during the GFC, which severely damaged the ideological credibility of mainstream monetary systems. Key contributions include the New Economics Foundation's *Creating New Money* by Huber & Robertson (2000), Benes & Kumhof's (2012) IMF paper, *The Chicago Plan Revisited*, Cooley's *Currency Wars* (2008) on monetary sabotage and warfare, and Sigurjonsson's (2015) report commissioned by Iceland's Prime Minister proposing sovereign money reform. These works collectively argue that the unchecked power of private banks to create money lies at the root of modern financial fragility, inequality, and state fiscal weakness. My own contribution, *Islamic Banking after Financial Crises* (2020a), supplements the sovereign money idea by adding elimination of interest, to make it conform to Islamic principles.

Critically, however, the resurgence of full reserve proposals must be understood not just in technical or ethical terms, but in light of the global political economy of monetary power. As I argued in *The Battle for the Control of Money* (Zaman, 2016), the history of money is marked by an enduring struggle between the state and private financial institutions over control of money creation. When governments hold a dominant position, they opt for outright nationalisation of banks. When financial institutions dominate, they firmly resist any constraints on their credit-creating powers. Full reserve banking thus emerges as a compromise—a power-sharing agreement, viable only in rare moments when neither side can fully impose its will. The Chicago Plan was precisely such a compromise, with its chief proponent, Irving Fisher (1936, p. 15), stating: “*In short: nationalise money, but do not nationalise banking.*” The fact that full reserve systems have never been implemented—even though banks have often been nationalised—is not an accident, but a reflection of how fragile and transient the conditions required for such a compromise truly are.

In the sections that follow, this paper critically assesses the QK-SU proposal by first summarising its main features, then situating it within the historical evolution of monetary reform, and finally explaining why it is politically unworkable in Pakistan's present institutional setting. It concludes by outlining more pragmatic alternatives grounded in both international experience and Pakistan's own historical and political realities.

The central methodological premise of the paper is that monetary systems are not merely technical devices for managing macroeconomic aggregates; they are political and moral institutions shaped by struggles over power, legitimacy, and public purpose. For that reason, the analysis developed here is historical, institutional, qualitative, and explicitly normative. The following section explains why this approach is necessary for the question at hand, and why the standard data-driven methods that dominate contemporary economics are not sufficient for analysing the feasibility of a monetary regime that has never been implemented. Thus, in addition to evaluating the full-reserve banking proposal, the paper also illustrates the usefulness of a historical—institutional methodology for addressing policy questions that cannot be resolved through conventional data-driven empirical methods.

2. MECHANISM-BASED CAUSAL INFERENCE AND HISTORICAL INSTITUTIONAL ANALYSIS

The question examined in this paper—whether a full-reserve banking regime could be implemented and sustained in Pakistan—is a question of institutional feasibility. It asks whether a particular monetary arrangement could realistically be created and maintained

within Pakistan's political and administrative system. Answering such questions requires counterfactual reasoning: we must consider what would happen if such a regime were introduced and whether the conditions necessary for its survival actually exist. Because the regime under discussion has never been implemented in the proposed form, the question cannot be addressed by comparing observed outcomes across different systems. For the same reason, the standard empirical strategies of modern economics—based on statistical analysis and regression estimation—cannot be applied directly. Instead, the analysis must examine the causal processes through which monetary institutions evolve and the power relations that shape their adoption and survival.

This section explains the methodological approach used in the paper. It proceeds in three steps. First, it explains the close connection between causality and counterfactual reasoning, a point emphasised in recent work on causal inference in econometrics. This literature clarifies that statistical methods such as regression do not reveal causal structure on their own; they operate under causal assumptions introduced—often implicitly—through theoretical reasoning and knowledge of how the data are generated. Second, the section introduces mechanism-based causal inference, drawing on the work of Heckman and Pinto, which emphasises that causal explanation requires understanding the mechanisms producing observed outcomes. Third, it explains how historical and institutional analysis can reveal such mechanisms, especially when the institutional arrangements under study have not yet been observed. The final subsection describes the kinds of evidence used in the analysis that follows.

2.1. Causality and Counterfactual Reasoning

To say that X causes Y is to claim that if X had not occurred, Y would have been different. Consider a familiar example: does additional schooling increase earnings? To answer this question, we would need to know what a person's wages would have been if a high school graduate had gone on to college. The causal claim therefore requires a counterfactual comparison between the wages we observe and the wages that would have been earned if the person had received more education.

Recent work in econometrics has clarified this point. Modern research on causal inference, especially associated with Angrist & Pischke (2009), emphasises that causal questions are inherently counterfactual: they ask what would happen under an alternative intervention. This insight has an important implication. Statistical methods such as regression do not discover causal relationships on their own. Instead, they estimate the size of a causal effect after the researcher has already made assumptions about the causal structure of the problem. Regression can measure the magnitude of an effect, but it cannot determine whether X causes Y . That judgment must come from theoretical reasoning and knowledge of the processes generating the data—an insight now widely recognised among econometricians, though not yet fully reflected in popular textbooks.

In regression models, economists typically describe some variables as exogenous and others as endogenous. The exogenous variables are treated as causes, while the endogenous variables are outcomes determined within the system being studied. The critical point—rarely stated clearly—is that this causal structure is assumed, not discovered by the regression itself. The data alone do not determine which variables must be treated as causes and which as outcomes. Researchers choose this structure when specifying the model, usually guided by economic theory and institutional knowledge. Statistical analysis can then estimate the magnitude of causal effects once the causal

structure has been specified, but it cannot establish that structure on its own (Heckman & Pinto, 2021).

Modern causal methods make this logic explicit. As the philosopher of science Nancy Cartwright has put it: “no causes in, no causes out.” Statistical analysis cannot produce causal conclusions unless causal assumptions have already been introduced into the analysis. Randomised experiments illustrate this clearly. When treatment is assigned by a coin flip, researchers assume that the outcome of the flip is not caused by any factors related to the experiment. Similar assumptions underlie other causal methods such as instrumental variables or regression discontinuity designs. In every case, causal inference becomes possible only when the researcher can argue that the observed variation in the supposed cause is generated by a causal mechanism that is independent of the outcome being studied.

2.2. Mechanism-Based Causal Inference

Consider the causal claim that increases in the money supply raise prices. The natural question is how this occurs. One possible mechanism is:

Central bank creates money → governments increase spending or banks expand credit → household income rises → spending increases → excess demand emerges → prices rise.

This sequence traces the process through which monetary expansion can affect prices. Importantly, the steps in this mechanism do not come from statistical data. They reflect knowledge about how monetary institutions operate and how households and firms respond to changes in income and credit. Understanding the mechanism also clarifies what a regression coefficient on money represents. A statistical estimate of the effect of money on prices summarises the combined influence of several links in this causal chain. Changes in any part of the mechanism—such as government fiscal policy or how households respond to income—can strengthen or weaken the observed relationship.

This emphasis on mechanisms also appears in modern work on causal inference in econometrics. Heckman & Pinto (2021) argue that causal analysis ultimately requires knowledge of the data-generating process—the real-world processes that produce the outcomes observed in the data. Statistical methods can summarise patterns in the data, but interpreting those patterns causally requires understanding the mechanisms that generate them. Econometric models therefore do more than summarise statistical relationships; they attempt to represent the causal processes operating in the real world. As Heckman & Pinto emphasise, specifying such models requires scientific knowledge about institutions, policies, and behavior. Without this knowledge, statistical relationships alone cannot establish causal conclusions.

In this paper, historical and institutional analysis is used to identify the causal mechanisms shaping monetary institutions and thereby enable the counterfactual analysis required to answer the central question under study.

2.3. Historical–Institutional Analysis of Causal Mechanisms

Historical–institutional analysis investigates causal mechanisms by tracing how economic decisions are made and implemented within specific institutional settings. Instead of treating policies as abstract variables, it examines the processes through which governments, financial institutions, and other actors interact to produce economic outcomes. Historical records—such as policy debates, central bank documents, legislative discussions, and institutional reports—often reveal the motivations, constraints, and strategies of the actors involved. Such evidence allows researchers to follow the sequence

of decisions and responses linking policies to outcomes. In this way, historical analysis makes it possible to reconstruct the mechanisms through which economic change occurs.

In the context of monetary reform, the relevant mechanisms are institutional and political. They include the allocation of authority over money creation, relationships between governments and banking systems, the administrative capacity of the state to implement reforms, and the influence of external actors such as international financial institutions. These mechanisms shape whether proposed reforms can be implemented and sustained. The analysis that follows therefore focuses on identifying the institutional processes through which monetary systems are created, maintained, and contested. By examining these processes in the Pakistani context, the paper evaluates whether the institutional conditions required for a full-reserve banking regime plausibly exist.

By tracing these institutional processes, historical analysis can reconstruct the causal mechanisms through which monetary institutions evolve.

2.4. What Counts as Evidence in This Paper

Within this methodological framework, causal claims are evaluated through triangulation—that is, by examining the same causal mechanisms using several different kinds of evidence rather than relying on statistical tests of an unobserved regime. Because the question concerns the feasibility of institutional reform rather than the measurement of parameters, the analysis draws on several complementary forms of evidence.

- Historical reconstruction of how monetary and banking institutions emerged in response to political and fiscal pressures, rather than as purely technical solutions to problems of economic optimisation.

- Comparative institutional reasoning, using near analogues—such as crisis-era reform proposals, episodes of credit guidance, or banking nationalisations—to clarify the political and institutional conditions under which large-scale financial reforms become feasible.

- Interpretive political economy, examining mechanisms of resistance and compliance within the financial system, including rent channels, legal constraints, credibility concerns, and external conditionalities.

- Explicit normative analysis, recognising that monetary constitutions inevitably involve distributive and ethical choices even when presented as purely technical issues (Myrdal, 1953; Hausman & McPherson, 2006).

Taken together, these forms of evidence enable the counterfactual analysis required to evaluate the coherence and plausibility of the causal mechanisms through which monetary reforms might be implemented and sustained.

3. FULL RESERVE BANKING: A FAMILY OF PROPOSALS

Proposals to eliminate private banks' ability to create money and vest that power exclusively in the state have resurfaced repeatedly since the Great Depression. Known collectively as *full reserve banking* or *sovereign money* proposals, they constitute a diverse family of reform ideas aimed at severing the link between money creation and private lending. In what follows, the central question is whether such a system could be implemented and sustained within Pakistan's historically evolved institutional constraints. As explained in Section 2, answering this question requires counterfactual reasoning about institutional feasibility.

Although QK-SU have recently advanced such a proposal for Pakistan, their version is one among many. Most modern iterations trace their lineage to the Chicago

Plan, developed in the 1930s by economists such as Henry Simons & Irving Fisher. More recent versions include the Iceland Sovereign Money Proposal Sigurjonsson (2015), Benes & Kumhof's (2012) simulation-based update of the Chicago Plan (2012), the UK's Positive Money initiative, and various contributions from heterodox economists and think tanks, such as Huber and Robertson's *Creating New Money* (2000).

A useful clarification is that not all heterodox traditions interpret this revival in the same way. Modern Monetary Theory (MMT), along with the broader "endogenous money" tradition, agrees with the descriptive claim that commercial banks create deposits in the act of lending; but it rejects the inference that this fact alone explains instability or that eliminating deposit creation is the master key to monetary reform. In this view, the decisive causes of crisis lie in deregulation, asset-speculation, and the transformation of banks into shadow-banking entities, not in the basic accounting fact that loans create deposits. Hence, several MMT contributors have been openly critical of "sovereign money" proposals advanced in the wake of the GFC, including the Icelandic proposal, arguing that the relevant policy task is to discipline and reorient credit through institutional design, regulation, and public purpose—not to imagine that a technical redesign of the payments-credit boundary can substitute for political control over finance. For deeper discussion, see Mitchell (2015a, 2015b).

Returning to the Full Reserve Proposals, these fall into two main categories:

1. Centralised Sovereign Money Models –
These involve a new public institution, such as a *Money Creation Committee*, which creates new money based on macroeconomic needs. Private banks are prohibited from creating money but may lend using funds obtained from savers or central sources.
2. Dual-System or "Narrow Bank" Models –
In these systems, full reserve institutions hold transaction accounts with 100 percent reserves, while separate investment banks handle lending using time deposits. This creates a legal and operational firewall between payments and credit.

In both frameworks, the defining goal is to restore public control over the quantity of money in circulation, while still allowing credit allocation to remain in (regulated) private hands. The technical architecture of these proposals varies significantly across jurisdictions, but all rely on institutional innovations that distance money creation from private profit motives.

Although the proposals differ in design, one commonality runs through them: they attempt to correct the problems of private money creation—including instability, excess debt, and asset bubbles—without resorting to outright nationalisation. The complexity of the entire family of proposals leads to the natural question: Isn't there a simpler and more transparent way to achieve these goals? What is the magic ingredient within these complex technical proposals which makes them produce the claimed miracles? These questions are important, and we will return to them later, when we evaluate these proposals in greater depth by examining the institutional mechanisms through which monetary systems actually operate.

4. WHAT THE PROPOSAL GETS RIGHT

While this paper offers a structural critique of full reserve banking proposals, it is important to acknowledge their significant ethical and systemic appeal. These proposals are motivated by a powerful dissatisfaction with the current financial system—one that

concentrates wealth, amplifies economic volatility, and undermines democratic control over money creation. In this respect, QK-SU's proposal, like others in this tradition, emerges from a deeply felt concern for justice, transparency, and macroeconomic stability. Because proposals of this kind arise from ethical concerns about justice and the public control of money, evaluating them necessarily involves normative reasoning in addition to institutional analysis.

Technically, full reserve banking offers a compelling alternative to the fractional reserve system. One of the most influential defenses of this system is found in Benes and Kumhof's (2012) *The Chicago Plan Revisited*, a simulation-based study published by the IMF. Using a DSGE model calibrated to the U.S. economy, they argue that full reserve banking would:

- Eliminate bank runs,
- Reduce both public and private debt,
- Improve monetary control and macroeconomic stability,
- Lower inflation volatility, and
- Increase long-term output and employment.

These projections have played a key role in the revival of interest in sovereign money systems and provide a sense of technocratic credibility to proposals that might otherwise be dismissed as utopian.

Beyond modeled benefits, many full reserve proposals also reflect a valuable institutional insight: that money creation and credit allocation should be functionally separated. The government may be well positioned to manage the money supply in line with the public interest, but it is typically not equipped to evaluate credit risk or allocate loans efficiently. The private sector, with its localised knowledge, competitive pressures, and risk-bearing incentives, is often better suited to perform this function.

Historical experience reinforces this point. In the 1970s, Pakistan's nationalised banking system frequently blurred the lines between political loyalty and financial creditworthiness. Lending decisions were often shaped more by political affiliations than by commercial viability, leading to widespread inefficiencies and a surge in non-performing loans. This erosion of financial discipline ultimately weakened the banking system and discredited the broader project of public sector control. This episode highlights an important causal mechanism: when political authorities control the allocation of credit, lending decisions often become instruments of patronage rather than economic judgment. Recognising this mechanism allows us to evaluate the counterfactual implications of proposals that place money creation under government control.

By creating an institutional firewall between public money creation and private lending decisions, full reserve banking offers a structure that may reduce rent-seeking, politicised lending, and systemic risk. If implemented with strong governance and oversight, such a system could reclaim monetary sovereignty while avoiding the pitfalls of full-scale state control over credit.

In short, full reserve banking proposals get three major things right:

1. A moral and systemic critique of the existing financial order,
2. Technically modeled benefits, including debt reduction and macroeconomic stability,
3. Institutional clarity about the dangers of concentrated monetary and credit powers.

These are significant achievements—and they merit serious engagement, even from those who may doubt the feasibility or underlying logic of these proposals.

5. FULL RESERVE BANKING AS A RESPONSE TO THE NATIONALISATION DILEMMA

Having acknowledged the ethical foundations and technical merits of full reserve banking, we now confront a natural question: *If the goal is to bring money creation under public control, why not pursue a simpler and more direct solution—nationalisation of the banking system?* Unlike full reserve banking, nationalisation is a straightforward institutional model with deep historical precedent and broad public intelligibility. It eliminates private money creation, ensures state control over credit flows, and does so without requiring complex institutional engineering.

Indeed, many of the benefits attributed to full reserve banking—reduced systemic risk, public debt reduction, greater monetary sovereignty—could in principle be achieved through nationalisation. But this raises a deeper issue: why has nationalisation failed in so many cases, and why have reformers instead turned to the more complex architecture of full reserve banking?

The answer lies not in the concept of nationalisation itself, but in how it is implemented. For nationalisation to work, the state must exercise ownership without operational interference. In practice, this is extremely rare. In Pakistan, the nationalisation of banks during the 1970s under the Bhutto government quickly devolved into a patronage system. Credit was extended based on political affiliation rather than commercial viability. As discussed earlier, lending decisions often rewarded loyalty, not investment merit, leading to inefficiency and long-term institutional decay. But this outcome was not inevitable—it reflected broader weaknesses in public sector governance.

In contrast, nationalised financial institutions in China have demonstrated that it is possible for state-owned banks to operate with professional standards and deliver impressive developmental outcomes. China's state banks account for the majority of industrial production financing and have supported sustained, high-growth development for over four-decades. These institutions operate under clear strategic mandates, but with relatively autonomous internal management insulated from short-term political pressures. Their success demonstrates that state ownership does not necessarily imply inefficiency or corruption provided institutional safeguards are in place.

Even within Pakistan, we have seen shifts in public sector performance over time. For example, the national carrier PIA was long regarded as an efficient and respected institution, operating effectively from its early decades through much of the 20th century. Its decline in performance began only when political interference became pervasive, eroding meritocracy and professional standards. This reinforces the idea that the failure of nationalised institutions is not inherent, but contingent upon political and institutional contexts.

Taken together, these comparisons illustrate the triangulation approach described in Section 2. By examining contrasting historical cases, it becomes possible to isolate the causal mechanisms shaping institutional outcomes. The comparison between China and Pakistan shows that state ownership of financial institutions does not inherently lead to inefficiency or corruption. The historical evolution of institutions within Pakistan, such as the trajectory of PIA, further shows that institutional decline is not inevitable within the country itself. These comparisons point to a common causal factor: the degree to which political interference displaces professional management and institutional

safeguards. Identifying this mechanism allows us to reason counterfactually about proposed reforms to the monetary system.

From this perspective, full reserve proposals can be seen not as rebranded nationalisation, but as a technocratic workaround—an attempt to design systems that *simulate* the benefits of nationalisation without triggering the risks associated with state ownership. These proposals aim to shift the power of money creation from private hands to public institutions but do so by placing that power in nominally independent committees or agencies, insulated from both private capture and political meddling.

This approach reflects a lack of confidence in the state's ability to manage credit institutions directly, especially in environments plagued by corruption, weak rule of law, and institutional fragility. In such settings, full reserve banking appears as a second-best solution—complex by necessity, not by choice. It seeks to protect the monetary system from both market excesses and political interference by erecting technical barriers and new governance structures.

But once we recognise full reserve banking as a power-sharing formula rather than a purely technocratic reform, we are forced to ask a different set of questions—questions that QK-SU's proposal, like many others in this space, leaves largely unanswered. How exactly will this power-sharing be structured? Who will sit on the money creation committee? Who will nominate them, who will oversee them, and who—if anyone—will have the authority to remove them? What role, if any, will elected representatives play? Will central bank independence be strengthened or diluted?

Proponents of these proposals treat these issues as peripheral technicalities, when in fact, they are the core of the proposals, the institutional heart of the reform. Without a clear and credible answer to these questions, the proposal remains suspended in abstraction: it outlines a desirable goal but provides no plausible roadmap for implementation.

In the next section, we turn to precisely this problem: the political and institutional feasibility of implementing such a power-sharing arrangement within Pakistan's current governance structure. We argue that the very conditions which make full reserve banking attractive—a mistrust of both market-led and state-led finance—are also the reasons such reforms are politically unworkable in practice.

6. WHY FULL RESERVE BANKING IS POLITICALLY UNWORKABLE

The preceding analysis has examined the intellectual appeal and institutional logic of full reserve banking proposals. Yet their persistent absence in practice suggests that the decisive obstacles are not technical but political. To understand why such proposals—despite their ethical appeal and theoretical coherence—remain unimplemented, we must shift our focus from institutional design to the causal mechanisms through which real-world power structures shape institutional outcomes. This section therefore examines the political economy of monetary reform in Pakistan. It first identifies the key actors and the balance of power among them, then explains how existing institutional arrangements shape their incentives, and finally evaluates how these mechanisms constrain the feasibility of full reserve banking.

6.1. From Institutional Design to Power Structures

Most discussions of full reserve banking treat the proposal primarily as a question of institutional design. Analysts debate how accounts would be structured, how money creation would be regulated, and how the transition from the current system might be

managed. These technical questions are important, but they do not address the central issue: whether such reforms are politically feasible. Monetary institutions allocate power over the creation and distribution of money. Any attempt to redesign the monetary system therefore alters the balance of power among governments, financial institutions, and other stakeholders. Evaluating the feasibility of full reserve banking consequently requires examining the power structures within which monetary institutions operate.

6.2. The Triangular Power Structure: State, Finance, and the IMF

In many discussions of banking reform, the political conflict is portrayed as a binary struggle between the state and the private financial sector. Governments are assumed to represent the public interest, while private banks seek to preserve their privileged role in money creation. In Pakistan, however, the relevant power structure is more complex. The configuration is not simply a contest between public and private actors, but a triangular relationship involving three powerful participants: the national government, the domestic and international financial sector, and the International Monetary Fund (IMF).

Each of these actors exerts influence over the structure of the monetary system. The government is formally sovereign and responsible for macroeconomic management but is frequently constrained by fiscal pressures and dependence on external financing. The private financial sector—comprising both domestic banks and international financial institutions—has strong incentives to preserve the current system, which allows private actors to create money through lending and earn interest on government debt. The IMF, meanwhile, plays a decisive role in shaping the policy space available to borrowing countries. Through lending programmes and conditionality agreements, it can exert substantial influence over fiscal policy, monetary institutions, and financial regulation. For example, it recently enforced Central Bank Independence in Pakistan (International Monetary Fund, 2022) against government resistance and popular disapproval, as a condition for further loans.

This triangular configuration significantly constrains the range of feasible monetary reforms. Governments must balance domestic political pressures with the interests of the financial sector and the conditions attached to international financial assistance. As a result, proposals that appear attractive at the level of institutional design—such as full reserve banking—must ultimately be evaluated in terms of how they affect this underlying balance of power.

6.3. Central Bank Independence and Fiscal Dependence

A central feature of Pakistan's current monetary framework is the legal independence of the State Bank of Pakistan (SBP) and the prohibition on direct government borrowing from the central bank. Under reforms adopted as part of IMF-supported stabilisation programmes, the government has effectively been barred from financing its expenditures through central bank money creation (Government of Pakistan—2021). Instead, it must borrow from private financial institutions by issuing government securities that are purchased by commercial banks. These banks, in turn, finance much of their lending through the creation of new deposits within the banking system (McLeay, et al. Bank of England, 2014).

This institutional arrangement creates a structural form of fiscal dependence. Rather than drawing directly on its own central bank for development finance, the government must rely on private lenders who earn interest on public debt. The fiscal scale of these payments is extraordinary. In recent years, interest payments on Pakistan's public

debt have reportedly absorbed more than half of government revenue, leaving limited fiscal space for development spending or social programmes. This burden illustrates the structural power of the financial sector and helps explain why reforms that threaten these revenue streams are likely to encounter intense resistance.

Prohibition of government borrowing from the central bank → fiscal dependence on private banks → large interest transfers to the financial sector → strong political resistance to reforms such as full reserve banking.

This configuration also helps explain a persistent puzzle in Pakistan's monetary policy debates. Critics often argue that the SBP maintains interest rates that are excessively high relative to domestic economic conditions, interpreting this as evidence of hidden IMF pressure. A mechanism-based perspective suggests a different interpretation. Once the central bank is institutionally insulated from the elected government and embedded within a financial system dominated by private banking interests, its policy orientation naturally aligns more closely with the priorities of financial stability, creditor confidence, and banking-sector profitability. In this institutional setting, relatively high interest rates are not necessarily the result of secret external instructions but emerge as a predictable outcome of the balance of power among the central bank, the financial sector, and international creditors.

These institutional constraints have important implications for monetary reform. Because governments must rely on private financial institutions to finance public expenditure, the financial sector acquires both economic leverage and political influence. Any reform that threatens this arrangement, including proposals that significantly reduce the role of private banks in money creation, will encounter strong resistance from actors who benefit from the existing system.

6.4. Why This Structure Blocks Full Reserve Banking

The institutional configuration described above has direct implications for the feasibility of full reserve banking. At its core, the proposal would significantly reduce the role of private banks in money creation and allow the state to reclaim greater control over the issuance of money. In practical terms, this would weaken the system of fiscal dependence through which governments currently rely on private financial institutions to finance public spending. Such a shift would inevitably alter the distribution of economic rents generated by the monetary system.

From the perspective of the domestic financial sector, full reserve banking would threaten a highly profitable arrangement. Commercial banks currently benefit from both credit creation and the substantial interest payments generated by government borrowing. Any reform that allowed governments to finance development directly through central bank money would reduce the volume of government securities held by banks and diminish a major source of financial-sector income. Strong resistance from financial institutions can therefore be expected.

The international dimension further strengthens this constraint. The IMF has consistently promoted a policy framework emphasising central bank independence, fiscal discipline, and market-based financing of government deficits. Within this framework, direct government access to central bank financing is viewed as a major source of macroeconomic instability, particularly in countries with histories of fiscal mismanagement. Policies that restore government control over money creation are therefore typically discouraged or prohibited within IMF-supported reform programmes.

As experience in Pakistan and other IMF-programme countries repeatedly demonstrates, attempts to expand government control over money creation tend to provoke strong reactions from international creditors. Such reforms would likely be interpreted as a departure from prevailing monetary orthodoxy and could trigger consequences such as the suspension of IMF lending programmes, credit-rating downgrades, or capital outflows. Even if carefully designed, the perceived risk of inflationary financing would make it difficult to sustain international financial support.

In this context, the political infeasibility of full reserve banking becomes easier to understand. The reform would simultaneously threaten the revenue streams of domestic financial institutions and challenge the policy framework promoted by international financial actors. Reforms that expand government control over money creation therefore tend to encounter resistance from this combined constellation of domestic and international financial interests.

7. ALTERNATIVE INSTITUTIONAL PATHWAYS

A key strength of QK-SU's proposal is that it opens space for rethinking the deeply flawed architecture of modern banking. However, a critical oversight is the assumption that replacing private banks with full-reserve institutions will automatically lead to more just and efficient outcomes. In this section, we examine two historical alternatives that pursued the same broad objective—restoring sovereign influence over money creation and aligning credit with social priorities. Following the historical–institutional approach outlined earlier, these cases help illuminate the institutional conditions under which such reforms succeed or fail.

7.1. Nationalisation of Banks: The Bhutto Experience

One conceptually straightforward alternative is nationalisation: bringing all banks under state ownership, thus enabling the government to direct lending in line with developmental priorities. Pakistan has already experimented with this path during the Bhutto era in the 1970s. While the idea aligned with socialist ideals of redistributing wealth and empowering the state, the implementation proved disastrous. Political elites used control over public banks to secure loans for themselves and their allies, which were rarely repaid.

This historical experience highlights an important causal mechanism: changing ownership structures without transforming the norms and accountability mechanisms governing political power can simply redirect opportunities for corruption rather than eliminate them.

7.2. The Japanese Window Guidance System

A more sophisticated and instructive model is found in post-war Japan. As described in *Princes of the Yen* by Richard Werner (2003), the Ministry of Finance (MoF) and the Bank of Japan (BoJ) operated a "window guidance" system. Instead of letting market forces or private banks determine the flow of credit, central planners set detailed credit growth targets for each economic sector. Banks were instructed to lend accordingly, creating money in the process. This system enabled the Japanese government to channel credit toward industrial sectors critical for development, while preventing speculative lending.

The effectiveness of this system depended on a set of institutional conditions that cannot be taken for granted. Two factors were particularly important:

1. Technical competence. A highly skilled bureaucratic apparatus was able to develop coherent long-term industrial strategies and translate them into credit allocation targets.
2. Institutional insulation. While not immune to political pressures, the Ministry of Finance and the Bank of Japan maintained sufficient autonomy to prevent systematic capture by political elites or private financial interests.

Under these conditions, this form of guided capitalism contributed to rapid industrial development without relying on gold standards or full-reserve banking models. Yet, as Werner emphasises, the system eventually collapsed—not because it failed economically, but because powerful interests pushed for liberalisation and deregulation, aiming to restore market dominance and central bank independence.

7.3. Lessons for the Full Reserve Proposal

The comparison of these historical experiences highlights a key lesson: controlling the money supply alone is not sufficient. The crucial question is: Who decides where the money goes?

QK-SU's proposal remains vague on this point. They suggest delegating the task to a team of experts, but this overlooks the tremendous political pressures such teams would face. If placed under direct state control, the same risks seen during Pakistan's Nationalization era would likely re-emerge. If kept independent, as in the Japanese case, the challenge becomes how to prevent elite capture and ensure accountability.

Furthermore, the full reserve model requires the same expertise in economic planning as the Japanese system. Even if we could control money creation, we would still need:

- Sectoral allocation targets,
- Monitoring systems,
- A buffer against political manipulation,
- And public trust in institutions.

In the absence of these supports, control over money creation is likely to be abused rather than used for public welfare.

These historical experiences suggest that redesigning the monetary system is not simply a matter of choosing the right institutional blueprint. The effectiveness of any such system depends on the political and administrative capacities of the institutions that operate it. Large-scale structural reforms such as full reserve banking therefore require institutional conditions that may be difficult to establish in the short run. This observation invites a more pragmatic question: what reforms could improve the functioning of the existing monetary system while remaining feasible within current institutional constraints?

8. PRAGMATIC REFORMS WITHIN EXISTING CONSTRAINTS

The preceding analysis has shown that monetary institutions evolve within specific political and institutional constraints. The question, therefore, is not whether reform is possible, but which reforms are feasible within the current configuration of power, institutions, and policy commitments. There remains significant room for incremental, yet impactful policy changes that can improve the stability, inclusivity, and developmental orientation of Pakistan's financial system. Drawing inspiration from successful models abroad—particularly Japan's postwar experience, as documented in *Princes of the Yen*—as well as Pakistan's own institutional history, this section outlines a set of policy

interventions that can be implemented without structural overhaul, and in many cases, without confronting current political constraints head-on.

Recognising that not all reforms are equally feasible, the proposals below are presented in approximate order of political viability, beginning with measures that could be implemented within the existing institutional framework.

8.1. Increasing Transparency in Credit Creation

One of the simplest and most politically viable reforms is to increase the transparency of how banks create and allocate credit. Public understanding of the money-creation process remains low—not only in Pakistan but globally—and commercial banks face little scrutiny over their role in directing financial flows. The State Bank of Pakistan (SBP) could require banks to regularly disclose how much credit they are creating, in which sectors, and under what terms. Such reporting could be published in sectoral “credit maps” and included in SBP’s monetary bulletins. These measures would not only improve accountability but also empower citizens, journalists, and civil society to monitor whether finance serves the public interest.

8.2. Reinstating Window Guidance for Commercial Banks

A more proactive step—also well within SBP’s existing regulatory authority—would be the revival of “window guidance”, a tool once central to Japanese economic planning. This involves setting informal but powerful credit allocation targets for commercial banks, encouraging them to lend to priority sectors such as agriculture, SMEs, exports, and green energy, while discouraging speculative or consumption-driven lending. SBP already influences bank behavior through reserve requirements and liquidity operations; window guidance would simply add a developmental lens to these tools, encouraging credit where it is socially valuable.

8.3. Reforming and Expanding State-Owned Financial Institutions

Rather than embarking on new institutional experiments, Pakistan could revive and reform its existing public sector financial institutions, which have long been part of its development finance landscape. In previous decades, organisations such as the Agricultural Development Bank and the Industrial Development Bank of Pakistan played key roles in channeling investment into strategic sectors. However, due to a combination of weak governance, political interference, and shifting economic ideologies, many of these institutions were sidelined or dismantled. Yet the legal frameworks, institutional memory, and physical infrastructure remain in place. With reforms focused on depoliticising management, strengthening oversight, and aligning mandates with national priorities, these institutions could once again become engines of inclusive and sustainable growth.

8.4. Expanding Credit to SMEs Through Public Guarantee Schemes

Small and medium enterprises (SMEs) are widely recognised as vital to Pakistan’s economic dynamism and employment generation, yet they remain severely underfinanced. A politically palatable and fiscally responsible strategy would be to expand credit guarantee schemes, allowing the state to absorb part of the risk in SME lending. These guarantees would incentivise private banks to lend to riskier but economically productive sectors, without placing the full burden on the public budget. This model has been successfully used in many developing and advanced economies and enjoys broad support across political lines.

8.5. Creating a Development Finance Window within SBP

A more ambitious, but still feasible, reform would be to create a dedicated development finance window within the SBP itself. Inspired by Japan's Fiscal Investment and Loan Programme (FILP), this unit could channel long-term, concessional financing to projects aligned with national development plans. It could work directly with public banks or on-lend to private institutions for targeted programmes. While SBP independence poses constraints, such a window could be designed as a non-fiscal, quasi-market instrument within SBP's broader monetary policy toolkit — especially if backed by clear rules, transparency, and parliamentary oversight.

8.6. Piloting Central Bank Digital Currency (CBDC) Initiatives

Though technologically and administratively demanding, Pakistan could begin laying the groundwork for a central bank digital currency (CBDC) through staged research, limited pilots, and public consultation. A retail CBDC is often framed by “sovereign money” proponents as “digital cash”—a digital form of risk-free public money that citizens can hold directly, reducing reliance on private bank deposits for everyday payments and potentially supporting financial inclusion as cash use declines (Dyson and Hodgson, 2016).

At the same time, proponents emphasize that a CBDC is not automatically transformative: its implications depend heavily on design choices (e.g., access model, holding limits, convertibility with bank deposits, and whether CBDC balances are remunerated), including how those choices interact with bank-run dynamics and the continued role of commercial banks in credit creation (Huber, 2019). Even within the sovereign money community, CBDC is debated as either a stepping-stone toward a safer public money architecture or a distraction/power shift that could leave core monetary arrangements unchanged (Alliance for Just Money, 2021).

Accordingly, Pakistan's near-term objective should be modest but strategic: develop the legal and operational architecture, run tightly scoped pilots (e.g., low-cost retail payments and government-to-person transfers), and use public consultation to build legitimacy and trust—so that any CBDC initiative strengthens inclusion and resilience without becoming a purely technological showcase.

8.7. Revisiting the Ban on Government Borrowing from the SBP

Of all possible reforms, the most contentious—yet potentially most impactful—would be to reconsider the legal and institutional ban on direct government borrowing from the SBP (Government of Pakistan, 2021). Currently prohibited under IMF conditionalities and possibly constitutional or legislative mandates, this restriction forces the government to borrow from private banks at interest, despite the fact that these banks fund their lending with state-created money. This architecture not only deepens public debt but also transfers unearned rents to financial intermediaries.

In principle, allowing the SBP to finance development—within strict, transparent, and accountable limits—would restore a degree of monetary sovereignty and resolve many of the fiscal constraints that QK-SU's proposal attempts to address. However, given widespread fears of inflation, mismanagement, and political abuse, this reform would require a profound shift in public trust, institutional safeguards, and the national development narrative. It is the least politically feasible of the options presented here, but also perhaps the most transformative if it could be responsibly implemented.

This is also the point at which the MMT vocabulary becomes directly relevant. MMT's core descriptive claim is that a monetarily sovereign government is not

operationally revenue-constrained in its own currency; its binding constraints are inflationary, institutional, and political (Wray, 2015). Read through that lens, the IMF-driven prohibition on direct SBP financing is not merely a prudential rule, it is a deliberate narrowing of fiscal-monetary policy space that forces the state to behave like a currency user and channels rents to the domestic banking system. Once this is understood, the attraction of full-reserve banking changes character: it is not a technological fix but rather a contested attempt to claw back degrees of sovereignty within an externally enforced settlement. This supports our central thesis that the dispute is fundamentally about power—who governs money and credit—rather than about an empirically testable efficiency claim.

8.8. Conclusion and Transition

The reforms outlined above demonstrate that many of the goals of full reserve banking—financial discipline, sovereign money, development-oriented credit—can be achieved incrementally within the existing institutional framework. Some of these reforms are readily implementable; others require stronger political backing, bureaucratic capacity, and public understanding.

In the next section, we explore an additional avenue for making ambitious reforms more viable: strategic framing through Islamic mandates and institutional camouflage. In Pakistan's unique political and legal environment, Islamic finance offers a powerful—and underutilised—channel for reforming money and banking in ways that align with constitutional principles, public sentiment, and long-term developmental goals.

9. STRATEGIC REFORMS THROUGH ISLAMIC FRAMING AND INSTITUTIONAL CAMOUFLAGE

While technocratic reforms offer one pathway toward financial transformation, their feasibility is often limited by entrenched power structures, ideological constraints, and external surveillance—particularly from institutions like the IMF. In such contexts, successful reform strategies must go beyond technical design. They must also engage with cultural legitimacy, legal precedent, and strategic narrative framing. As the historical analysis in earlier sections suggests, institutional change often occurs through adaptation within existing legal and cultural frameworks rather than through abrupt structural redesign.

In Pakistan, one of the most underutilised levers of reform is the country's Islamic constitutional framework. Specifically, the ongoing project of Islamic banking. Islamic finance is a constitutional and legal mandate in Pakistan, as well as a popular aspiration of the public. A 2022 Supreme Court decision reaffirmed the state's obligation to eliminate *riba* (interest) and transition toward a fully Islamic financial system. This directive enjoys widespread public support and is backed by both religious sentiment and national identity. Unlike full reserve banking—which appears abstract, foreign, and technocratic—Islamic finance carries deep social and cultural legitimacy. This provides an opportunity: to use the language and framework of Islamic banking to advance pragmatic development finance goals, while disarming resistance from both domestic elites and international institutions.

9.1. Islamic Banks as Development Partners

One concrete strategy is to reposition Islamic banks as developmental institutions, similar in function to Japan's postwar banks under state guidance. This can be operationalised through the State Bank of Pakistan's regulatory authority. Legally and

institutionally, the SBP has immense power over the banking sector. It can dictate the terms of licensing, liquidity access, and compliance—and it can do so quietly, through administrative discretion.

The SBP could offer zero-interest liquidity facilities to Islamic banks—framed as support for Shariah-compliant operations—under the condition that they:

- Extend zero-interest or participatory financing (e.g., *musharakah*) to priority sectors,
- Allocate a credit quota to government-identified development projects, and
- Operate under a “development partnership” charter aligning profitability with public service.

This approach would repurpose Islamic banking—currently focused on form-compliant profit maximisation—into an engine for social transformation, while remaining within existing constitutional and regulatory frameworks.

9.2. Public Interest through Religious Framing: Mobilising the ‘Ulamā’

A critical, often overlooked actor in this transformation is the ‘Ulamā’—religious scholars whose authority remains deeply rooted in public sentiment. Unlike the government, the financial elite, or even the IMF, the ‘Ulamā’ possess the ability to mobilise mass support and influence public narratives. If they can be persuaded to adopt a simple and powerful proposition—that an Islamic bank must serve the public good, by virtue of the term “Islamic” in its name—then a grassroots moral movement becomes possible.

This would reintroduce a missing element in all monetary reform proposals: a representative of the public interest. The ethical framing of Islamic economics, reinforced by jurisprudential authority and moral clarity, can reclaim public trust, shape institutional expectations, and anchor reform efforts in a broader social vision.

Zaman (2020b) articulates this point in “Reclaiming Economics as a Moral Science”, introducing the concept of a triangular architecture:

1. Islamic Banks: Agents of money creation.
2. The State: Provider of regulatory scaffolding and macroeconomic coordination.
3. The ‘Ulamā’: Moral overseers who ensure alignment with public welfare and *maqāṣid al-sharī‘ah*.

Without the third pillar, all reform efforts remain vulnerable to elite capture. By restoring the ‘Ulamā’ to their traditional role as institutional stewards and ethical guardians, the Islamic financial system can gain both moral legitimacy and political viability. This legitimacy can be further strengthened by linking financial reforms to institutions capable of articulating and embodying public values—including community-based structures and socially embedded networks aligned with Islamic principles.

9.3. Extending the Offer to Secular Banks

To ensure equity and avoid backlash, the same developmental incentives can be offered to conventional banks. Those willing to adopt “public-interest lending” mandates could gain access to SBP zero-interest liquidity or development finance guarantees—effectively creating a public-private partnership model for national development.

This would reposition banks not merely as profit-maximisers but as collaborative agents of public policy, with a diverse range of operational models that remain compatible with Pakistan’s constitutional ethos and financial needs.

9.4. Institutional Camouflage and Counter-Deception

This approach exemplifies what we might call institutional camouflage—using legitimate frameworks (Islamic banking, public interest mandates, Supreme Court rulings) to advance development goals that would otherwise face resistance. IMF opposition to full reserve banking or direct money creation would be difficult to mount in the face of an Islamic revival framed around the ethical obligations of banking institutions.

Here, we echo a principle from *Princes of the Yen*: when reform is difficult to implement head-on, it may succeed if cloaked in familiar institutional clothing, guided by publicly acceptable narratives. Just as postwar Japan used Western rhetoric to mask an interventionist developmental state, Pakistan can use Islamic finance to quietly reorient its monetary institutions.

9.5. Conclusion: The Real Battle is for Moral Legitimacy

The reforms proposed in this section do not rely on confrontation, legislation, or external funding. They rely on something more powerful and more difficult: a reawakening of moral purpose in institutions designed to serve the public. The inclusion of the ‘Ulamā’ as ethical stewards offers the only viable route to representing the people’s interests, anchoring reforms in both legitimacy and mobilisation potential.

The discussion in this section highlights a central theme of the paper: meaningful monetary reform cannot be achieved through technical design alone. It must also draw on institutional legitimacy, cultural authority, and politically viable pathways for implementation. In the final section, we bring together the threads of this analysis—evaluating the QK-SU proposal in light of historical experience, contemporary monetary theory, and the institutional realities of Pakistan’s political economy, and outlining a path forward that is both ethically grounded and politically feasible.

10. CONCLUSION

The full reserve banking proposal advanced by Qanit Khaleelullah and Sohaib Umar is motivated by a powerful and widely shared concern: the need to reclaim control over money creation, align finance with the public good, and protect the economy from cycles of speculative excess and financial instability. These concerns are not only valid but deeply important, particularly in countries such as Pakistan, where financial systems often operate in ways that exclude large segments of the population from meaningful access to credit and opportunity.

However, as this paper has argued, full reserve banking is best understood not primarily as a technical innovation but as a power-sharing arrangement within the monetary system. Historically, such arrangements have emerged in periods when neither the state nor private financial institutions could fully dominate the process of money creation. The Chicago Plan and its modern variants illustrate this pattern. These proposals were never implemented not because they lacked intellectual merit, but because they depended on a delicate balance of power that rarely exists in practice. In contemporary Pakistan—where IMF programmes constrain monetary sovereignty, domestic financial interests benefit from the existing system, and the state itself faces limitations of capacity and credibility—the political conditions required to implement full reserve banking are unlikely to arise.

The analysis developed in this paper therefore suggests that the central obstacle to full reserve banking is not technical feasibility but political legitimacy. Technocratic

proposals for monetary reform often fail not because their institutional design is flawed, but because they remain disconnected from the social and institutional sources of legitimacy required to mobilise political support.

At the same time, the objectives motivating full reserve banking can often be pursued through simpler and more context-appropriate institutional reforms. As the preceding sections have shown, a wide range of pragmatic policy tools—such as credit guidance, development finance windows, greater transparency in credit allocation, and targeted support for SMEs—already exist within Pakistan’s legal and institutional framework. These measures do not require sweeping institutional redesign; rather, they depend on administrative competence, regulatory leadership, and sustained political commitment.

Beyond such technocratic reforms, Pakistan also possesses an important and underutilised source of institutional legitimacy: its constitutional commitment to Islamic finance. Because Islamic banking is embedded in the country’s legal framework and supported by widespread public sentiment, reforms framed within this tradition can mobilise moral authority and social legitimacy in ways that purely technocratic proposals cannot. When combined with institutional reforms that align banking practices with public welfare, this framework offers a pathway for monetary reform that is both politically feasible and ethically grounded.

Ultimately, the central challenge of monetary reform lies in the representation of the public interest. Many reform proposals, including full reserve banking—focus primarily on institutional design while leaving unresolved the question of who will ensure that monetary institutions serve society rather than narrow financial interests. By incorporating the ethical oversight of the ‘Ulamā’ and reorienting Islamic financial institutions toward public purpose, it may be possible to reconstruct a monetary system in which finance once again serves the broader community.

This paper also illustrates the value of an alternative methodological approach to political economy. Instead of relying on statistical correlations or regression-based inference, the analysis proceeds by identifying the institutional mechanisms through which monetary systems evolve and operate. By examining historical experience, institutional arrangements, and the balance of power among key actors, it becomes possible to conduct the counterfactual reasoning required for policy evaluation even in cases—such as full reserve banking—where no direct empirical comparisons are possible. In this sense, the paper demonstrates how historical and institutional analysis can complement, and in some contexts substitute for, conventional data-driven methods in the study of economic policy.

Wrapping up, we see that monetary reform is not merely a technical adjustment to the banking system. It is a redefinition of the relationship between finance, the state, and the society they are meant to serve. Pakistan already possesses many of the legal, institutional, and moral foundations required for such reform. The challenge lies not in discovering new tools, but in mobilising the vision, leadership, and institutional creativity needed to use them.

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Field-Based Yield Gap Analysis of Basmati Rice: A Case Study of Two Districts in Central Punjab, Pakistan

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Understanding the yield gaps in rice-based farming systems is crucial for achieving food security. Pakistan is the 11th largest rice producer, and rice contributes 0.7 percent to the country's GDP. The country faces a yield gap across farms and rice-producing districts, with actual yields falling short of potential yields. This study assesses the productivity and yield differences in paddy rice farming in selected districts of Central Punjab. Two major rice-producing districts, Gujranwala and Sheikhupura, were randomly selected for analysis. This study finds significant yield gaps in rice production across the selected districts. On average, the combined yield gap is 31 percent, rising to 36 percent for Basmati rice. At the district level, Gujranwala records a total yield gap slightly lower than that of Sheikhupura. For Basmati rice, the gaps are even higher for both districts. These results highlight significant potential for productivity gains, underscoring the importance of reducing inefficiencies in rice farming systems. The exploitable yield gap was calculated by comparing the yield of the top 10 percent of farmers with the population average using the top-decile approach, also known as on-farm yield potential. The study identifies the importance of farm extension services in limiting the yield gap. Policymaking should focus on improving the relationship between farm extension agents and farmers and on ensuring the timely, affordable availability of necessary resources.

Keywords: Rice, Small-Scale Farmers, Yield Gap, Exports, Punjab, Pakistan.

1. INTRODUCTION

Rice is a major cereal in Pakistan, considerably contributing to export base and the domestic food security. Rice is one of the five major crops and the second most widely cultivated staple food in the country. Pakistan produces a surplus of rice and exports it to build foreign reserves. Rice is Pakistan's second-largest export commodity after cotton (Government of Pakistan, 2021).

There are two primary types of rice varieties cultivated in Pakistan: coarse and fine. Fine varieties, including Basmati rice, are preferred worldwide for their exceptional taste and aromatic qualities. Basmati rice attracts customers and commands a higher sales price than that of non-Basmati rice. Super Kernel, PK-386, Super Basmati, Kainat, and Basmati-515 are the most common fine varieties known for their aroma, texture, colour, and taste (Ejaz, et al. 2020).

Pakistani Basmati rice has been a popular choice among consumers, but its market share has been declining internationally over the years. Pakistan lost its share of Basmati

from 46 percent to 10 percent between 2006 and 2017 due to India capturing the global Basmati market with the introduction of the Pusa-1509 variety (Saeed, et al. 2020). Technological innovations, increased production efficiency, and effective marketing tactics have made India more competitive, while rice farmers in Pakistan face higher production costs and inefficiencies related to conventional methods (Abdullah, et al. 2013; Javed, et al. 2015; Rizwan, et al. 2020; Saeed, et al. 2020).

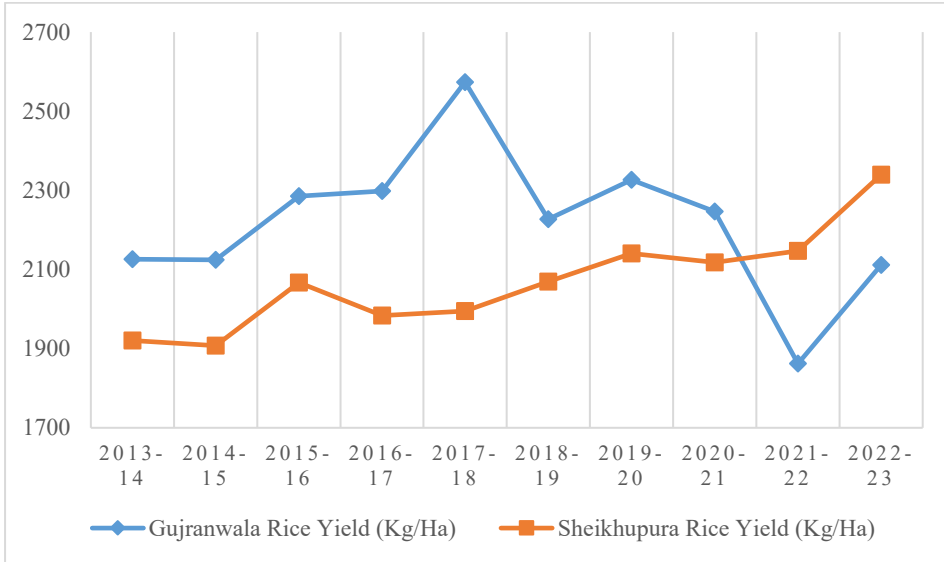
Pakistan is divided into four provinces: Punjab, Sindh, Khyber Pakhtunkhwa (KPK), and Balochistan. Punjab is the leading rice-producing province, contributing 5.779 million tonnes in 2021–22, followed by Sindh with 2.566 million tonnes (Table 1). A major policy concern is the minimum per-hectare yield of Punjab among all provinces despite its dominance in production and output share. Punjab is widely known for Basmati rice, considered unique worldwide and preferred for its aroma, whereas Sindh is renowned for coarse IRRI varieties (Taniguchi, 2018). Kainat PK-1121 and Super Basmati are two widely cultivated varieties in Punjab that account for 28.3 percent and 69.2 percent of the total Basmati area, respectively (Saeed, et al. 2020).

Punjab is known for Basmati production, accounting for over 3600 thousand tons. Punjab consistently produces an average of 54.5 percent of the country's rice, followed by Sindh at 36.2 percent, Balochistan at 7.2 percent, and KPK at 2.1 percent. Punjab's basmati yield followed an upward trend from 2011 to 2018 but showed variations afterward: a slight drop of 50 kg/ha in 2019, a rise of 193 kg/ha in 2020, and a decrease of 87 kg/ha in 2022. Despite the low and fluctuating yields, Punjab remains the leading region for Basmati rice production in Pakistan (API, 2020).

In recent years, rice yields observed in Pakistan have been low. Yield gaps are more noticeable in Punjab, which endures considerable variations in rice yields and still contributes over half of the domestic output. We sampled from Punjab's top rice-producing districts: Gujranwala and Sheikhupura. Historical data from the crop reporting survey (CRS) show that rice yields in Gujranwala fluctuate more than those in Sheikhupura (see Figure 1). Rice production is adversely affected by environmental factors, including erratic rainfall and temperature trends, as well as biotic and abiotic stresses, leading to sharp reductions in rice yields (Ahmed, et al. 2019; Rizwan, et al. 2020; Abbas & Mayo, 2021). Besides environmental challenges, agronomic factors such as suboptimal fertilizer uptake, which are essential for plant growth, also reduce rice output (Khaliq, et al. 2019). Combined stress from climate factors and inadequate nutrient delivery poses significant obstacles to achieving optimal yields in Pakistan's rice sector.

Rice farmers need to monitor these trends and adapt their farming practices accordingly to ensure stable and consistent yields in the future. Additionally, seeking guidance from agricultural experts (Ferroni & Zhou, 2012; Danso-Abbeam, et al. 2018) and adopting modern farming technologies can help ensure stable, consistent yields in the future (Barham, et al. 2018; Verma & Sinha, 2018).

Rice farmers are facing numerous problems due to rising input prices (Rizwan, et al. 2020) and the high cost and limited availability of fertilizers (Javed, et al. 2015), both of which pose a serious threat to their exports. There is a need to manage the export process for rice, as there is a greater scope to increase net exports of Super Basmati Rice in the international market. The Rice Exporters Association of Pakistan (REAP) encourages rice exporters to use their brand names and labels to secure higher prices and own their products (Javed, et al. 2015). Socioeconomic factors, such as limited information and low levels of education, exacerbate the situation for rice farmers in Punjab, Pakistan.

Fig. 1. Rice Yield Trends in Gujranwala and Sheikhupura Districts

Source: crop reporting survey, unit: kg/ha.

To overcome these challenges, farmers require training in every aspect of production, including land preparation, seed and seedling management, water and weed control, fertilization, disease and pest control, harvesting, and post-harvesting procedures, with particular emphasis on weed and water management training, which are the most important aspects for training rice growers (Riaz, et al. 2021). These issues have led to disparities in rice yields among farmers, as the national potential rice grain yield is 9,267 kg/ha, whereas actual yields average just 2,483 kg/ha, creating a yield gap of 6,784 kg/ha (ZTBL, 2020). The average yield gap for Basmati rice in Gujranwala is 33 percent. Khaliq et al. (2019) identify Nitrogen deficiency as a leading factor for yield gaps in this region.

In order to overcome the increasing challenges of rice growers, there is a need to shift from the conventional sowing method, which demands abundant labour, to direct seeding of rice (Ishfaq, et al. 2021) and invest in human capital to increase the technical and allocative efficiency of small-scale farmers (Mahmood, et al. 2022). Small-scale rice growers can increase their efficiency by incorporating advanced agricultural machinery and technologies into their cultivation methods (ADB, 2018).

Overall, the existing literature provides key understandings of rice yield fluctuations in Pakistan and comparable contexts. Although, it highlights environmental, economic, and institutional barriers, it often lacks a detailed, segmented analysis of heterogeneous productivity among farmers. In this regard, the present study applies the top decile approach in Gujranwala and Sheikhupura districts, in order to identify evidence-based strategies aligned with the context of smallholder rice systems in Pakistan.

The rest of the paper is as follows. Section 2 describes the policy significance of the yield gap, followed by the theoretical framework given in Section 3. The research methodology is delineated in Section 4. The results are discussed in Sections 5 and 6, while Section 7 concludes the study.

2. POLICY SIGNIFICANCE OF THE YIELD GAP

Basmati rice is a cash crop of Pakistan's agricultural economy and a leading pillar of food security and export earnings. While it is crucial, yield differentials are a major policy concern, as Punjab's basmati-producing regions consistently fall short of their potential. A significant body of research has examined rice yield optimization, focusing on agronomic practices (Riaz, et al. 2021; Arshad, et al. 2017), varietal performance (Zohaib, et al. 2022), and the impact of biotic and abiotic stresses (Rizwan, et al. 2020). Despite this, these studies do not provide a quantification of a sufficiently localized yield gap, restricting their scope for tailored strategies. Furthermore, although limited research has been conducted to explore yield-limiting factors, there is a lack of structured, empirical yield-gap analysis across various agro-climatic regions. These shortcomings obstruct the identification of primary regions where intervention could successfully produce optimal results by enhancing yield and export development, and underscore the demand for a more systematic, field-based yield-gap analysis in key basmati-producing districts of Punjab, Pakistan. It further identifies area-wise patterns of yield gaps and site-specific measures for optimizing resource allocation. These evidence-based findings would be critical for informing policies and guiding future research into the determinants of yield constraints.

This study examines the above analytical issues by applying a rigorous, data-driven approach through systematic field trials in Gujranwala and Sheikhupura districts. These districts were chosen because they are within the basmati-producing hub of Punjab and were among the 32 districts that sustain some of the highest financial and yield losses due to climate change. Such characteristics make these districts significant cases for quantifying basmati rice yield and climate-smart agricultural adaptations. Although identifying directly the underlying factors that drive yield gaps is not the aim of this study, yet this analysis lays the groundwork for subsequent investigations of determinants by linking on-ground surveys with primary data. This investigation underscores the role of the agricultural department in rationalizing resource allocation and infrastructure development to minimize yield gaps and adopt actionable strategies for export-driven agricultural growth. Furthermore, it implies that extension services must disseminate tailored solutions, such as precise agriculture tools and climate-resilient practices, to address key challenges facing rice cultivators.

3. THEORETICAL FRAMEWORK

The research framework of this study is based on Production Economics and Efficiency Theory, and the Diffusion of Innovations Theory (Rogers, 2003). Taken together, our frameworks elucidate both the structural and behavioral aspects of heterogeneous production among rice cultivators. The production efficiency theory provides an analytical foundation for assessing on-farm yield gaps, whereas the Diffusion theory offers a behavioral rationale for why such productivity variance persists within the rather similar agro-ecological environments.

3.1. Production Economics and Efficiency Theory

Production Economics and Efficiency Theory conceptualise productivity differences as variations in farmers' distance from the production frontier (Farrell, 1957; Kumbhakar & Lovell, 2000). The production frontier represents the maximum attainable output under existing technology, resource endowments, and agro-ecological conditions. Farmers operating below this frontier exhibit technical inefficiency, as measured by the yield gap.

Formally, let $\hat{y}_d^{90}$ denote the average yield of the top 10 percent of farms in district d and y_{id} , the observed yield of farm i . The yield gap for farm i is as below.

$$YieldGap_{id} = \hat{y}_d^{90} - y_{id} \quad (1)$$

The relative efficiency (or yield-gap ratio) can be expressed as follows.

$$TE_{id} = \frac{y_{id}}{\hat{y}_d^{90}} \quad (2)$$

The key objective of this study is to determine the yield gap as a percentage.

$$Yield\ Gap\ \% = \frac{Yield\ Gap}{Economic\ Yield} \times 100 \quad (3)$$

Equation (1) measures the absolute shortfall from the empirical frontier in kg/ha. Equation (2) measures the proportional efficiency of each farm relative to the top-performers benchmark, but this study will instead focus on Equation (3), which estimates the yield gap as a percentage, providing a more intuitive metric than Equation (2). Lobell et al. (2009) introduced the top-decile approach, which is an explicit and empirically supported estimation method. This approach evaluates each farmer's productivity relative to the mean output in a district.

This model highlights that productivity differentials are not limited to agro-ecological constraints, but suboptimal production techniques also contribute to yield disparity when implemented on rice growers in Punjab. The study investigates rice farmers in selected villages of Gujranwala and Sheikhpura districts. The study provides a district-specific analysis of the productivity gap by contextualizing it within efficiency theory and applying the top-decile approach. These estimates offer a benchmark for future research seeking to identify the drivers of performance bottlenecks and implement optimized solutions to reduce productivity gaps.

3.2. Diffusion of Innovations Theory

The determinants of yield gaps are theoretically aligned with diffusion of innovation theory (Rogers, 2003). This framework posits that behavioral tendencies, information availability, farmers' knowledge and technology adoption drive variation in technical efficiency. These factors determine the farm efficiency levels. Diffusion can be defined in four parts: (1) communication network (2) adoption period (3) Inherent innovation, and (4) Social framework within which diffusion takes place.

Rogers (2003) emphasized that adoption is a gradual process, influenced by individual perceptions and interactions within Peer-to-peer (P2P) networks. This framework explains how information dissemination and learning through community networks help in adoption of agricultural technology. Normally, Farmers do not adopt new practices based primarily on technical skills. Adoption often depends on components such as access to extension services, P2P influence, and expected risk.

Generally, innovations spread through extension systems, farmer networks, and local knowledge exchanges. As a result, differences in exposure and learning can explain variations in efficiency, even in similar agro-climatic conditions. Yield gaps are viewed in this study as arising from uneven diffusion of agronomic knowledge and management practices among rice farmers in Punjab. Hence, yield gaps are basically the result of inconsistent productivity trends, shaped by resource use and the diffusion of agronomic

knowledge. The framework offers a theoretical rationale for understanding these fluctuations without requiring the estimation of a causal model. It places yield gap measurements within the broader theoretical context that incorporates information diffusion and technical efficiency. The theoretical framework of the study incorporates behavioral diffusion of opinions and technical efficiency to provide an understanding of inconsistent productivity. Measurable parameters of yield gaps are explained by this Production Efficiency Theory. Diffusion of Innovation theory helps to interpret the informational and behavioral dimensions in these differences. Combining both theories provides a coherent basis for analyzing the variations in productivity without assuming a causal relationship between inputs and outcomes. The top-decile approach measures yield shortfalls relative to locally attainable yields and cannot estimate the causal effects of potential determinants such as input prices, extension exposure, or adoption. Any discussion of causal relation can be seen as descriptive and hypothesis-generating. The estimates from this research will serve as a baseline for future studies that might focus on pinpointing inefficiency sources and developing interventions to narrow yield gaps.

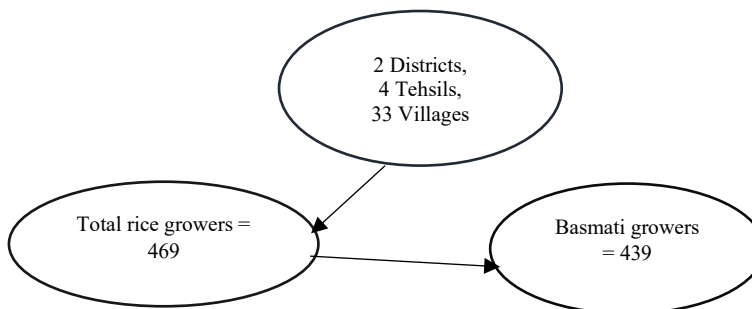
4. RESEARCH METHODOLOGY

4.1. Study Site and Sample Design

The study focuses on small- to medium-scale farmers with landholdings ranging from 5 to 30 acres.² Farmers in the selected districts with at least two years of rice farming experience were included. These inclusion criteria lead to findings that differ from official crop reporting statistics. We collected primary data from 469 farmers on total rice productivity and 439 on basmati production, across 33 villages in the two districts (for a summary, see Figure 2).

Our sampling design was as follows. A random sampling method was employed. Initially, five districts of the Basmati rice hub of Punjab were considered, including Sialkot, Nankana Sahib, Sheikhupura, Hafizabad, and Gujranwala. Table 2 presents the overall yield and basmati yield for these five districts. Among these, Gujranwala and Sheikhupura were selected for detailed analysis, as their yields fall in the mid-range rather than at the extremes, making them suitable for sampling. Within each selected district, two tehsils were chosen: Sheikhupura and Muridke from Sheikhupura, and Kamoke and Nowshera Virkan from Gujranwala. Rice cultivation in these regions normally begins in May every year and concludes in November, spanning approximately 120 days.

Fig. 2. Research Design–Sample Selection



² We used an Acre in our data collection because it is a commonly used unit of land measurement in Pakistan. 1 acre = 8 Kanals.

Table 2

<i>District-Wise Rice Yield</i>				
District	Rice Avg. Yield (Kg/ha)	Basmati Avg. Yield (Kg/ha)	Rice Avg. Yield (Kg/ha)	Basmati Avg. Yield (Kg/ha)
	(2023-24)		(2022-23)	
Shiekhupura	2084	2080	2282	2288
Nankana Sb	2257	2237	2474	2467
Hafizabad	2238	2238	2448	2430
Sialkot	1880	1847	2017	1912
Gujranwala	2177	1898	2269	1996

Source: CRS, 2023.

The research was carried out among small-scale rice cultivators in the selected villages of Gujranwala and Sheikhupura. The survey used a structured questionnaire to gain a deeper insight into the rice cultivation process. Our research involved collecting detailed information from farmers on their socioeconomic characteristics, crop yields, agricultural practices, overall cost of rice farming, and input use. This analysis covers all authorized rice varieties typically grown in the region, and specifically basmati varieties. The category of total rice varieties encompasses all types grown in the region, including both basmati and non-Basmati varieties. The analysis of basmati rice is conducted separately due to its particular significance. Data for this study were collected in collaboration with the agricultural extension department, leveraging farmers' familiarity with local extension agents to facilitate information sharing and to ensure that the treatment group received the information.

The total number of rice varieties included in this study was 7, comprising PK-386, Super 515, Kissan Basmati 1509, Super Basmati, PK-1121 Kainat, Chenab, and Super Fine. However, for the Basmati-specific analysis, Super Fine and PK-386 were excluded as they are non-basmati varieties. All varieties included in this analysis are government-approved. While a small number of farmers cultivate unapproved varieties, their proportion was negligible; therefore, these varieties are not considered in this survey. Deepening our understanding of yield gaps in rice farming involves comparing economic yields with actual yields. This approach offers valuable insights into exploitable yield gaps. Employing the same dataset enables an investigation of how various socio-economic, management, and environmental factors affect crop productivity. Examining yields would help to determine the limiting factors, including both physical impediments and social constraints.

4.2. Empirical Strategy

This research adopted a mixed-method approach, combining diagnostic field measurements with statistical analysis to assess yield disparities among rice farmers. The primary analytical framework is based on the top-decile approach, accompanied by one-way ANOVA and independent-samples T-tests to assess the statistical significance of yield variation across the region.

The top-decile approach was applied to isolate the top 10 percent of high-performing farmers in the sample, based on yield. This method segregates the most productive segment to baseline realistic yield potential under current agro-ecological conditions, serving as a reference point for estimating yield gaps among the remaining 90 percent of farmers. This approach is particularly relevant for small- to medium-scale growers where productivity is widely disparate. The top-decile approach provides a

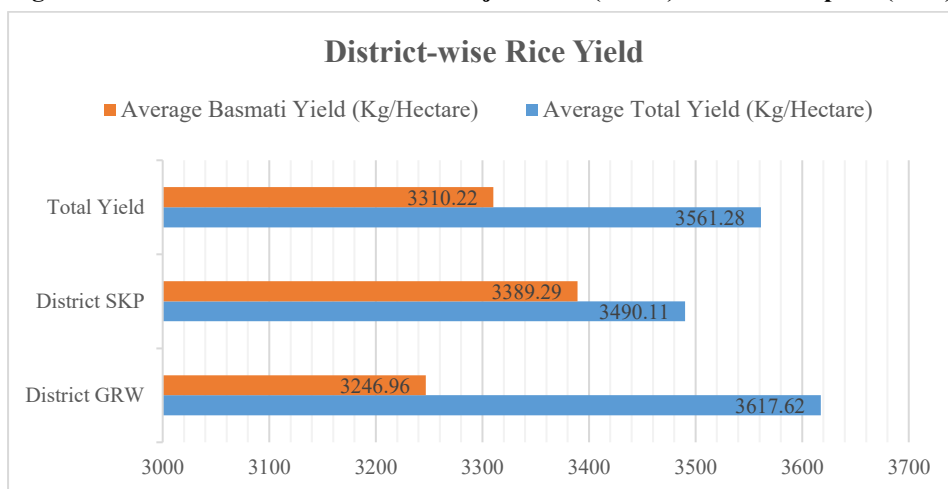
The economic yield gap defined as the difference between actual yield and economic yield was analyzed using the top-decile approach. Using this approach, we estimated the economic yield as the mean of the upper 10 percentiles; these farmers are considered progressive. Progressive farmers are defined as agents who update their information and farming practices, engage in self-initiated experimentation (Stephens, 1991). The top decile approach is widely used in yield gap analysis because it provides a concise way to identify areas for improvement. This approach provides a reliable method for determining yield gaps that is both methodologically sound and relevant. This technique substantiates that estimates are consistent and transparent across regions and agricultural commodities (Van Ittersum, 2013). It explores what can realistically be achieved given the relevant socioeconomic and ecological factors of a specific area (Stuart, et al. 2016).

The application of econometric techniques: top decile approach, ANOVA, and T-tests are technically integrated. Together, these approaches provide a detailed examination of yield variability. The top-decile approach underscores the potential for productivity gains across districts, while ANOVA and T-tests investigate whether yield patterns demonstrate structured heterogeneity within each district. This multidimensional empirical framework not only measures current yield volatility but also highlights spatial and management-based productivity dynamics. As a result, it establishes a robust empirical foundation for future studies to examine and identify the causal factors behind yield gaps. It suggests context-specific policy measures aiming to enhance smallholder performance.

5. RESULTS AND DISCUSSION

The results show significant spatial heterogeneity in rice yields across districts and tehsils, reflecting both yield response and explanatory determinants of productivity. Understanding these yield trends would pave the way for determining through which mechanism interventions could minimize yield gaps and improve farm revenue.

Fig. 4. Total Rice and Basmati Yield in Gujranwala (GRW) and Sheikhupura (SKP)



Our results indicate that the mean total yield is 3,561.28 kg/ha, compared with 3,310.22 kg/ha for basmati rice. The District Gujranwala has a higher average total yield per hectare (3617.62) than Sheikhupura (3490.11), while Sheikhupura has a higher average yield per

hectare for basmati rice (Figure 4). The P-value for total yield and basmati yield is 0.11, indicating that we cannot reject the null hypothesis, which posits that there is no difference in total yield and basmati yield between the two districts.

Among the four tehsils, Sheikhpura has the highest average total yield (4083.16 kg/ha) and basmati yield (3999.15 kg/ha). In contrast, Muridke has the lowest average total yield and basmati yield, at 2950 kg per hectare and 3435.75 kg per hectare, respectively (Table 3a). The dataset used in this study was collected initially under a quasi-experimental setup, in which Tehsil Muridke served as the control site with extension staff present. The relatively lower yields observed in Muridke may therefore reflect differences in extension exposure, rather than a tested causal effect within this analysis. Effective communication and collaboration between these groups are crucial for disseminating modern agricultural practices and technologies, which can significantly enhance crop productivity (Balasubramanian, et al. 2000).

The results below indicate a p-value of zero, suggesting a significant difference among one or more tehsils (Table 3a). To identify yield differences among tehsils, we applied the Bonferroni correction. The findings reveal that the total rice yield is not significantly different between Nowshehra Virkan and Kamoke, whereas all other pairs show significant differences in total yield. Similarly, there is no significant difference in basmati yield between Muridke and Kamoke tehsils; however, all other pairs of tehsils exhibit significant differences in basmati yields (Table 3b).

Table 3

Tehsil-wise Average Total Paddy Rice Yield and Basmati Rice Yield in 2023-24

(a) Tehsil	Average Total Yield (Kg/Hectare)		Average Basmati Yield (Kg/Hectare)	
KMK	3546.45 (7.25)		3036.43 (9.03)	
MDK	2950.43 (29.85)		2821.94 (9.26)	
NV	3681.86 (37.25)		3435.75 (8.25)	
SKP	4083.16 (41.31)		3999.15 (9.42)	
Total	3561.28 (8.81)		3310.22 (9.59)	
P-value	0.00		0.00	

(b) Tehsil-wise Analysis of Variance using Bonferroni							
	Total Rice Yield				Basmati Yield		
	KMK	MDK	NV		KMK	MDK	NV
MDK	-6.03 (0.00)			MDK	-2.17 (0.35)		
NV	1.37 (0.97)	7.39 (0.00)		NV	4.04 (0.00)	6.21 (0.00)	
SKP	5.44 (0.00)	11.46 (0.00)	4.06 (0.00)	SKP	9.74 (0.00)	11.91 (0.00)	5.70 (0.00)

Note: (a) One-way ANOVA is used. Within brackets are standard deviations. (b) Bonferroni correction is applied, and within brackets are p-values. MDK=Muridke, SKP=Sheikhpura, KMK=Kamoke, NV=Nowshehra Virkan.

Our focus now shifts to conducting a yield gap analysis, using the upper 10-percentile method. By taking the average yield of the upper 10-percentile as the economic yield, we found that the attainable yield gap for rice (Basmati and Non-Basmati) is

1523.16 kg/ha (30.88 percent), and for basmati rice, the yield gaps are larger at 1745.55 kg/ha (35.57 percent) in both districts (Table 4). The Gujranwala district has an economic yield of 4902.56 kg/ha, with a yield gap of 1413.44 kg/ha (28.83 percent), while the Sheikhupura district has an economic yield of 4960.88 kg/ha, with a yield gap of 1658.57 kg/ha (33.43 percent). Gujranwala and Sheikhupura rank among the leading districts in Punjab, out of 32 districts, that suffer the most significant financial and yield losses due to climate vulnerability (Janjua, et al. 2021). Our findings are consistent with those of Khan et al. (2021), who reported a significant rice yield gap of 7,476 kg/ha in the Punjab province. A recent study evaluating rice yield gaps in Punjab province found substantial yield disparities, particularly in the Gujranwala and Sheikhupura districts (Hussain, Akmal & Altaf, 2025).

The yield gaps for basmati rice are even higher, with the Gujranwala district having a yield gap of 1721.83 kg/ha (35.70 percent) relative to an economic yield of 4822.5 kg/ha, while the Sheikhupura district has a slightly higher yield gap of 1760.38 kg/ha (35.24 percent), with an economic yield of 4995.47 kg/ha (Table 4). Our results corroborate those of Khaliq (2019), who documented a 33 percent yield gap in basmati rice in the Gujranwala district. Farmers from the Sheikhupura district show higher yield gaps for both overall rice and basmati rice, indicating significant potential to increase rice productivity by addressing farmers' challenges and reducing these yield gaps. A T-test assessed the significance of differences between two districts. The results show that both districts exhibit significantly different actual total yields. At the same time, there is no significant difference between the actual yield of basmati rice. Additionally, while the economic yield of basmati rice varies between the two districts, their total yields are comparable.

Table 4

<i>Total Yield Gaps and Basmati Yield Gaps during 2023-24</i>				
	Total Yield Gap (Kg/Hectare)		Basmati Yield Gap (Kg/Hectare)	
Actual Yield	3409.06		Actual Yield	3161.96
Economic Yield	4932.22		Economic Yield	4907.51
Yield Gap	1523.16		Yield Gap	1745.55
	Total Yield Gap (Kg/Hectare)		Basmati Yield Gap (Kg/Hectare)	
	District GRW	District SKP	District GRW	District SKP
Actual Yield	3489.12 (0.44)	3302.31 (0.67)	3100.67 (0.50)	3235.10 (0.70)
p-value	0.01		0.11	
Economic Yield	4902.56 (0.53)	4960.88 (0.40)	4822.50 (0.39)	4995.47 (0.39)
p-value	0.40		0.00	
Yield gap	1413.44	1658.57	1721.83	1760.38

Note: Within parentheses are standard errors. GRW=Gujranwala, SKP=Sheikhupura. The total yield gap accounts for both basmati and non-basmati varieties.

Significant yield gaps exist at the tehsil as well as the district levels. Tehsil Sheikhupura (SKP) has the highest total yield gaps (1679.33 kg/ha), with Kamoke (KMK) and Nowshera Virkan (NV) also showing significant gaps. Tehsil Muridke (MDK) has

the highest basmati yield gaps of 1954.11 kg/ha, against an economic yield of 4630.75 kg/ha (Table 5).

Overall, significant basmati rice yield gaps, combined with spatial variation, reveal critical opportunities to increase yields by making farmers adopt improved technologies through extension services, particularly in high-yield gap areas such as Sheikhpura and Muridke tehsils.

Table 5

Tehsil-wise Total Yield Gaps and Basmati Yield Gaps during 2023-24

	Total Yield Gap			
	MDK	SKP	KMK	NV
Actual Yield	3834.08 (7.23)	2762.63 (8.05)	3576.10 (6.85)	3411.04 (6.49)
Economic Yield	5078.50 (0.86)	4441.96 (3.91)	5031.06 (3.19)	4799.77 (1.58)
Total Yield Gap (Kg/Hectare)	1244.42	1679.33	1454.95	1388.73
	Basmati Yield Gap			
	MDK	SKP	KMK	NV
Actual Yield	2676.64 (7.95)	3877.57 (7.28)	2872.35 (7.66)	3304.29 (7.20)
Economic Yield	4630.75 (4.06)	5081.47 (0.86)	4704.88 (0.97)	4942.1 (1.87)
Basmati Yield Gap (Kg/Hectare)	1954.11	1203.90	1832.53	1637.81

Note: Within Brackets are standard deviations. MDK=Muridke, SKP=Sheikhpura, KMK=Kamoke, NV=Nowshera Virkan. Actual yield and economic yields are measured in maunds per acre.

6. DISCUSSION

The results imply that to effectively limit yield gaps in rice production, the agricultural extension department needs to enhance and expand its services. This can be realized by maintaining a strong and continuous connection with rice farmers that may require regular training sessions, technical support, and access to the training of the trainers of the latest agricultural research and innovations. Through this enhanced connectivity with farmers, the extension staff would gain strategic insights into field-level constraints, demands, and contextual factors, thereby delivering more context- and region-specific solutions that can considerably increase rice yield.

Tehsil-wise yield gap analysis reveals that Muridke is not ideally fit for Basmati cultivation, with significant yield gaps, though it exhibits satisfactory performance in overall rice production. On the contrary, Sheikhpura is more regionally adapted for Basmati cultivation but it faces wider gaps in total rice yield, suggesting that farmers in this area should be incentivized to cultivate Basmati varieties rather than adopting non-basmati varieties.

The survey data indicate that many farmers experience challenges while incorporating improved rice cultivation techniques. In particular, the rising production cost and limited access to fertilizers made it difficult for them to comply with the suggested protocols. The lack of awareness in farmers also discourages them from adopting new technologies, such as the mechanical rice transplanter. Although the extension department encouraged its adoption in the last rice cropping season, most

farmers utilized leased machinery. Because they lacked training and experience, the results were marginal, thereby many growers reverted to conventional hand transplanting this season.

While our findings do not directly quantify the causes of rice yield gaps, previous research provides several plausible explanations. For instance, Niazi & Farooq (2019) found that higher fertilizer prices significantly reduce Basmati rice production, with a 1 percent increase in fertilizer prices leading to a 0.7 percent decrease in yield. High transportation costs, limited market size, and poor dealer networks further contribute to elevated input prices, which in turn widen yield gaps (Morris, et al. 2007; Van Dijk, et al. 2017). Fertiliser management practices are particularly influential, accounting for approximately 65 percent of yield variability in rice production (Saberali & Darzi-Naftchali, 2024). On the whole, a suboptimal use of agricultural inputs remains a significant factor contributing to rice yield gaps (Silva, et al. 2017). Climate change also poses a significant threat, with projected scenarios indicating that the most severe conditions could reduce rice yields by nearly 50 percent. In comparison, even the least severe scenarios may result in a decline of approximately 20-25 percent (Gaydon, et al. 2023). Therefore, implementing effective adaptation strategies is essential to mitigate the negative impacts on rice production (Ahmad, et al. 2015; Shabbir, et al. 2020; Gaydon, et al. 2023).

This study provides a precise estimate of yield gaps among the farmers in different districts, it has certain limitations. For instance, it does not account for weather shocks or breakdown inefficiencies within specific sources. Additionally, the analysis focuses on yield gap estimates without examining their underlying determinants. More research needs to investigate the underlying factors driving these gaps, such as input use, technology adoption, and institutional influences, to inform more effective strategies for closing these gaps and improving rice productivity.

7. CONCLUSION AND IMPLICATIONS

This study provides evidence of yield volatility among medium to small-scale rice growers in Gujranwala and Sheikhpura districts using the top-decile approach. The findings highlight significant gaps and, consequently, massive potential to improve productivity among rice growers. Although Basmati rice is a premium export-quality cereal, its yield in the selected districts remains suboptimal due to asymmetric agronomic information, biotic and environmental stressors, and resource constraints. The empirical evidence indicates that high-performing growers mostly benefit from crop-related information provided by the agricultural extension services, which frequently and effectively engage with farmers in some tehsils, whereas the less productive farmers receive limited institutional support.

Therefore, targeted collaboration between the extension department and Basmati rice growers is imperative to bridge the yield gaps. This integrated effort should enhance farmer-inclusive strategies that engage both large-scale and small-scale farmers, ensuring equitable access to information, training, and resources. The farmers consistently report that knowledge alone is insufficient without logistical assistance. Furthermore, addressing yield gaps across districts and tehsils through region-specific interventions will encourage equitable rural development and livelihood improvement.

Therefore, public institutions must interact synergistically with the extension department to facilitate farmers with targeted financial interventions, including subsidies on inputs such as seeds, fertilizers, electricity, and agricultural machinery, specifically

designed to Basmati rice cultivation. By reducing cost barriers and enhancing institutional responsiveness, the government can reinforce the economic sustainability of Basmati rice farming, improve farmer wellbeing, and strengthen Pakistan's competitiveness in global rice markets. Thus, a systematic approach that integrates field-level recommendations with institutional backing will be essential to minimize yield gaps and encourage sustainable Basmati rice production.

Appendix

Table 1

Rice Production and Yield of Rice in Pakistan in 2021-22

Province	Area (000 hectares)	Production (000 tonnes)	Yield per Hectare (kgs/ha)
Punjab	2555.1	5779.0	2262
Sindh	756.6	2566.2	3392
Balochistan	161.4	524.7	3251
Khyber Pakhtunkhwa	64.2	157.6	2453

Source: GOP (2021-22).

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Family Size and Nutritional Outcomes in Children: Lessons from Pakistan

FILZA AYAZ

Deteriorating child health impacts socioeconomic outcomes and is a critical concern. This study explores how the child nutrition is affected by the family size in Pakistan, utilising data of 4031 individuals from the Demographic Health Survey of Pakistan 2017-18. The indicators like height for age S score, weight for height S score, and weight for age S score are used to estimate child nutrition. To address endogeneity, instrumental variable approach is employed, and the family size is instrumented by gender of the first child (girl). The results show that if there is an increase in the family size the HAS score lowers by 0.19 SD and the probability of stunting increases by 4.2 percent while no significant impact is observed on WHS and WAS. However, if family size increases, it is also associated with a 3.1 percent increase in the child's likelihood of being underweight. Hence, an increase in family size will have a long-term detrimental effect on children's nutritional status.

JEL Classification: I14, J13, O15, C26.

Keywords: Family Size, Child Nutrition, Stunting, Wasting, Instrumental Variable.

1. INTRODUCTION

A child's health, particularly in the early years, is fundamental to leading a prosperous life. Healthy children can learn, grow, and contribute positively to society and the nation, while unhealthy children are more susceptible to diseases and health issues, leading to poorer educational and occupational outcomes (Case, 2005; Currie, 2009; Grunewald, 2010; Villadsen, et al. 2023). Despite extensive literature on child health, further research is necessary, especially given the high rates of stunting, being underweight and wasting in Pakistan. The PDHS survey 2017-18 reveals that in Pakistan 38 percent children are stunted and around 17 percent are severely stunted. The stunting rate is even higher (48 percent) for children aged 24-35 months. Similarly, 15 percent of children aged one year or below and 23 percent of children five years or below are wasted, with 8 percent severely wasted. Alarming, 57 percent of newborns are stunted at birth, and 41 percent are underweight. Additionally, 20 percent of children are both stunted and wasted, whereas 21 percent of children who have large sizes at birth are underweight, and 35 percent of them are stunted. The National Nutrition Survey NNS (2019) further underscores the severity of the situation, showing that 17.7 percent of children below 5

years of age are wasted and 11.8 percent of adolescent girls and 21.1 percent of adolescent boys are underweight. These statistics highlight the urgent need to examine the determinants of child health in Pakistan to address this critical issue.

The impact of an individual's health on their future is well-documented. Previous research has extensively explored the various determinants of child health outcomes and their effects on later life (Sewdie & Abebaw, 2013; Mahgoub, et al. 2005; Koivusilta, et al. 2024). Among these determinants, family size is considered a key factor (Lundborg, et al. 2013). Children in large families often receive less attention, care, time, and financial support from their parents, leading to physical and mental health issues. The quality-quantity model (Becker & Lewis, 1973) posits that as family size increases, the costs of investing in children's health rise, having an adverse effect on children's health outcomes (Mogstad & Wiswall, 2016).

In the existing literature there are various concepts and theories explaining the effect of large families on investment in children and their health outcomes, for instance, the dilution effect, the hygiene hypothesis and some biological arguments (Lundborg, et al. 2015). According to dilution effect, in larger families, the cost of investment and care increases, leading to unequal resource distribution (Keyser & Rossem, 2017; Lwisa, et al. 2023), often favouring the first child (Horton, 1988; Luo, et al. 2022). This hypothesis implies a tradeoff between the quality and the quantity of the children; this concept is same as the Becker's quality-quantity model (Becker & Tones, 1976).

The hygiene effect asserts that as the number of siblings increase, the risk of health issues like infectious diseases also rises. Biological arguments support this view, suggesting that as mothers age and have more children, their health deteriorates, resulting in less healthy offspring (Khalil, et al. 2013). This is particularly relevant in Pakistan, where the average household size is 6.4 persons (Aheron, et al. 2022).

However, some researchers have different perspectives. Bamba, et al. (2010). Mogstad & Wiswall (2016); Spencer (2003), and Wang (2014) highlight the ambiguity in the concept of how child health is affected by the family size. Similarly, Bras, et al. (2010) and Nicoletti & Tonei (2017) also argue that assuming a fixed resource supply is incorrect, as resources can change due to subsidies, career progress, or government support, positively impacting child health. Nevertheless, this aspect cannot be tested in this study due to insufficient data.

This study aims to analyse how family size influences child nutritional outcomes in Pakistan, examining both the short-term and long-term effects. Although there is extensive literature on child health in Pakistan, none has specifically explored family size as a determinant of health outcomes. Most studies focus on socio-economic and demographic indicators, such as parents' education and employment (Arif, et al. 2012; Bhuiya, et al. 1987; Shahidi, et al. 2025), healthcare access, and household factors like household type, water source, and type of sanitation (Shehzad, 2006; Iram & Butt, 2006; Anwar, et al. 2015 and Arif & Arif, 2012). In a study, Monfardini & See (2012) and Collin (2013) examined how the birth order of a child affects their health due to unequal resource distribution in the household, but still there is limited literature on the association of family size and child health. This paper offers two significant contributions to existing literature. First, this study uniquely investigates the impact of family size on child nutrition in Pakistan, emphasising two major challenges prevalent in the country: large family sizes and widespread nutritional deficiencies among children. Though gender of the first child is used as an instrument in other studies however, its use in this kind of analysis in context of Pakistan is an important contribution. Second, this study utilises the most recent and nationally representative PDHS 2017–18 data. It not only examines the

HAS, WHS, and WAS scores but also investigates how family size influences the likelihood of stunting, wasting, and underweight among children under the age of 5 years. Moreover, it includes some unique control variables like childhood diarrhea and access to water and sanitation, which have been rarely used in previous studies, further augmenting the contribution of this paper.

Since, the existing studies often do not account for the heterogeneity within households which may contribute to nutritional deficiencies, this study addresses these gaps by providing empirical evidence of how the child's nutritional status is affected by family size, thereby informing efficient policymaking. Additionally, this research also offers valuable insights for addressing the determinants of poor child health and issues related to increased family size through the implementation of family planning measures and the improvement of existing policies.

In the light of the existing gaps in literature, this paper analyses the causal impact of family size on child nutritional outcomes in Pakistan using recent, nationally representative data from the PDHS 2017-18 and applying an instrumental variable approach. To address the issue of endogeneity the gender of the first child is used as an instrument for family size. The estimation results show that if family size increases it has an adverse effect on children's long-term nutritional outcome i.e., lower HAS score (increase in stunting). It is also associated with a lower WAS score (increase in underweight).

The paper is organised in the following sections: Section 2 is the discussion on the previous literature. Section 3 provides information on the data used and the variables estimated in the analysis. Following this, Section 4 discusses the identification strategy. Section 5 consists of the results while Section 6 concludes the study.

2. PRIOR EVIDENCE

Child health is critically important, as it has serious implications not only for a child's development but also for their future outcomes in adulthood. A study by Campisi, et al. (2017) highlighted that there is a high prevalence of stunting across the world with around 156 million children being stunted and belonging to low and middle-income countries. Another study by Ssentongo, et al. (2021) also analysed the prevalence of child nutritional deficiencies in low- and middle-income countries showing that there was 29.1 percent, 6.3 percent and 13.7 percent prevalence of stunting, wasting, and underweight respectively. Additionally, South Asia, Western Africa, and Southeast Asia had the highest prevalence of undernutrition. Supporting the above study, statistics reported in a recent report by UNICEF, WHO, and World Bank Group (2025) indicate that in 2024, approximately 150.2 million children were stunted and 42.8 million were wasted, with around 51 percent of the stunted children residing in Asia.

Hence, there have been numerous studies analysing children's nutritional outcomes however, there is very limited research on how child health varies by the family size in Pakistan. However, the existing research highlights key themes that shed light on this relationship. For instance, the quantity-quality model suggests that larger family sizes strain resources, negatively impacting child health. Kucera & McIntosh (1991) applied the dilution model, showing that as family size increases, available resources like time, money, and energy per child decrease, constraining both physical and social development. Similarly, Baes (2008) in Colombia found that children from larger families had less access to education and essential services like clean water and sanitation, leading to poorer health outcomes.

Several studies highlight how socioeconomic and environmental factors interplay with family size and how it affects the child's health. In a study, Islam, et al. (2003) identified mother's education, income, and breastfeeding duration as significant factors for child nutrition in Bangladesh, alongside family size. Iram & Butt (2006) in Pakistan also noted that household size and childcare practices significantly influence child nutritional status. Okeyo & Kirabira (2016) in Kenya emphasised the compounded effect of large family size and poor living conditions on malnutrition and health outcomes.

Research also points to birth order as a critical factor in the association of child nutrition and family size. Studies by Monfardini and See (2012) and Collin (2013) indicate that higher birth order children receive fewer resources, impacting their health negatively. Hatton & Martin (2008) in Britain found that larger family sizes and higher birth orders negatively affected children's heights, illustrating an inverse relation between the family size and child health outcomes.

In some papers quasi-experimental methods also have been used for the estimation of the relationship between child health and family size. The use of instrumental variable approaches to study family size and child health has provided robust evidence for the negative impacts of larger family sizes. Delpiano (2005) used multiple births to instrument family size, showing that as family size increases there is a reallocation of resources away from each child, consistent with the quantity-quality model. Angrist, et al. (2010) also used instruments of multiple births and same-sex siblings to analyse the data for Israel. The study identified that larger family sizes lead to declines in child health indicators such as stunting, wasting, and underweight.

Despite the prevailing evidence, some studies challenge the notion of a negative effect of family size on the nutritional outcomes of the children. Dasgupta & Solomon (2018) found no substantial evidence to confirm the validity of the quantity-quality model for child health, suggesting that other factors might mediate this relationship. Similarly, Mmopelwa (2019) in Botswana showed that while larger family sizes generally have adverse effects, the impact can vary significantly across different contexts and household dynamics.

In conclusion, while most of the literature supports the idea that larger family sizes negatively impact child health due to strained resources and socio-economic factors, there are nuanced views and debates that suggest the need for context-specific studies. The instrumental variable approach remains a key method for unraveling these complex relationships, particularly in developing countries like Pakistan.

3. THEORETICAL FRAMEWORK

Children's nutritional outcomes are measured by stunting (HAS score), wasting (WHS score) and underweight (WAS score). Prior research shows that an increase in family size, due to the birth of additional children, leads to the dilution of household resources among all members. Therefore, an increase in the family size reduces the number of resources available per child, adversely affecting the child's nutritional outcomes. This effect is primarily supported by 'Becker's Quantity and Quality Trade-off Model' (Becker, 1960) and the Resource Dilution Hypothesis (Blake, 1981) which suggest that larger family sizes decrease the resources allocated to each child leading to poor health outcomes.

The gender of the first child influences the family size, as parents who have a daughter may continue having children in pursuit of a son or desired number of sons, often leading to larger families and this is especially common in Asian countries including Pakistan. Hence, it is important to use it as an instrument for this analysis. Similarly, it is

important to include parent's characteristics as controls in the model as they may significantly affect the child's nutritional status. If a child has well-educated parents they may be more aware about the child health issues and needs resulting in better outcomes. Similarly, educated mothers play a significant role in their children's development. Moreover, educated parents are more likely to have better jobs and a stable source of resources for their children, increasing investment in their health outcomes (Lindeboom, et al. 2009). In addition to these factors, parents' age is also important as births in older age are associated with birth defects and low weight at birth (Chung, et al. 2022). It is also observed that if the parents are married, they invest more in children's development and provide them with a better standard of living compared to divorced, separated or widowed parents. Some studies also show that children from single mother households have more chances of being stunted and underweight as compared to children belonging to single father households (Laksono, et al. 2025).

Literature also shows that if a child frequently has diarrhea it may result in stunting (Arief & Nurafifah, 2025). Similarly, access to clean water and sanitation are also important factors affecting child health. If the families do not have access to clean drinking water and improved sanitation facilities the children face health issues and diseases resulting in nutritional deficiencies (World Health Organisation, 2009). Additionally, the location of the household may influence a child's nutritional status, as those living in urban areas often have better access to facilities and healthcare services, positively affecting child nutrition (Ayele & Tadesse, 2025). Similarly, parents in wealthier families invest more in their children, which contributes to better health outcomes.

4. DATA AND VARIABLES

This study utilises data of the Demographic Health Survey of Pakistan from 2017-18, which is conducted by the National Institute of Population Studies (NIPS). This fourth round of the survey provides national data, also consisting of an urban-rural breakdown.

The survey includes data from all the provinces, Punjab, Balochistan, Sindh and Khyber Pakhtunkhwa) as well as regions like Gilgit, Kashmir, the Capital Islamabad (ICT) and FATA.

It includes information on a range of indicators related to men and women, children, and household specific indicators.

The PDHS employs two-stage stratified sample design. Initially, eight regions are divided into rural and urban strata, creating 16 strata for sampling. Samples are then selected using a two-stage process, with systematic sampling of households at the second stage. In total, 28 households were selected from each cluster from the total of 561 clusters, leading to a sample of 16,240 households. Out of these, 12,338 households were occupied, and out of them 11,869 households were successfully interviewed. Additionally, 12,364 eligible women were interviewed, and 4,794 children aged 5 years or below were selected for anthropometric measurements.

The PDHS dataset provides data on child health indicators such as HAS score which is the child's height for their age, WHS score which the weight for child's height, and WAS score which measures the child's weight for their age. These are the dependent variables in this analysis. These child nutrition indicators are computed through the World Health Organisation standards, expressed as z scores that standardise deviations from the median population reference. A z-score within the range of -2 to +2 indicates normal growth, while values outside this range suggest malnutrition. For instance, a child with HAS score of less than -2 standard deviation (SD) is considered stunted and a child who

has z score lower than -3 standard deviation, is considered very highly stunted. Likewise, a child will be wasted or underweight with WHS < -2 SD and WAS < -2 SD, respectively. Hence, along with these scores, the likelihood of stunted, wasted and being underweight is also examined, with 1 being assigned with a score of less -2 SD for these indicators, and 0 otherwise. The distributions of HAS, WHS and WAS scores are shown in Figure 1 Appendix A. All the distributions have single peaks but show some differences. The HAS score distribution represented by the blue line is towards left, showing that many children have low HAS scores indicating the prevalence of stunting. Whereas the WHS scores represented by the red line and WAS scores represented by the green line show that the prevalence of wasting and underweight is less compared to stunting. Hence, stunting is observed to be a more persistent issue than other forms of nutritional deficiencies among children in Pakistan.

In Pakistan the growing population and large family sizes are an important and a persistent issue. Besides this, Pakistan also has a significantly high rate of undernutrition in children below the age of 5 years. Hence, it is important to see how these large family sizes influence HAS, WHS and WAS scores which are used as a measure of undernutrition in this paper. Moreover, in Pakistan the joint family system complicates the identification of nuclear versus extended families within households. In joint families, more household members can constrain available resources for child health investment, or conversely, contribute additional resources. Hence, this analysis uses the total number of household members as proxy for the main explanatory variable which is the family size.

In this analysis total number of people in the household are considered as a measure of family size instead of children under 5 years of age because the resource allocation among the children as well as the supply of resources are both influenced by all the members of the households especially in joint families which are common in Pakistan. Hence, using all household members captures overall resource sharing within the household. However, as a robust check, the number of children under five years of age is also used as an alternative measure as younger children might have more share in the household resources. The distribution of family size is given in the Appendix A in Figure 2. The distribution of family size is right skewed showing that fewer households have household members between 20 to 30.

The other control variables used in the study include child's characteristics like gender, age, child has diarrhea or not. We have controlled for diarrhea as it is a significant health issue among children under 5 years of age in Pakistan and having frequent diarrhea or being vulnerable to it is likely to result in poor nutritional outcomes for children. The some parental controls have been used like parent's age, employment, education and marital status which are also very important and have significant implications for children's health and growth. Similarly, important household characteristics like gender of the household head, household wealth index, type of water and sanitation facilities, region and place of residence are also used as controls. These variables account for children's living conditions and their access to water and sanitation, which have important implications for their health and nutritional status. The correlation matrix for important variables is also given in Table 1 in Appendix B.

5. IDENTIFICATION

Endogeneity arises when factors such as fertility, income, migration, autonomy, and mortality, which influence household size, are themselves determined by other underlying factors (Hoddinott & Mekasha, 2017). To address this issue, literature often

employs the instrumental variable approach for family size (Dasgupta & Solomon, 2018). Employing the same instrumental variable approach De Haan (2010) used twin births and sex composition of children to instrument family size. However, some studies also use household fixed effects to analyse the effect of family size (Horton, 1988). For this study as well, an instrumental variable approach is employed, in which gender of the first born is used to instrument family size. To estimate this relationship of family size and child health the below mentioned OLS model is used:

$$Y_{chd} = \beta_0 + \beta_1 FS_{hd} + \beta_2 X_{chd} + \beta_3 Z_{mhd} + \beta_4 \theta_{hhd} + \mu \quad (1)$$

Where Y_{chd} denotes the child's nutrition indicator for child 'c', living in household 'h', located in district 'd'. It represents the HAS, WAS and WHS scores along with the probability of stunting, wasting and being underweight in separate regressions. Further, FS_{hd} is family size, X_{chd} , Z_{mhd} , and θ_{hhd} are the child, parent, and household related covariates, respectively. μ is the error term with usual assumptions. Moreover, FS_{hd} represents family size where as X_{chd} , Z_{mhd} , and θ_{hhd} are vectors of child, parental, and household characteristics, respectively. μ is the error term.

5.1. Endogeneity and Instrumental Variable Approach

To determine how family size influences the children's health outcomes, it is crucial to account for endogeneity. When estimating the family size and child nutrition simultaneously, the coefficient β_1 experiences a problem of endogeneity, in which the independent variable correlates with the error term either due to reverse causality or omitted variables. In such cases, β_1 does not accurately approximate the causal effect of family size on the indicators of the child nutrition. This bias due to endogeneity can be upward or downward, and the direction of it depends upon the cause. For example, wealthier households in Pakistan may have fewer children and invest more in their health and education, leading to an upward bias in the quantity-quality tradeoff. Conversely, highly committed parents may have more children while still investing heavily in their quality, resulting in a downward bias.

Hence, an instrumental variable approach is used to resolve this issue of endogeneity, by estimating a 2SLS (two stage least squares) regression model. This captures the exogenous variation in family size however, it requires identifying another variable which only has an influence on the family size but does not correlate with error terms.

Hence, gender of the first born (girl) is used to instrument family size, as parents in Pakistan may continue to have more children if the first-born is a girl, in hopes of having a son. This instrument helps isolate the exogenous variation in family size, allowing for a more accurate estimation of its causal effect on child health outcomes.

5.2. Testing the Instrument's Reliability and Exclusion Restriction

The validity of instrumenting family size with first born child's gender (girl) can be assessed using different conditions and arguments. According to the first condition the main explanatory variable family size should have a significant correlation with the instrument variable i.e., gender of the first child.

$$Corr.(FG_{hd}, FS_{hd}) \neq 0$$

In Pakistan, people prefer to have a male child first or to have one or more male children as they are seen as the carriers of the family legacy and primary financial

supporters. Girls, on the other hand, marry and join other families. Additionally, gender inequality in society and the higher likelihood of male children being a support for their parents and having more access to employment and educational opportunities further contributes to son preference. Even in the rural areas of Pakistan, people prefer to have sons because they have more inheritance rights. They usually inherit the agricultural land and assets and are also expected to participate in farming activities. Consequently, if couples first have a daughter they continue having children till they have a boy.

The second condition for testing the validity of the instrument which in this analysis is the gender of first child (FG), is that it should not be correlated with the stunting and the probability of stunting, except through its impact on family size:

$$\text{Corr.}(FG_{hd}, Y_{chd}) = 0$$

The above requirement is met as the child's gender is determined by nature and is random, hence not directly correlated with child health outcomes such as stunting. While this instrument might be less efficient in cases of sex-selective abortions, these are illegal in Pakistan, and there is no reliable data on their prevalence. The statistics reported in the PDHS 2012-13 about 2 percent pregnancies end in abortion, but the rate of sex-selective abortions is lower because abortions occur for several reasons.

Saidi & Morgan (2016) analysed three rounds of PDHS data and found a strong preference for sons, influencing the child rearing and contraceptive use decisions. Their findings indicate that couples keep having children till they have one or more male children, without evidence of increased sex ratios at birth, which would suggest sex-selective abortions. A study by Sathar, et al. (2015) highlights that PDHS 2006-07 had higher sex ratio at birth as compared to PDHS 2012-13 and this decline in 2012-13 could be due to improved reporting. These studies support the use of first child's gender for instrumenting family size, as they provide sufficient evidence that the child's gender is randomly and exogenously determined. However, the exclusion restriction also needs to be proved from biological perspective to prove the validity of this instrument. Biological perspective posits that with an increase in family size mothers' health deteriorates, potentially leading to the birth of more unhealthy children. This indicates that family size significantly affects child health and should be accounted for in the model. However, by using the first-born child's gender as an instrument in this analysis, the exclusion restriction is satisfied, as the instrument impacts child health only through its effect on family size, not directly.

5.3. The 2SLS (Two Stage Least Squares) Model

The 2SLS model employed to estimate how family size impacts the child nutrition is presented below:

$$FS_{hd} = \alpha_0 + \alpha_1 FG_{hd} + \alpha_2 X_{chd} + \alpha_3 Z_{mhd} + \alpha_4 \theta_{hhd} + \mu \quad (2)$$

$$Y_{chd} = \gamma_0 + \gamma_1 \widehat{FS}_{hd} + \gamma_2 X_{chd} + \gamma_3 Z_{mhd} + \gamma_4 \theta_{hhd} + \mu \quad (3)$$

In the first stage regression presented in Equation (2), the family size is regressed on the instrumental variable which is the first-born child's gender (taking the value 1 for female child and zero otherwise) and other covariates. In the second stage regression presented in equation (3), the child nutritional status is regressed on the predicted family size obtained through equation (2) and other covariates. Further, two types of first and second stage models are estimated i.e., Model 1 with no control variables and Model 2 with child, parent, and household-related control variables.

6. RESULTS AND DISCUSSIONS

Table 1 is the descriptive statistics table. The HAS score indicates that, on average, children are 1.5 Standard Deviations (SD) below population median value whereas WHS score indicates a score of 0.24 SD less than the median value. Moreover, according to the WAS score children are 1.0 SD below the reference population median value. Furthermore, the mean values highlight that in Pakistan the probability of stunting is around 38 percent and the probabilities of wasting and underweight are 8 percent and 22 percent.

Table 1
Descriptive Statistics

Variable	Observation	Mean	SD	Minimum	Maximum
HAS	4031	-1.55	1.68	-5.99	5.81
WHS	4031	-0.24	1.29	-4.94	4.99
WAS	4031	-1.08	1.26	-5.9	3.9
Stunted	4031	0.39	0.49	0	1
Wasted	4031	0.08	0.27	0	1
Underweight	4031	0.22	0.42	0	1
Family Size (FS)	4031	9.41	4.64	2	30
Gender of First Born (Girl)	4031	0.29	0.45	0	1
Mother's Age	4031	29.08	6.07	15	49
Father's Age	4029	34.01	7.53	17	81
Child's Age	4031	29.22	17.38	0	59

Source: Own estimations from PDHS Data (2017-18).

Note: Age of child is reported in months.

6.1. Strength and Relevance of the Instrument

The first-stage regressions in Table 2 and Table 3 show that the instrument (gender of first child) is strongly correlated with the endogenous variable family size as the F statistic of model 1 is 15.48 and F statistic of model 2 is 24.78 which are both greater than 10 hence, satisfying the condition for validity of the instrument. The strength and relevance of the instrument is further tested through the IV diagnostic tests like Anderson LM and weak identification tests. The results of the under-identification test show a value of 24.60 and a P value of 0.00, rejecting the null hypothesis and indicating that the instrument used is relevant. Similarly, the Cragg-Donald Wald F statistic for weak identification is 24.63, which is greater than 10 (F stat > 10) hence the instrument gender of first child is strong.

The 2SLS regression results presented in Tables 2 and 3 for stunting and the probability of stunting, respectively, incorporate different controls for children, household and parent related indicators. In each table both the stages of regressions in Model 1 exclude the control variables. In Model 2, both stages include control variables.

The first stage regression in Model 1 of Table 2 shows that there is a significantly positive relationship between first child's gender and the family size, showing that if a girl is born first then there is an increase in FS (family size). While, in the second stage regression model which regresses HAS score on the predicted family size, the results show an insignificant and negative coefficient, suggesting the omission of important variables. When control variables are added in Model 2, the first stage regressions give the similar positive coefficient. However, in the second stage, when HAS score is regressed on the predicted family size while controlling various factors reveals that when family size increases by one member the HAS score decreases by 0.194 standard deviations. It is a long-term nutritional deficiency and therefore is efficiently captured by the family size.

Similarly, Table 3 reports the results for the 2SLS regression for both models. The first stage regressions for both models are same as those in Table 2. The second stage regression of the stunting probability on the predicted family size in first Model shows a negative and insignificant coefficient. In Model 2 (Table 3), with the addition of control variables the coefficient becomes statistically significant. A plausible explanation can be that temporary fluctuations in income and resources might not immediately affect the probability of having lower height.

Table 2

Family Size Effect on (Height for Age) HAS score

<i>Panel A: The First Stage Regressions using Family Size as Dependent Variable</i>		
Variables	Model 1	Model 2
Gender of First Born (girl=1)	0.64*** (0.16)	0.86*** (0.16)
Obs.	4031	4028
F-Stats	15.48***	24.78***
Adjusted R^2	0.00	0.10
<i>Panel B: The Second Stage Regressions using HAS as Dependent Variable</i>		
Family Size	-0.02 (0.09)	-0.19*** (0.07)
Obs.	4031	4028
Adjusted R^2	-0.00	0.17
Children Controls	NO	YES
Parent Controls	NO	YES
Household Controls	NO	YES

Source: Own estimations from PDHS Data (2017-18).

Note: The Standard Errors (SE) are mentioned in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The child control variables include the child's age (5 years or below 5), birth order, child's gender and diarrhea (child has diarrhea or not). The parent related controls include the father and mother's age, employment, education and marital status. The household variables used in the model are the place of residence type, region, time taken to reach the water source, type of toilet facility and cooking fuel, household head's gender and wealth.

Table 3

Family Size Effect on the Probability of Stunting

<i>Panel A: The First Stage Regressions using Family Size as Dependent Variable</i>		
Variables	Model 1	Model 2
Gender of First Born (girl=1)	0.64*** (0.16)	0.86*** (0.16)
Obs.	4031	4028
F-Stats	15.48***	24.78***
Adjusted R^2	0.00	0.10
<i>Panel B: The Second Stage Regressions using Probability of Stunting as Dependent Variable</i>		
Family Size	-0.00 (0.03)	0.04** (0.02)
Obs.	4031	4028
Adjusted R^2	-0.00	0.12
Children Controls	NO	YES
Parent Controls	NO	YES
Household Controls	NO	YES

Source: Own estimations from PDHS Data (2017-18).

Note: The Standard Errors (SE) are mentioned in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The child control variables include the child's age (5 years or below 5), birth order, child's gender and diarrhea (child has diarrhea or not). The parent related controls include the father and mother's age, employment, education and marital status. The household variables used in the model are the place of residence type, region, time taken to reach the water source, type of toilet facility and cooking fuel, household head's gender and wealth.

Table 4 displays the regression results for the 2SLS model for wasting (WHS score) and probability of wasting. Since the first stage regressions are the same as in Tables 2 and 3, the results are only reported for the second stage for WHS (Panel A) and probability of wasting (Panel B). The results show that exogenous increase in family size affects neither WHS score nor the probability of wasting.

There can be various reasons for the insignificant impact of family size on wasting. First, family size may have a more pronounced effect on long-term nutritional outcomes (e.g., stunting) rather than short-term ones (like wasting). Larger family size can strain resources, but these effects may manifest more significantly over time, affecting height (HAS) rather than weight (WHS), which can fluctuate more rapidly and be influenced by short-term factors. Second, wasting is often a result of recent illness or infection, which can cause rapid weight loss. These health shocks are less likely to be directly correlated with family size and more related to immediate health and environmental conditions. Hence, the variation in WHS might be more influenced by episodic health events rather than the steady resource allocation issues that come with larger family sizes. Finally, in larger families, there might be mechanisms in place to buffer short-term nutritional deficits. For instance, community or extended family support might temporarily mitigate the effects of acute malnutrition (wasting), making the impact of family size less apparent.

Like Table 4, Table 5 presents the results of the second stage of 2SLS on WAS and probability of underweight. While the findings indicate insignificant effect of family size on WAS score consistent with literature (see, for instance, Delpiano, 2005; Iram & Butt, 2006; Mmopelwa, 2019), it is also observed that the family size similarly influences probability of underweight. Though the results are not very significant they show that if family size increases it positively affects the likelihood of being underweight (Panel B, Table 5). This could be because, in larger families, parental attention and care are divided among more children. This division can lead to less individualised care and monitoring of each child's health and nutritional needs, increasing the likelihood of

underweight conditions. Moreover, larger families often face greater economic pressures. With more mouths to feed, parents might be forced to cut back on the quantity or quality of food provided to each child. Economic constraints can also limit access to healthcare and proper nutrition, essential for maintaining a healthy weight. Likewise, larger families may experience barriers to accessing and utilising healthcare services, such as immunisations, regular check-ups, and treatment for illnesses. Limited healthcare access can exacerbate undernutrition, as children may not receive timely interventions for health issues that could affect their weight.

Table 4

<i>Family Size Effect on (Weight for Height) WHS score and the Probability of Wasting</i>		
<i>Panel A: The Second Stage Regressions using WHS as Dependent Variable</i>		
Variables	Model 1	Model 2
Family Size	0.10 (0.07)	0.09 (0.06)
Obs.	4031	4028
Adjusted R^2	0.00	0.03
<i>Panel B: The Second Stage Regressions using Probability of Wasting as Dependent Variable</i>		
Family Size	0.00 (0.01)	-0.00 (0.01)
Obs.	4031	4028
Adjusted R^2	-0.00	0.02
Children Controls	NO	YES
Parent Controls	NO	YES
Household Controls	NO	YES

Source: Own estimations from PDHS Data (2017-18).

Note: The Standard Errors (SE) are mentioned in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The child control variables include the child's age (5 years or below 5), birth order, child's gender and diarrhea (child has diarrhea or not). The Parent related controls include the father and mother's age, employment, education and marital status. The household variables used in the model are the place of residence type, region, time taken to reach the water source, type of toilet facility and cooking fuel, household head's gender and wealth.

Table 5

<i>Family Size Effect on (Weight for Age) WAS score and the Probability of Underweight</i>		
<i>Panel A: The Second Stage Regressions using WAS as Dependent Variable</i>		
Variables	Model 1	Model 2
Family Size	0.04 (0.07)	-0.05 (0.05)
Obs.	4031	4028
Adjusted R^2	-0.00	0.10
<i>Panel B: The Second Stage Regressions using Probability of Underweight as Dependent Variable</i>		
Family Size	-0.00 (0.02)	0.03* (0.02)
Obs.	4031	4028
Adjusted R^2	-0.00	0.09
Children Controls	NO	YES
Parent Controls	NO	YES
Household Controls	NO	YES

Source: Own estimations from PDHS Data (2017-18).

Note: The Standard Errors (SE) are mentioned in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The child control variables include the child's age (5 years or below 5), birth order, child's gender and diarrhea (child has diarrhea or not). The parent related controls include the father and mother's age, employment, education and marital status. The household variables used in the model are the place of residence type, region, time taken to reach the water source, type of toilet facility and cooking fuel, household head's gender and wealth.

The above results have also been re-estimated using number of children under 5 years of age as a measure of family size. The results show a little decline in significance for HAS score, stunting and being underweight, though HAS scores and probability of stunting remain statistically significant. The relationship directions remain consistent even after changing the independent variable however, the standard errors significantly increased indicating less precision in the estimates. The coefficients changed and only the coefficient of being wasted remains consistent.

To check for robustness OLS model results are shown in Appendix B Table 3. The results of the OLS model show that family size significantly and negatively affects HAS, WHS and WAS scores. Whereas, it has a positive and significant effect only on the probability of stunting and being underweight.

For comparative analysis, 2SLS models were also estimated separately for urban and rural areas, as shown in Table 4 and Table 5 in Appendix B. The results are not statistically significant, with small coefficients indicating no meaningful effects. However, when comparing father and mother's employment in Table 6 Appendix B (for HAS score and stunting) results show that in households where father is employed, an increase in family size lowers the HAS score and increases probability of stunting. Similar is the case with households with unemployed mothers. The results for WHS score show that for households with employed fathers an increase in family size positively affects WHS score while for rest of the indicators the results are insignificant.

7. CONCLUSION AND POLICY RECOMMENDATION

In conclusion, this study highlights how significantly the size of family effects the children's nutritional outcomes in Pakistan, with important implications for labour force productivity and economic growth. Using the Demographic & Health Survey of Pakistan 2017-18 data with an instrumental variable approach, the 2SLS (two stage least squares) model is employed to estimate the effects of family size on HAS score (height for child's age), WHS score (weight for child's height), and WAS score (weight for child's age), and the likelihoods of stunting, wasting and underweight. Findings of this paper reveal that with an increase in the size of the family, the children's nutritional outcomes are adversely affected, with significant decline in HAS scores by 0.19 SD and increase in the probability of stunting by 4.2 percent. Conversely, family size showed an insignificant effect on WHS scores. Similarly, the increase in family size does not significantly affect the WAS scores but has a significant effect on the probability of being underweight, increasing it by 3.1 percent. For robustness check these results have also been estimated by using number of children under 5 years of age as a measure of family size. The results remain statistically significant for HAS scores and stunting regardless of the choice of independent variable. Though there are variations in the coefficients the direction of the relationships remains consistent. In addition to these results, OLS regressions were also done, and the results are presented in Table 3 of Appendix B, showing that family size significantly affects all nutrition indicators except for probability of wasting. For comparative analysis 2SLS models are also estimated for urban and rural areas as well as for parents' employment. However, the results for urban and rural regions are insignificant. Whereas for households where the father is employed or the mother is unemployed, an increase in family size lowers the HAS score and increases the probability of stunting. Contrarily for households with employed fathers, family size lowers the WHS score improving child nutrition.

The positive impact on stunting and underweight probabilities can be attributed to resource dilution within larger families. As siblings increase, the allocation of food, healthcare, and parental attention becomes stretched, leading to chronic undernutrition

and poor growth outcomes. This is particularly evident in stunting, a long-term indicator of nutritional deficiency, which reflects the cumulative effects of sustained inadequate nutrition and healthcare. Similarly, the probability of being underweight increases as larger family sizes exacerbate economic constraints, limiting the quality and quantity of food available to each child.

Similarly, the negative effect of the size of the family (FS) on wasting underscores the nature of wasting as an indicator of acute malnutrition, which is more sensitive to short-term fluctuations in diet and health conditions. Wasting is often influenced by immediate factors such as illness and temporary food shortages, which may not directly correlate with family size. The temporary nature of the conditions leading to wasting means that while family size does impact overall nutritional status, its effect on acute measures like wasting is less pronounced.

This paper makes some important contributions to existing literature as none of the existing studies examine the effect of family size on child nutrition in Pakistan using the instrumental variable approach. For the estimation of the results, the paper uses the most recent, nationally representative PDHS data 2017-18. One major contribution of this study is that it not only analyses the effect of family size on HAS, WHS and WAS scores but also on probability of stunting, wasting and being underweight using important controls which are quite relevant in context of Pakistan, like diarrhea among children and water and sanitation etc.

Overall, these findings emphasise the importance of considering family size in designing new efficient policies and the policy interventions aimed at improving child health outcomes. Addressing the resource constraints and economic pressures faced by larger families can be crucial in reducing the rates of stunting among children. By focusing on long term nutritional support and equitable resource distribution, the adverse effects of larger family sizes on child health outcomes can be mitigated.

The findings also suggest that measures should be taken to address the issues related to child health like diarrhea, access to clean water and sanitation while also focussing on mother's role in decision-making to improve child nutrition, along with implementation of family planning initiatives. Specific origrammes can be designed for targeting the child's nutritional needs in early years to reduce nutritional deficiencies. Besides this, improving the quality and accessibility to child and maternal health services can also yield beneficial results in lowering the family size as well as child nutritional deficiencies.

Given the critical nature of child nutrition for future labour force productivity and economic growth, these findings underscore the urgent need for population control measures in Pakistan, which has the highest population growth rate in South Asia. Successful population control origrammes from countries like Thailand, China, and Iran provide valuable models. Implementing similar strategies in Pakistan could help reduce fertility rates and manage population growth. Moreover, coordinated efforts among the government agencies, effective public-private partnerships, and institutional changes are essential to enhance the capacity of service providers and improve the provision and accessibility of quality food, healthcare, and living conditions for families.

In addition to suggesting important policy implications for Pakistan this study also highlights that child nutrition is an important issue across the world with serious socio-economic causes and implications. Hence, even at a global level investment in children's nutrition, particularly in early years along with parent's education and employment and household living conditions, have long term implications.

Thus, to summarise, the study highlights that larger family sizes adversely affect child nutritional outcomes resulting in serious effects on their development, productivity and adult life outcomes. This reiterates the need for effective policies and programmes which address both the issue of large family sizes and undernutrition.

In Pakistan joint family and extended family systems are quite common, which means more family members residing in a household and a dilution of resources. But this also means more working adults and higher supply of resources. However, in this study it was not possible to include the exact family size and isolate the effects of family size on child nutrition in nuclear family households as compared to joint family households, which is also very important and an area for future research. Besides this, analyse these trends over time to see how the changing family sizes and other factors influence child nutrition with the passage of time may also be an interesting analysis which has not been covered in this study.

Declaration of Interest

The author declared no potential conflicts of interest regarding the authorship or the publication of this paper.

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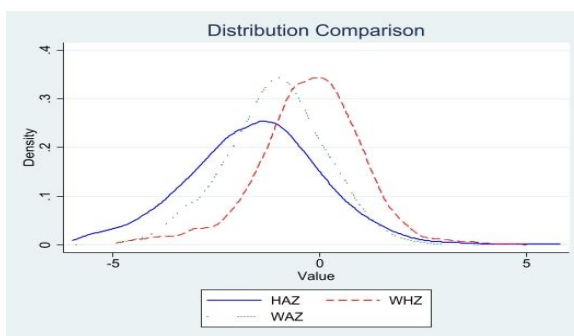
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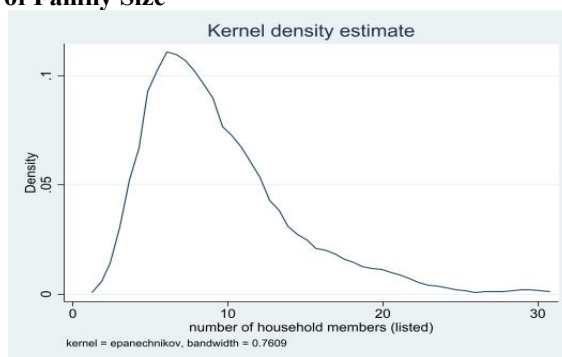
Appendix A

Fig. 1. Distribution of HAS, WHS and WAS scores



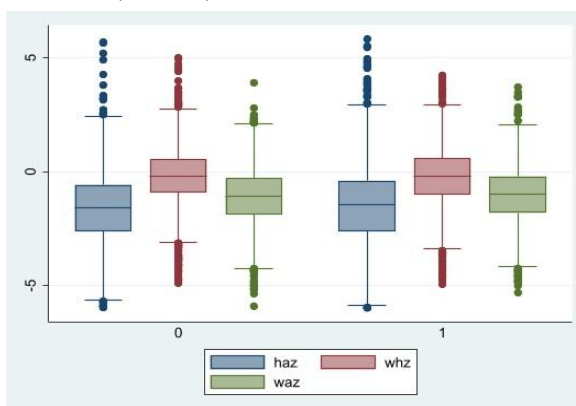
Source: Own estimations from PDHS Data (2017-18).

Fig. 2. Distribution of Family Size



Source: Own estimations from PDHS Data (2017-18).

Fig. 3. Plots for HAS, WHS and WAS scores comparing households with only 1 child aged 5 years or below (child=1) and for households with 2 or more children aged 5 years or below (child=0)



Source: Own estimations from PDHS Data (2017-18).

Appendix B

Table 1

Correlation Matrix

Variables	Family Size	HAS	WHS	WAS	Gender (First Child)
Family Size	1.00				
HAS	-0.04	1.00			
WHS	-0.03	-0.11	1.00		
WAS	-0.05	0.70	0.62	1.00	
Gender (first child)	0.06	-0.00	0.02	0.1	1.00

Source: Own estimations from PDHS Data (2017-18).

Table 2

Correlation between Family Size and Children under 5 Years of Age

Variables	FS	Children under 5
FS	1.00	
Children Under 5	0.09	1.00

Source: Own estimations from PDHS Data (2017-18).

Table 3

OLS Regression Results

VARIABLES	HAS	Stunted	WHS	Wasted	WAS	Underweight
Family Size	-0.02*** (0.01)	0.02*** (0.00)	-0.017* (0.00)	0.00 (0.00)	-0.02*** (0.00)	0.00** (0.00)
Observations	4028	4028	4028	4028	4028	4028
R-squared	0.17	0.12	0.03	0.024	0.15	0.09
Child Controls	YES	YES	YES	YES	YES	YES
Parent Controls	YES	YES	YES	YES	YES	YES
Household Controls	YES	YES	YES	YES	YES	YES

Source: Own estimations from PDHS Data (2017-18).

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 4

2SLS Regressions Results by Urban and Rural Regions For the Probability of Stunting, Wasting and Being Underweight

Variables	Stunted Urban	Stunted Rural	Wasted Urban	Wasted Rural	Underweight Urban	Underweight Rural
Family Size	0.13 (0.10)	0.02 (0.02)	-0.05 (0.05)	0.01 (0.01)	0.06 (0.07)	0.02 (0.02)
Observations	1825	2203	1825	2203	1825	2203
R-squared	0.00	0.12	0.00	0.01	0.00	0.05
Child Controls	YES	YES	YES	YES	YES	YES
Parent Controls	YES	YES	YES	YES	YES	YES
Household Controls	YES	YES	YES	YES	YES	YES

Source: Own estimations from PDHS Data (2017-18).

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 5

2SLS Regressions Results by Urban and Rural Regions for HAS, WHS and WAS Scores

Variables	HAS Urban	HAS Rural	WHS Urban	WHS Rural	WAS Urban	WAS Rural
Family Size	-0.45 (0.36)	-0.11 (0.07)	0.34 (0.23)	0.02 (0.05)	0.01 (0.17)	-0.06 (0.05)
Observations	1825	2203	1825	2203	1825	2203
R-squared	0.00	0.14	0.00	0.03	0.14	0.12
Child Controls	YES	YES	YES	YES	YES	YES
Parent Controls	YES	YES	YES	YES	YES	YES
Household Controls	YES	YES	YES	YES	YES	YES

Source: Own estimations from PDHS Data (2017-18).

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 6

2SLS Regressions Results of HAS and Stunting for father and Mother's Employment

HAS score				
Variables	Father Unemp.	Father Emp.	Mother Unemp.	Mother Emp.
Family Size	0.14 (0.22)	-0.17** (0.07)	-0.24*** (0.09)	0.03 (0.11)
Observations	134	3894	3582	446
R-squared	0.06	0.01	0.00	0.27
Child Controls	YES	YES	YES	YES
Parent Controls	YES	YES	YES	YES
Household Controls	YES	YES	YES	YES
Stunting				
Variables	Father Unemp.	Father Emp.	Mother Unemp.	Mother Emp.
Family Size	0.06 (0.06)	0.04** (0.02)	0.06** (0.03)	-0.02 (0.03)
Observations	134	3894	3582	446
R-squared	0.12	0.00	0.00	0.20
Child Controls	YES	YES	YES	YES
Parent Controls	YES	YES	YES	YES
Household Controls	YES	YES	YES	YES

Source: Own estimations from PDHS Data (2017-18).

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Climate Vulnerability and Debt: How Energy and Road Access Shape Household Coping in Pakistan

SAIMA NAWAZ

Does public infrastructure influence how people respond to climate shocks through borrowing? This study, using nationally representative household data merged with tehsil-level climate shocks, finds that rainfall shocks significantly increase the probability of household borrowing and the borrowed amount. It also shows that access to energy infrastructure significantly reduces the likelihood of household borrowing and the amount of debt. Access to road infrastructure reduces debt in normal conditions but increases it during climatic shocks. This study constructs a unique instrument, community-level access to media services, to address endogeneity in infrastructure. The heterogeneity analysis finds that poor and female-headed households face disproportionately higher debt burdens but derive greater financial protection from access to infrastructure. From a policy perspective, this study concludes that the availability of public infrastructure should be considered as a major factor in climate adaptation strategies.

Keywords: Household Debt, Climatic Shocks, Energy Infrastructure, Road Connectivity, Pakistan.

1. INTRODUCTION

Climate shocks threaten the financial stability of developing economies. The impacts of climate change, such as more frequent extreme events of droughts, earthquakes and heavy rainfall, have devastating effects on livelihoods, especially in low-income countries such as Pakistan (Mukherjee & Fransen, 2024). These climate shocks exacerbate financial distress by reducing income while increasing consumption needs (Kandikuppa & Gray, 2022; Dercon, 2004). However, access to public infrastructure, such as energy and roads, can mitigate these effects by stabilising income, improving connectivity, and reducing dependence on borrowing (Sovacool, 2012; Donaldson, 2018; Nawaz, 2021).

The literature on climate vulnerability and household debt indicates that climatic shocks exacerbate borrowing needs. Kandikuppa & Gray (2022) show that increased rainfall variability significantly raises household debt levels in rural India, while Acosta et al. (2021) highlight how climate shocks deepen poverty traps in developing economies. Similarly, Nawaz (2021) shows that energy poverty, when combined with climate-induced disruptions, increases health deprivation. However, limited attention has been paid to how public infrastructure moderates these vulnerabilities, especially in developing

countries where infrastructure deficits remain pronounced (Bazilian & Pielke, 2013; Chakravarty & Tavoni, 2013). This research gap is particularly crucial for Pakistan, where around 30 percent households depend on borrowing from various sources such, as formal and informal (Javed, et al. 2019). This necessitates investigating how access to public infrastructure, mainly energy and road connectivity, can reshape household decision-making during climate shocks.

Given this background, this study examines the interplay among public infrastructure, climate shocks, and borrowing behaviour of households in Pakistan. Pakistan is economically fragile and highly vulnerable to climate change (Adnan, et al. 2024). Pakistan faces recurrent climate shocks that have increased poverty, food insecurity, and economic vulnerabilities (World Bank, 2024; GoP, 2023). The study empirically measures the impact of climate shocks, namely rainfall anomalies, on the likelihood of household borrowing and the amount borrowed. This study also examines how public infrastructure, such as energy and road connectivity, softens these effects using interaction terms. This design is consistent with theoretical frameworks indicating that infrastructure stabilises income and reduces financial dependence on loans during climatic events (Khandker, et al. 2009; Dinkelman, 2011; Churchill, et al. 2023). The study examines heterogeneity in borrowing responses across socioeconomic groups to establish the robustness of the analysis (Dercon, 2004).

This study uses the Household Integrated Economic Survey (HIES) 2018-19 to achieve the desired objectives. The HIES provides comprehensive information on borrowing patterns among households along with other socio-demographic characteristics. Pakistan Mouza Census 2020 is used to capture community infrastructure, public services, and environmental conditions, and rainfall shocks are constructed using CHIRPS satellite data. The MOUZA Census and CHIRPS satellite data are merged with HIES using tehsil-level identifiers. For robustness checks, this study uses alternative climate-shock proxies, such as droughts and earthquakes (Dercon, 2004; Acosta et al., 2021; Aggarwal, 2021; Hirvonen, 2016).

The empirical analysis yielded numerous key results. This study shows that the likelihood of borrowing decreased by 46 percent to 53 percent with an increase in household income, while larger households are 4.7 percent to 5.0 percent more likely to borrow and accumulate higher debt. Experience and literacy reduce the probability of borrowing by 18 percent to 30 percent, while the effects of gender vary across regions and sociocultural contexts. Energy access (odds ratios of 0.794–0.876) and metal-paved roads (odds ratios of 0.750–0.870) reduce the likelihood of borrowing and debt amount among households. On the other hand, rainfall shocks increase both the likelihood of borrowing (odds ratios 1.039–1.656) and debt amounts (coefficients 0.931–0.938) among households. The empirical analysis shows that access to energy significantly reduces financial pressures from rainfall shocks. In contrast, the interaction of rainfall shocks with road infrastructure increases the likelihood of borrowing.

The heterogeneity analysis shows that rainfall shocks increase the likelihood of borrowing across all income groups, with the poor more vulnerable (odds ratio 1.770) than the non-poor (odds ratio 1.622). More importantly, access to public infrastructure reduces the likelihood of borrowing, particularly for poor households, highlighting the important role of public infrastructure in financial stability for vulnerable groups. The gender-disaggregated analysis shows that rainfall shocks place greater borrowing pressure on female-headed households (odds ratio 1.794 versus 1.635). Additionally, energy access enhances financial stability for female-headed households by lowering debt

(−0.358). Road infrastructure effects are mixed: it significantly reduces debt for male-headed households (−0.209) but has no notable impact on female-headed households.

This study builds on previous research demonstrating financial vulnerabilities induced by climatic shocks by incorporating the moderating effects of infrastructure (Kandikuppa & Gray, 2022; Dercon, 2004). It provides a comprehensive framework linking climatic shocks, public services, and borrowing behaviour in a developing-country context, contributing to debates on building resilience and economic adaptation (Donaldson, 2018; Sovacool, 2012). It complements studies on the role of infrastructure in economic development by quantifying its interaction with climate-induced borrowing needs (Nawaz, 2021; Jacoby & Minten, 2009).

This study offers three key contributions to the literature. First, it reconceptualises household debt as a structural consequence of climate vulnerability rather than merely a neutral means of smoothing consumption, thereby guiding climate–household analysis towards an understanding of financial fragility and reliance on debt. Second, it presents causal evidence on the impact of public infrastructure by addressing the endogeneity of energy access with a new community-level instrument, media service access, which remains underexplored in climate debt research. Third, this study shows that, using different proxies, infrastructure not only reduces the likelihood of borrowing but also improves the sustainability of debt management during climatic shocks. This analysis offers a mechanism-based understanding of how infrastructure influences coping strategies in climate-vulnerable household contexts.

The rest of the paper is organised as follows: Section 2 presents the theoretical model. Section 3 provides a detailed discussion on methodology and data construction. Section 4 presents the results and discussion based on empirical analysis. The final section provides the conclusion.

2. THEORETICAL MODEL

This section presents a simple decision-making model to analyse the impact of climatic shocks on the borrowing decisions of households. It also provides a mechanism to study the moderating role of public infrastructure in the face of climate shocks, thereby ensuring financial stability. This model assumes that households face an optimisation problem where they aim to maximise utility (U_i) by deciding whether to borrow (L_i), a choice influenced by income (Y_i), consumption needs (C_i), access to public services (S_i), and exposure to environmental shocks (Z_i). This model is based on the basic principles of utility maximization among households (Deaton & Muellbauer, 1980; Deaton, 1992; Alem, et al. 2023). This model assumes that the borrowing decision is binary: $L_i = 1$ if the utility with borrowing (U^L) exceeds the utility without borrowing (U^N); otherwise, $L_i = 0$.

In the absence of shocks, borrowing decisions are determined by income, consumption needs, and public services. The utility functions are given as:

$$U_i^L = Y_i + BC_i - \gamma L_i + \delta S_i,$$

$$U_i^N = Y_i + BC_i + \delta S_i$$

where β represents the marginal utility of consumption, γ denotes the cost of borrowing, and δ captures the utility derived from public services. Households choose to borrow if:

$$U_i^L > U_i^N \rightarrow -\gamma L_i + \delta S_i > 0.$$

Public services (S_i) reduce borrowing dependency by alleviating financial constraints. For example, energy stabilises income (Sovacool, 2012; Nawaz, 2021; Bazilian and Pielke, 2013; Churchill, et al. 2022), and road infrastructure improves market connectivity (Donaldson, 2018; Jacoby & Minten, 2009; Nawaz & Mangla, 2021). Both reduce dependence on loans (Khandker, et al. 2009; Dinkelman, 2011; Churchill, et al. 2023). This implies:

$$\frac{\partial L_i}{\partial S_i} < 0$$

Climatic shocks, such as rainfall anomalies, droughts, or earthquakes, affect income and increase consumption needs, making borrowing more likely (Dercon, 2004; Acosta, et al. 2021; Aggarwal, 2021; Hirvonen, 2016). For example, agricultural households facing rainfall variability may experience reduced crop yields, leading to income shortfalls and higher borrowing needs (Waqas, et al. 2025; Premand & Stoeffler, 2022; Amare, et al. 2021; Trinh, 2018). In this case, the utility functions become:

$$U_i^L = Y_i + BC_i - \gamma L_i + \delta S_i - \theta Z_i$$

$$U_i^N = Y_i + BC_i + \delta S_i - \theta Z_i$$

where θ represents the utility loss caused by shocks. Borrowing occurs if:

$$U_i^L > U_i^N \rightarrow -\gamma L_i + \delta S_i - \theta Z_i > 0.$$

Climatic shocks reduce income and increase consumption needs:

$$Y_i' = Y_i - \theta Z_i, C_i' = C_i + \phi Z_i,$$

where $\phi > 0$ reflects the extent to which shocks increase consumption. Substituting these adjustments into the utility functions:

$$U_i^L = (Y_i - \theta Z_i) + \beta(C_i + \phi Z_i) - \gamma L_i + \delta S_i - \theta Z_i$$

$$U_i^N = (Y_i - \theta Z_i) + \beta(C_i + \phi Z_i) + \delta S_i - \theta Z_i.$$

The borrowing condition then becomes:

$$-\gamma L_i + \beta\phi Z_i + \delta S_i > 0$$

Households maximise utility by selecting the optimal loan amount (L_i^*) to offset shocks. The utility maximisation problem is:

$$\max L_i \quad U_i^L = (Y_i - \theta Z_i) + \beta(C_i + \phi Z_i) - \gamma L_i + \delta S_i - \theta Z_i$$

The first-order condition (FOC) for utility maximisation is:

$$\frac{\partial U_i^L}{\partial L_i} = -\gamma + \delta \frac{\partial S_i}{\partial L_i} = 0.$$

Assuming $\delta \frac{\partial S_i}{\partial L_i} = 0$ (Short-term public service availability), the optimal loan amount is:

$$L_i^* = \frac{\beta\phi Z_i}{\gamma}$$

Public services (S_i) interact with shocks (Z_i) to influence borrowing. Improved access to energy and roads mitigates the adverse financial effects of shocks by reducing borrowing needs. This interaction modifies the utility function:

$$U_i^L = Y_i + \beta C_i - \gamma L_i + \delta S_i - \theta Z_i + \phi(S_i \times Z_i).$$

The interaction term ($S_i \times Z_i$) reduces the borrowing induced by shocks:

$$\frac{\partial^2 L_i}{\partial S_i \partial Z_i} < 0.$$

From this framework, the following hypotheses arise: (1) Climatic shocks (Z_i) increase the likelihood of borrowing ($\frac{\partial L_i}{\partial Z_i} > 0$) (Dercon, 2004; Aggarwal, 2021); (2) Public services (S_i) reduce borrowing ($\frac{\partial L_i}{\partial S_i} < 0$) (Khandker, et al. 2009; Dinkelman, 2011; Churchill, et al. 2023); (3) The interaction between public services and shocks ($S_i \times Z_i$) mitigates the adverse effects of shocks on borrowing ($\frac{\partial^2 L_i}{\partial S_i \partial Z_i} < 0$); and (4) the effects vary by household characteristics, such as income levels or the gender of the household.

3. METHODOLOGY

3.1. Data Description

We use multiple data sources to achieve the objectives. The primary data set is the 2018–19 Household Integrated Economic Survey (HIES), conducted by the Pakistan Bureau of Statistics (PBS). This nationally representative survey includes 24,809 households in Pakistan and provides comprehensive data on economic and social indicators at the national and provincial levels, with urban and rural disaggregation (Nawaz, 2021).

Second, we use the Pakistan Mouza Census 2020 to capture village-level road infrastructure. The census, conducted by the Agricultural Census Wing of the Pakistan Bureau of Statistics, covers all Mouzas, the smallest administrative units in rural Pakistan, and collects data on land use, crops, irrigation, livestock, forestry, and the socioeconomic conditions of the population.²

Data on natural disasters, such as droughts and earthquakes, and access to road infrastructure, are derived from the Mouza Census 2020.

We used monthly Climate Hazards Group InfraRed Precipitation with Station Data (CHIRPS) rainfall data to construct the final rainfall measure at the tehsil level, aggregating spatially using tehsil shapefiles. CHIRPS is a satellite-based dataset publicly available for research purposes from 1981 to 2018.³ For analytical purposes, monthly data covering the period from 1989 to 2018 were aggregated at the tehsil level and

²The Mouza Census provides vital information on major crops, sources of irrigation, cultivated areas, natural resources, disasters, and the number of settlements within communities. It also documents socioeconomic indicators, including access to drinking water, electricity, sewerage systems, healthcare, education, veterinary facilities, and sports facilities. In addition, the census captures data on infrastructure, such as roads and markets, as well as accessibility to police stations, financial institutions, and other services. For further details, see <https://www.pbs.gov.pk/content/mouza-census-2020>.

³For more information; see <https://www.chc.ucsb.edu/data/chirps>

subsequently merged with HIES data using tehsil identifiers. The tehsil-level identifiers were obtained from the PBS.

3.2. Variable Construction

This employs two different measures to analyse the debt dynamics at the household level:

- (1) **Debt Take-Up:** This study defines an indicator (a binary variable) that captures household borrowing decisions in the past year. If the household borrows, it takes the value 1; otherwise, it takes the value 0. This variable captures the household's decision to borrow and serves as a proxy for credit access (Kandikuppa & Gray, 2022; Churchill, et al. 2023).
- (2) **Debt Amount:** This variable captures total borrowing reported by the household. This measure is in line with the global literature on capturing the financial intensity of borrowing. (Kandikuppa & Gray, 2022; Churchill, et al. 2023).

These two measures capture extensive (decision to borrow) and intensive (amount borrowed) margins of debt, allowing for a comprehensive assessment of borrowing behaviour. This study constructs two variables to analyse the impact of public infrastructure on borrowing patterns among households.

Energy Access Index: First, a composite Energy Access Index (EAI) is constructed using three dimensions of energy-related infrastructure: electricity access, availability of clean water, and safe sanitation. Each component is standardised and centred using the inverse covariance index (Anderson method), which assigns weights based on the components' inverse covariance matrix. The EAI ranges from 0 to 1, with higher values reflecting improved energy service access. The EAI provides comprehensive details on energy infrastructure, as reported in the global literature (Chakravarty & Tavoni, 2013; Sovacool, 2012).

Road Infrastructure: This variable is constructed as a binary indicator of primary road access in the Mouza that is paved (1 = metal-paved, 0 = otherwise). This data is taken from the Pakistan Mouza Census 2020, which provides detailed information on community infrastructure. According to literature, access to paved roads enhances market connectivity, facilitates access to financial and public services, and reduces the economic impacts of climatic shocks (Donaldson, 2018; Jacoby & Minten, 2009; Arif & Iqbal, 2009).

3.3. Estimation Method

This study uses a logistic regression model for borrowing decisions to examine the relationship between public services, climatic shocks, and household borrowing behaviour. Furthermore, a linear regression model is used to analyse debt amounts. This empirical strategy allows to validate the hypotheses developed based on theoretical framework. It also allows to evaluate the direct and interaction effects of climatic shocks and public services on household borrowing dynamics. The borrowing decision (L_i) is captured as a binary outcome, where $L_i = 1$ if a household borrows and $L_i = 0$ otherwise. The corresponding probability of borrowing is estimated using a logistic regression framework:

$$\text{Logit}(P(L_i = 1)) = \alpha + \beta_1 Z_i + \beta_2 S_i + \beta_3 (Z_i \times S_i) + X_i \Gamma + \mu_r + \nu_p + \epsilon_i,$$

where:

Z_i : Climatic shocks (for example, rainfall anomalies).

S_i : Access to public services, such as energy and roads.

$(Z_i \times S_i)$: Interaction term capturing the mitigating role of public services during shocks.

X_i : Vector of household characteristics, including income, household size, head experience, head gender, and head literacy.

μ_r : Regional fixed effects to account for unobserved heterogeneity at the regional level.

ν_p : Provincial fixed effects to account for province-level factors.

ϵ : Error term that captures unobserved individual-specific factors.

For the debt amount (A_i), we estimate the following linear regression model:

$$A_i = \alpha + \beta_1 Z_i + \beta_2 S_i + \beta_3 (Z_i \times S_i) + X_i \Gamma + \mu_r + \nu_p + \epsilon_i,$$

where all variables are defined as above, and A_i represents the inverse hyperbolic sine (IHS) transformed debt amount to address skewness in the data.

We incorporate regional fixed effects (μ_r) and provincial fixed effects (ν_p) in all to control unobserved heterogeneity, ensuring that the estimates of Z_i , S_i , and their interaction are not biased by omitted regional or provincial factors. We also include various household characteristics (X_i) to address individual-level heterogeneity (see Appendix Table A1 for a detailed description of all variables). The interaction term ($Z_i \times S_i$) which helps us assess whether public services mitigate the financial impact of climatic shocks.

4. RESULTS AND DISCUSSION

This section presents empirical results and discussion aligned with the objectives of the study.

4.1. Baseline Results

The empirical analysis started by estimating baseline regression models. Table 1 presents baseline results showing the impact of household characteristics on the likelihood of household borrowing and per capita debt. Four different specifications are used to ensure the robustness of results. Model 1 captures basic household characteristics, while Model 2 extends the specification by including provincial fixed effects. Model 3 includes regional fixed effects, while Model 4 provides a more fully extended version with both provincial and regional fixed effects.

The empirical results show that household income, measured as log expenditures, is an important factor in shaping borrowing decisions. Table 1 shows that a one-unit increase in income (log expenditures) reduces the probability of borrowing by 46 to 53 percent (odds ratio 0.54 to 0.60) and reduces per capita debt by coefficients from -0.561 to -0.904. This suggests that richer households rely less on loans, possibly due to better financial stability, savings, or access to other resources. On the other hand, larger households are inclined to borrow more. Each additional member increases the likelihood of borrowing by 4.7 to 5.0 percent ($p < 0.01$) and debt amounts ranging from 0.018 to 0.092.

Table 1

Household Debt Dynamics in Pakistan

Variables	Debt Take-up (Odds Ratios)				Debt Amount (Coefficients)			
	1	2	3	4	1	2	3	4
Income	0.543*** (0.024)	0.454*** (0.022)	0.607*** (0.027)	0.471*** (0.024)	-0.756*** (0.067)	-0.904*** (0.065)	-0.561*** (0.070)	-0.857*** (0.069)
Household Size	1.047*** (0.006)	1.011* (0.006)	1.050*** (0.006)	1.012* (0.006)	0.086*** (0.011)	0.018* (0.010)	0.092*** (0.011)	0.020** (0.010)
HH Exp	0.816*** (0.046)	0.696*** (0.042)	0.813*** (0.045)	0.695*** (0.042)	-0.325*** (0.097)	-0.515*** (0.093)	-0.333*** (0.097)	-0.516*** (0.093)
HH Gender	0.892** (0.050)	1.325*** (0.081)	0.916 (0.052)	1.335*** (0.082)	-0.219** (0.099)	0.411*** (0.094)	-0.171* (0.099)	0.419*** (0.094)
HH LIT	0.801*** (0.029)	0.771*** (0.030)	0.824*** (0.030)	0.778*** (0.031)	-0.394*** (0.065)	-0.381*** (0.062)	-0.340*** (0.065)	-0.369*** (0.062)
Wald chi2/F stat	562.18	2,848.54	635.64	2,845.35	94.89	394.08	97.12	354.54
Observations	23,000	23,000	23,000	23,000	23,000	23,000	23,000	23,000
Pro FE Effects	No	Yes	No	Yes	No	Yes	No	Yes
Region FE Effects	No	No	Yes	Yes	No	Yes	No	Yes

Note: Author's own estimation. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Robust S.E. in parentheses., respectively.

The analysis shows that the age of the head of household, used as a proxy for experience, has a negative impact on the probability of borrowing by the household as well as on the debt amount. Table 1 reveals that one additional year of experience (age) reduces the likelihood of borrowing by 18.4 percent to 30.4 percent (odds ratio 0.69 to 0.82) and lowers debt levels, with coefficients between -0.325 and -0.516. These results indicate that experienced heads can manage financial resources more effectively and diversify their income to rely less on borrowing, especially during a crisis.

The analysis shows that male-headed households are less likely to borrow (odds ratio 0.892, $p < 0.05$) in model 1. Male-headed households are more likely to borrow (odds ratio 1.325, $p < 0.01$) and have higher per capita debt (coefficients of 0.411 to 0.419) when regional fixed effects are included. These differences are important for understanding decision-making about borrowing under different socio-economic and cultural factors.

The literacy head has consistently had a negative impact on the probability of borrowing and debt levels. Table 1 shows that literate households are 18 percent to 23 percent less likely to borrow (odds ratios from 0.771 to 0.824), and their per capita debt is lower, with coefficients from -0.340 to -0.394. This implies that literacy plays an important role in improving financial management.

4.2. Role of Energy, Road, and Rainfall Shocks

This subsection analyses the impact of access to energy and road infrastructure on household debt dynamics, including both the likelihood of borrowing and the amount owed, after controlling for covariates (see Table 2). The Energy Access Index (EAI) is constructed using the Anderson method, which combines clean water, electricity, and safe sanitation. This study finds that access to energy is significantly associated with lower borrowing and smaller debt levels. Table 2 shows that energy access reduces the likelihood of borrowing by 0.794 to 0.876 ($p < 0.01$). This study further finds that energy access has a negative impact on the amount of debt (coefficients ranging from -0.397 to -

0.161, $p < 0.01$). These results indicate that the availability of energy infrastructure reduces financial vulnerability, lowers living costs, and enhances overall resilience.

Table 2

Variables	<i>Impact of Energy and Road on Debt Dynamics</i>							
	Debt Take-up (Odds Ratios)				Debt Amount (Coefficients)			
	1	2	3	4	1	2	3	4
Energy	0.794*** (0.023)	0.862*** (0.029)	0.847*** (0.026)	0.876*** (0.031)	-0.397*** (0.051)	-0.180*** (0.049)	-0.283*** (0.053)	-0.161*** (0.052)
Road	0.750*** (0.064)	0.849* (0.076)	0.838** (0.073)	0.870 (0.080)	-0.474*** (0.120)	-0.145 (0.106)	-0.299** (0.122)	-0.116 (0.110)
Wald chi2/F Stat	659.57	2,832.24	693.82	2,846.23	82.23	325.87	79.96	299.52
Observations	23,000	23,000	23,000	23,000	23,000	23,000	23,000	23,000
Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pro FE Effects	No	Yes	No	Yes	No	Yes	No	Yes
Region FE Effects	No	No	Yes	Yes	No	Yes	No	Yes

Note: Author's own estimation. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Robust S.E. in parentheses., respectively.

Table 2 shows that access to metal-paved roads significantly reduces the likelihood of borrowing (odds ratios ranging from 0.750 to 0.870) and lowers debt levels (coefficients ranging from 0.474 to -0.116). This implies that access to road infrastructure helps diversify and expand income opportunities, reduces time and transaction costs, and enhances market access. This, in turn, implies that it reduces the borrowing requirements. These results depict the transformative role of public infrastructure in overcoming financial stress by providing alternative income opportunities and reducing transaction costs (Donaldson, 2018; Jacoby & Minten, 2009; Arif & Iqbal, 2009).

Table 3 presents the analysis after including rainfall shock as an additional variable. Annual rainfall deviation from long-term averages is used to capture rainfall shocks. This study uses annual rainfall deviation to assess the impact of shocks on household debt. All specifications also include covariates, as in Tables 1 and 2, to ensure robustness. Table 3 shows that rainfall shock is significantly associated with borrowing decisions and borrowing amounts. The results indicate that households are significantly more likely to borrow when rainfall deviates, with odds ratios ranging from 1.039 to 1.656 (mostly $p < 0.01$). These results suggest that climate shocks, such as excessive or insufficient rainfall, adversely affect household incomes, particularly in rural areas where agriculture is the primary source of income and is highly sensitive to such shocks. Table 3 shows that rainfall shock has a positive and significant impact on debt size, with coefficients ranging from 0.931 to 0.938 ($p < 0.01$). These results indicate that rainfall anomalies increase both the likelihood and size of household debt, highlighting the financial stress caused by climate shocks. Overall, these results underline household vulnerability to climatic shocks.

Table 3

<i>Impact of Energy, Road, and Climate on Debt Dynamics</i>								
Variables	Debt Take-up (Odds Ratios)				Debt Amount (Coefficients)			
	1	2	3	4	1	2	3	4
Energy	0.884*** (0.027)	0.865*** (0.029)	0.920*** (0.029)	0.880*** (0.031)	-0.219*** (0.049)	-0.177*** (0.049)	-0.153*** (0.051)	-0.156*** (0.052)
Road	0.829** (0.071)	0.848* (0.076)	0.880 (0.077)	0.870 (0.080)	-0.150 (0.109)	-0.144 (0.106)	-0.047 (0.112)	-0.112 (0.109)
Rain Shock	1.656*** (0.021)	1.039 (0.027)	1.648*** (0.021)	1.041 (0.027)	0.938*** (0.023)	0.067 (0.045)	0.931*** (0.023)	0.070 (0.045)
Wald chi2/F Stat	1,970.48	2,844.27	1,970.90	2,857.07	289.84	301.48	258.75	278.90
Observations	23,000	23,000	23,000	23,000	23,000	23,000	23,000	23,000
Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pro FE Effects	No	Yes	No	Yes	No	Yes	No	Yes
Region FE Effects	No	No	Yes	Yes	No	Yes	No	Yes

Note: Author's own estimation. *** p<0.01, ** p<0.05, * p<0.10. Robust S.E. in parentheses., respectively

4.3. Interaction Effects: Rainfall Shock, Energy Access, and Road Infrastructure

One of the key objectives is to examine the role of infrastructure in moderating the financial impacts of climatic shocks, specifically rainfall anomalies. This study uses interaction terms between rainfall shocks and infrastructure variables, such as energy access and road connectivity, to analyse the moderating impacts. All specifications given in Table 4 include covariates, as in Tables 1 and 2, to ensure robustness. Table 5 presents the interaction effects of rainfall shocks with energy access and road infrastructure on household debt dynamics.

The analysis shows that rainfall shocks have a positive and significant impact, with odds ratios for debt take-up ranging from 1.546 to 1.580 and coefficients for debt amounts ranging from 0.835 to 0.871 ($p < 0.01$). These results align with those presented in Table 3. Households are likely to borrow more and incur more debt when rainfall deviates from long-term averages.

Table 4

<i>Impact of Rainfall Shock Interactions with Energy and Road on Debt Dynamics</i>								
Variables	Debt Take-up (Odds Ratios)				Debt Amount (Coefficients)			
	1	2	3	4	1	2	3	4
Rain Shock	1.580*** (0.021)	1.572*** (0.020)	1.553*** (0.020)	1.546*** (0.020)	0.866*** (0.023)	0.871*** (0.023)	0.841*** (0.023)	0.835*** (0.023)
Energy	0.902** (0.045)	0.780*** (0.023)	0.928 (0.047)	1.019 (0.053)	0.058 (0.066)	-0.381*** (0.048)	0.107 (0.066)	0.263*** (0.069)
Energy*Rain	0.931*** (0.017)	—	0.924*** (0.017)	0.917*** (0.017)	-0.251*** (0.031)	—	-0.264*** (0.031)	-0.277*** (0.031)
Road	0.750*** (0.063)	0.318*** (0.068)	0.302*** (0.063)	0.374*** (0.077)	-0.380*** (0.110)	-0.939*** (0.158)	-1.154*** (0.158)	-0.907*** (0.159)
Road*Rain	—	1.520*** (0.119)	1.546*** (0.120)	1.468*** (0.111)	—	0.450*** (0.103)	0.516*** (0.102)	0.474*** (0.101)
Wald chi2/F Stat	1,811.56	1,754.29	1,787.80	1,816.61	263.22	263.64	242.02	221.67
Observations	23,000	23,000	23,000	23,000	23,000	23,000	23,000	23,000
Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pro FE Effects	No	Yes	No	Yes	No	Yes	No	Yes
Region FE Effects	No	No	Yes	Yes	No	Yes	No	Yes

Note: Author's own estimation. *** p<0.01, ** p<0.05, * p<0.10. Robust S.E. in parentheses., respectively

Energy access reduces the likelihood of borrowing (odds ratios ranging from 0.780 to 0.928, significant in most models) and the amount of debt (coefficients ranging from -0.381 to 0.263, significant in some cases). The interaction term between the rainfall shock and energy access is significant and negative. For debt take-up, the odds ratios for the interaction term (Energy*Rain) range from 0.917 to 0.931 ($p < 0.01$), and for debt amounts, the coefficients range from -0.251 to -0.277 ($p < 0.01$). Using model 1, the net effect of the rainfall shock on the dynamics of household debt is calculated by combining the direct impact of the rainfall shock, the direct effect of energy access, and their interaction term, using the formula Net Effect = $\beta_{\text{Rain}} + \beta_{\text{Energy}} + \beta_{\text{Energy*Rain}}$. For debt take-up, the coefficients are $\beta_{\text{Rain}} = 1.580$, $\beta_{\text{Energy}} = 0.902$, and $\beta_{\text{Energy*Rain}} = 0.931$ (Table 5). Substituting these values, the log odds are $\ln(1.580) + \ln(0.902) + \ln(0.931) = 0.283$, yielding a net odds ratio of $e^{0.283} \approx 1.327$, which means that the likelihood of borrowing increases by approximately 32.7 percent with energy access. However, without energy access (odds ratio = 1.580), borrowing pressures due to rainfall shocks are significantly higher. The mitigating effect of energy access reduces the likelihood of borrowing $1 - \frac{1.327}{1.580} \approx 16.0\%$. For debt amounts, the coefficients are $\beta_{\text{Rain}} = 0.835$, $\beta_{\text{Energy}} = 0.263$, and $\beta_{\text{Energy*Rain}} = -0.277$ (Table 4). Substituting these values, the net effect on the per capita debt amount transformed by IHS is $0.835 + 0.263 - 0.277 = 0.821$. To interpret this in monetary terms, the net effect is multiplied by the mean per capita debt of PKR 5509, resulting in an increase of approximately PKR 4521. This indicates that rainfall shocks, moderated by energy access, increase the per capita debt by 4521 PKR. However, the negative interaction term ($\beta_{\text{Energy*Rain}} = -0.277$) indicates that energy access mitigates the overall debt burden relative to scenarios without adequate energy infrastructure. Without energy access, the financial impact of rainfall shocks on debt amounts would be significantly higher.

Table 5

Impact of Rainfall Shock, Energy Access, and Road Infrastructure on Debt Dynamics

Infrastructure	Outcome	β_{Rain}	β_{Infra}	$\beta_{\text{Infra*Rain}}$	Net Effect
Energy Access	Debt Take-Up (Odds Ratios)	1.580	0.902	0.931	0.283 (Log Odds)
	Debt Amount (Coefficients)	0.835	0.263	-0.277	0.821
Road Infrastructure	Debt Take-Up (Odds Ratios)	1.572	0.849	1.520	0.426 (Log Odds)
	Debt Amount (Coefficients)	0.871	-0.939	0.450	0.382

Note: Author's own estimation based on Table 4.

Road infrastructure alone shows mixed effects. It reduces debt take-up (odds ratios from 0.302 to 0.750) and debt amounts (coefficients from -0.907 to -0.380), though its effects are less robust than those of energy access. However, the interaction term between the rainfall shock and road infrastructure (Road*Rain) reveals a significant positive association with both debt take-up (odds ratios ranging from 1.468 to 1.546) and debt amounts (coefficients of 0.450 to 0.516, $p < 0.01$). Using model 2, the net effect of the rainfall shock on household debt dynamics is calculated by combining the direct impact of the rainfall shock, the direct effect of road infrastructure, and their interaction term. For debt take-up, the coefficients are $\beta_{\text{Rain}} = 1.572$, $\beta_{\text{Road}} = 0.849$, and $\beta_{\text{Road*Rain}} = 1.520$ (Table 4). Substituting these values, the log odds are $\ln(1.572) + \ln(0.849) + \ln(1.520) = 0.426$, resulting in a net odds ratio of $e^{0.426} \approx 1.531$, which means that the likelihood of borrowing increases by approximately 53.1 percent with the road infrastructure. However, without road infrastructure (odds ratio = 1.572), borrowing pressures due to rainfall shocks remain higher. For debt amounts, the coefficients are $\beta_{\text{Rain}} = 0.871$, $\beta_{\text{Road}} = -0.939$, and $\beta_{\text{Road*Rain}} = 0.450$ (Table 4). Substituting these values, the net effect on the per capita debt amount transformed by IHS is $0.871 - 0.939 + 0.450 = 0.382$. To

interpret this in monetary terms, the net effect is multiplied by the mean per capita debt of PKR 5509, increasing approximately PKR 2105.

This analysis shows that rainfall shocks, moderated by road infrastructure, increase per capita debt by PKR 2105. The positive sign of the interaction term ($\beta_{\text{Road}*\text{Rain}} = 0.450$) indicates that access to road infrastructure increases the financial impact of rainfall shocks. One possible reason for this outcome is that it might increase by allowing access to credit and market connectivity. Although the direct negative effect of access to road infrastructure ($\beta_{\text{Road}} = -0.939$) partially offsets this increase, it reflects the dual role of road infrastructure in both reducing baseline debt levels and increasing borrowing during climatic shocks. Table 5 shows the impact of Rainfall shock, energy Access, and road infrastructure on debt dynamics. The net effects calculated are based on Table 4.

4.4. Heterogeneity Analysis

This section extends the analysis by analysing the moderating effects across two key dimensions: (i) poverty status, where households are divided based on income profile and categories as poor and non-poor, and (ii) the gender of the household head, where the sample is split into male-headed vs female-headed. The empirical reveals distinct patterns in the impact of rainfall shocks, energy access, and road infrastructure on debt dynamics across poor and non-poor households.

Table 6 shows that rainfall shocks significantly increase the likelihood of borrowing for both groups, with odds ratios of 1.622 ($p < 0.01$) for non-poor households and 1.770 ($p < 0.01$) for poor households, indicating greater financial vulnerability among the poor. The empirical results regarding Energy Access Index (EAI) show that energy access reduces the likelihood of borrowing, with odds ratios of 0.900 ($p < 0.01$) for nonpoor households and 0.792 ($p < 0.01$) for poor households, reflecting the critical role of energy infrastructure in buffering financial shocks, particularly for the poor.

Similarly, access to road infrastructure reduces the likelihood of borrowing, with odds ratios of 0.851 ($p < 0.10$) for non-poor households and 0.679 ($p < 0.05$) for poor households, highlighting a stronger alleviating effect of connectivity on vulnerable groups. The analysis further shows that energy access has negative coefficients of -0.193 ($p < 0.01$) for non-poor households and -0.407 ($p < 0.01$) for poor households, while road infrastructure shows coefficients of -0.131 ($p > 0.10$) and -0.601 ($p < 0.05$) for debt amount, respectively. These results indicate that access to infrastructure significantly stabilises finances, with greater reductions in borrowing observed among poor households.

Table 6

Heterogeneous Analysis: Poverty Status

Variables	Debt Take-up (Odds Ratios)		Debt Amount (Coefficients)	
	Non-poor	Poor	Non-poor	Poor
Energy	0.900*** (0.031)	0.792*** (0.049)	-0.193*** (0.055)	-0.407*** (0.107)
Road	0.851* (0.081)	0.679** (0.124)	-0.131 (0.117)	-0.601** (0.298)
Rain Shock	1.622*** (0.024)	1.770*** (0.048)	0.866*** (0.025)	1.227*** (0.050)
Wald chi2/F Stat	1,433.31	486.45	201.54	86.70
Observations	18,554	4,446	18,554	4,446
Covariates	Yes	Yes	Yes	Yes
Pro FE Effects	Yes	Yes	Yes	Yes
Region FE Effects	Yes	Yes	Yes	Yes

Note: Author's own estimation. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Robust S.E. in parenthesis., respectively.

The gender-based analysis of debt dynamics reveals distinct patterns in how rainfall shocks, energy access, and road infrastructure affect borrowing behavior and debt levels for male- and female-headed households. For debt take-up, rainfall shocks significantly increase the likelihood of borrowing for both groups, with odds ratios of 1.635 ($p < 0.01$) for male-headed households and 1.794 ($p < 0.01$) for female-headed households, indicating slightly higher vulnerability among female heads. Energy access reduces the likelihood of borrowing for both groups, with an odds ratio of 0.891 ($p < 0.01$) for male-headed households and 0.864 ($p > 0.10$) for female-headed households, though the effect is more pronounced and significant for male-headed households. Road infrastructure has a significant positive impact on borrowing among male-headed households (odds ratio 0.796, $p < 0.05$), whereas for female-headed households, the effect is positive but not statistically significant (odds ratio 1.377, $p > 0.10$) (Table 7). For debt amounts, rainfall shocks again have a significant positive impact, with coefficients of 0.920 ($p < 0.01$) for male-headed households and 1.028 ($p < 0.01$) for female-headed households, suggesting higher debt burdens for female-headed households during rainfall anomalies. Energy access reduces debt amounts for both groups, with coefficients of -0.197 ($p < 0.01$) for male-headed households and -0.358 ($p < 0.05$) for female-headed households, indicating that access to energy infrastructure provides stronger financial stability for female-headed households. Road infrastructure reduces debt for male-headed households (-0.209, $p < 0.10$), while its effect on female-headed households is positive but not statistically significant (0.542, $p > 0.10$).

Table 7

Heterogeneous Analysis: Gender of Household Head

Variables	Debt Take-up (Odds Ratios)		Debt Amount (Coefficients)	
	Female Head	Male Head	Female Head	Male Head
Energy	0.864 (0.089)	0.891*** (0.028)	-0.358** (0.159)	-0.197*** (0.052)
Road	1.377 (0.447)	0.796** (0.071)	0.542 (0.441)	-0.209* (0.113)
Rain Shock	1.794*** (0.080)	1.635*** (0.022)	1.028*** (0.069)	0.920*** (0.024)
Wald chi2/F Stat	295.23	1,676.44	60.69	274.55
Observations	2,208	20,792	2,208	20,792
Covariates	Yes	Yes	Yes	Yes
Pro FE Effects	Yes	Yes	Yes	Yes
Region FE Effects	Yes	Yes	Yes	Yes

Note: Author's own estimation. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Robust S.E. in parenthesis., respectively.

4.5. Robustness

This study extends the analysis by investigating the impact of an alternative proxy for climate shocks to establish robustness. It employs drought and earthquake events at the tehsil level, generated from the MOUZA Census 2020. The MOUZA Census 2020 provides self-reported shocks at the mouza level. These variables provide information on the impacts of different shocks across various environmental stressors, mainly drought and earthquakes. The analysis presented in Table 8 confirms that the impacts of climatic shocks on debt dynamics are consistent across alternative proxies for environmental stressors, namely self-reported drought and earthquake events.

The results show that both drought and earthquake shocks significantly increase the likelihood of borrowing, with odds ratios of 1.880 ($p < 0.01$) and 4.640 ($p < 0.01$) for debt take-up, respectively. This indicates that households are more likely to rely on loans in response to both types of shocks, with earthquakes showing a particularly pronounced effect. Similarly, for debt amounts, both drought and earthquake shocks significantly increase borrowing levels, with

coefficients of 0.751 ($p < 0.01$) for drought and 3.050 ($p < 0.01$) for earthquakes, highlighting the financial strain these events impose (Table 8). These results show the robustness of the findings.

Table 8

<i>Robustness Analysis: Impact of Drought and Earthquake on Debt Dynamics</i>				
Variables	Debt Take-up (Odds Ratios)		Debt Amount (Coefficients)	
	Drought	Earthquake	Drought	Earthquake
Energy	0.902*** (0.032)	0.898*** (0.032)	-0.125** (0.052)	-0.127** (0.052)
Road	0.894 (0.083)	0.915 (0.083)	-0.054 (0.111)	-0.055 (0.110)
Shock	1.880*** (0.197)	4.640*** (0.758)	0.751*** (0.137)	3.050*** (0.276)
Wald chi2/F Stat	2,842.20	2,909.03	282.03	316.01
Observations	23,000	23,000	23,000	23,000
Covariates	Yes	Yes	Yes	Yes
Pro FE Effects	Yes	Yes	Yes	Yes
Region FE Effects	Yes	Yes	Yes	Yes

Note: Author's own estimation. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Robust S.E. in parenthesis., respectively.

Following the literature, we also use the debt-to-income ratio as an alternative measure of borrowing to establish the robustness of the results (Churchill, et al. 2023; Kasoga & Tegambwage, 2021; Schicks, 2014; Chichaibelu & Waibel, 2017). The findings using the debt-to-income ratio as an outcome variable closely align with the results of the debt take-up and per capita debt amount analyses presented earlier (Table 9). Energy access and road infrastructure consistently show a negative relationship with the debt-to-income ratio, while rainfall shocks, as expected, significantly increase it (Table 9).

Table 9

<i>Impact of Rainfall Shock, Energy, and Road on Debt Dynamics: Alternative Measure</i>				
Variables	Debt Take-up (Odds Ratios)		Debt Amount (Coefficients)	
	Drought	Earthquake	Drought	Earthquake
Energy	-0.060*** (0.010)	-0.044*** (0.010)	-0.036*** (0.010)	-0.032*** (0.011)
Road	-0.061*** (0.023)	-0.057** (0.023)	-0.028 (0.024)	-0.040* (0.023)
Shock	0.169*** (0.005)	0.011 (0.009)	0.168*** (0.005)	0.013 (0.009)
Wald chi2/F Stat	200.63	217.93	178.02	199.55
Observations	23,000	23,000	23,000	23,000
Covariates	Yes	Yes	Yes	Yes
Pro FE Effects	No	Yes	No	Yes
Region FE Effects	No	No	Yes	Yes

Note: Author's own estimation. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Robust S.E. in parenthesis., respectively.

4.6. Dealing with Endogeneity

The relationship between energy access and household debt may be confounded by endogeneity arising from unobserved factors that simultaneously influence energy access and borrowing behaviour (Nawaz, 2021; Churchill, et al. 2022; Churchill & Smyth, 2021). Nawaz (2021) & Zhang, et al. (2021) suggest using the Lewbel (2012) approach to address endogeneity issues, particularly when instruments are weak. Building on this

framework, we implement the two-stage least squares (2SLS) method of Lewbel (2012), incorporating both external and internally generated instrumental variables (IVs) to mitigate endogeneity. We use community-level media exposure as a novel and justified instrument in this context. Media penetration often reflects external investments in communication infrastructure, which are unlikely to directly affect individual household borrowing decisions. However, it indirectly influences energy access by increasing awareness and demand for community-level infrastructure improvements. Using this approach, we estimate the impact on debt take-up, debt amount, and debt-to-income ratio. The results are presented in Table 10. The Cragg-Donald weak-identification Wald test confirms the validity of the proposed instrument (Jiang & Lyu, 2019; Desbordes & Verardi, 2012), and the overidentification tests (Sargan statistics) confirm the instrument exogeneity (Table 10). These results ensure that the instruments are uncorrelated with the error term, a key requirement for IV validity. The results demonstrate the significant impact of energy access on household debt indicators. We have seen that energy access and road infrastructure reduce debt take-up, per capita debt, and the debt-to-income ratio, while rain shock increases them (Table 10). These results are in line with earlier findings.

Table 10
Instrumental Variable (IV) Regression Results

	Std IV	Gen Inst	Gen Ext Inst
Panel A: Debt Take Up)			
Energy	-0.065*** (0.016)	-0.554*** (0.096)	-0.085*** (0.016)
Road	-0.016 (0.012)	0.100*** (0.027)	-0.011 (0.012)
Rain Shock	0.093*** (0.002)	0.095*** (0.002)	0.093*** (0.002)
Constant	0.073*** (0.004)	0.064*** (0.006)	0.073*** (0.004)
Observations	23,000	23,000	23,000
Cragg-Donald F-stat	1811.351	37.236	629.072
Overidentification Test (p-value)	—	0.0445	0.0000
Panel B: Per Capita Debt			
Energy	-0.472*** (0.162)	-4.672*** (0.913)	-0.644*** (0.159)
Road	-0.226* (0.126)	0.769*** (0.259)	-0.185 (0.126)
Rain Shock	0.958*** (0.019)	0.972*** (0.022)	0.959*** (0.019)
Constant	0.695*** (0.043)	0.620*** (0.053)	0.692*** (0.043)
Observations	23,000	23,000	23,000
Cragg-Donald F-stat	1811.351	37.236	629.072
Overidentification Test (p-value)	—	0.0459	0.0000

Note: Author's own estimation. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Robust S.E. in parenthesis., respectively. StdIV means Standard IV, GenInst means IV with Generated Instruments only, and GenExtInst means IV with Generated Instruments and External Instruments.

5. CONCLUDING REMARKS AND POLICY LESSONS

This study offers key insight into the dynamics of household debt in Pakistan, with a focus on the interaction among climatic shocks, public infrastructure, and borrowing behaviour. The empirical findings indicate that access to public infrastructure plays a key role in mitigating financial vulnerabilities stemming from environmental stressors. The results

show that climatic shocks, such as rainfall shocks, significantly increase the likelihood of borrowing and the amount of debt. By contrast, access to energy infrastructure significantly reduces the probability of borrowing and the amount of debt. Road infrastructure has a dual role: it reduces borrowing overall but increases borrowing during climatic shocks. The analysis of heterogeneity indicates that poor and female-headed households are heavily impacted by climatic shocks and tend to rely more on borrowing. Access to public infrastructure, especially energy access, is crucial in stabilising vulnerable populations by easing financial pressures and enhancing resilience. These insights carry important implications for infrastructure investment and disaster management policies in Pakistan.

The analysis presented in this paper highlights key areas for policy intervention to overcome financial vulnerabilities and improve well-being. First, access to energy infrastructure for all is a key factor to stabilise income vulnerabilities. Expansion of these facilities, especially in rural areas, should be given top priority by provincial governments. Second, improved local road infrastructure, especially its access, helps to address debt vulnerabilities at the household level.

Addressing regional disparities is essential, especially as provinces like Balochistan and Sindh face major climate and economic vulnerabilities. Implementing targeted interventions such as improving infrastructure and disaster risk management in these areas can help narrow the resilience gap. Additionally, integrating financial services into climate adaptation policies is vital for providing households with alternative safety nets. Expanding access to microfinance, affordable insurance, and emergency relief funds can lessen borrowing pressures during climate shocks, allowing households to recover more effectively and sustainably. These policy measures will enable Pakistan to develop a more resilient and equitable socioeconomic system capable of handling the impacts of climate change.

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APPENDIX

APPENDIX A1: VARIABLE DEFINITIONS

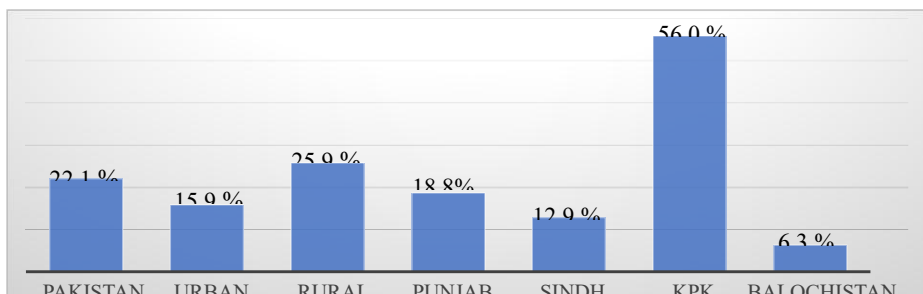
Appendix Table A1: Variable Definitions

Variables	Descriptions	Sources
Household Size	The total number of individuals living in the household, including all family members and dependents, regardless of their age or economic contribution (Continuous)	HIES
HH EXP	The age (in years) of the head of the household is used to measure experience (continuous – years)	
HH Gender	A binary variable indicating the gender of the household head, where 1 = Male and 0 = Female.	HIES
HH Lit	A binary variable indicating whether the household head is literate, where 1 = Literate and 0 = Illiterate.	HIES
Clean Water	A binary variable indicating access to clean water. Takes the value 1 if the household has access to piped water or water from a hand pump; 0 otherwise.	HIES
Safe Sanitation	A binary variable for access to safe toilet facilities. Takes the value 1 if the household has a flush toilet connected to a public sewerage system, a pit, or an open drain; 0 otherwise.	HIES
Electricity	A binary variable for access to electricity. Takes the value 1 if the household has an electricity connection; 0 otherwise.	HIES
Energy Access	Aggregates three energy-related facilities, including clean water, access to electricity, and safe sanitation. Standardized and aggregated using an inverse covariance index. Energy Access Index is constructed using the Anderson method [ICW INDEX], which involves standardizing and centering variables before computing the index based on the inverse covariance matrix.	Index, HIES
Road	Indicates whether roads in the MOUZA are metal-paved (coded as 1 if yes, 0 otherwise).	MOUZA Census
Rain shock	Rainfall shock is defined as the absolute deviation of annual rainfall from its long-term mean values and is expressed as $\text{Rainfall Shock} = x - \bar{x} $, where x is the rainfall value for 2018 and $\bar{x}$ is the average rainfall over the last 30 years, constructed at the tehsil level.	CHIRPS
Drought	A continuous variable representing the mean value of drought experienced by MOUZA within a tehsil in the last five years.	MOUZA Census
Earthquakes	A continuous variable representing the mean value of earthquakes experienced by MOUZA within a tehsil in the last five years.	MOUZA Census
Media Access	Aggregates four media facilities, including Radio, TV, Cable, and Newspaper. Standardized and aggregated using an inverse covariance index. Media Access Index is constructed using the Anderson method [ICW INDEX], which involves standardizing and centering variables before computing the index based on the inverse covariance matrix.	Index, MOUZA Census

Notes: Author's formulation.

APPENDIX A2: HOUSEHOLD DEBT DYNAMICS

Household debt plays a key role in the socioeconomic landscape of Pakistan, reflecting financial stress to fulfil both consumption and investment needs. The analysis shows that about 22 percent of households use loans, indicating widespread reliance across the population. Rural households (26 percent) are more likely to borrow than urban ones (16 percent). As shown in Figure 1, borrowing rates vary significantly between provinces, with Khyber Pakhtunkhwa (KP) having the highest and Balochistan the lowest, highlighting regional differences in borrowing behaviours. These variations reflect underlying socioeconomic and infrastructural factors that influence household debt patterns in Pakistan.

Appendix Figure A1: Percentage of Households Involved in Borrowing

Notes: Author's calculation based on the Household Integrated Economic Survey (HIES) 2018-19 data, which is nationally representative. The outcome variable "Loan Taken" is a binary variable, assigned a value of 1 if a loan has been taken by the household and 0 otherwise.

Table A2 presents the distribution of household-level debt in Pakistan. Debt is calculated using information from the Household Integrated Economic Survey (HIES) 2018-19, adjusted for 2023 conditions. Debt amounts are adjusted for inflation using annual inflation rates. The total number of households reported in the 2023 Census (38.3 million) is used to construct the national-level debt estimate. Simulated debt amounts are disaggregated across groups.

This study shows that 22.1 percent of households report borrowing, with an average debt of PKR 72,158 per household and a total debt of PKR 2,767 billion (Table A2). At the provincial level, Khyber Pakhtunkhwa (KP) has the highest borrowing percentage (56.0 percent) and total debt (PKR 1,278 billion), while Balochistan has the lowest borrowing percentage (6.3 percent) and total debt (PKR 27 billion). Rural households are more likely to borrow than urban households, contributing PKR 1,859 billion and PKR 898 billion to total debt, respectively. Across income groups, borrowing is most prevalent among the poorest households (30.4 percent) and least common among the wealthiest (12.3 percent) (Table A2).

Appendix Table A2: Distribution of Household Debt in Pakistan

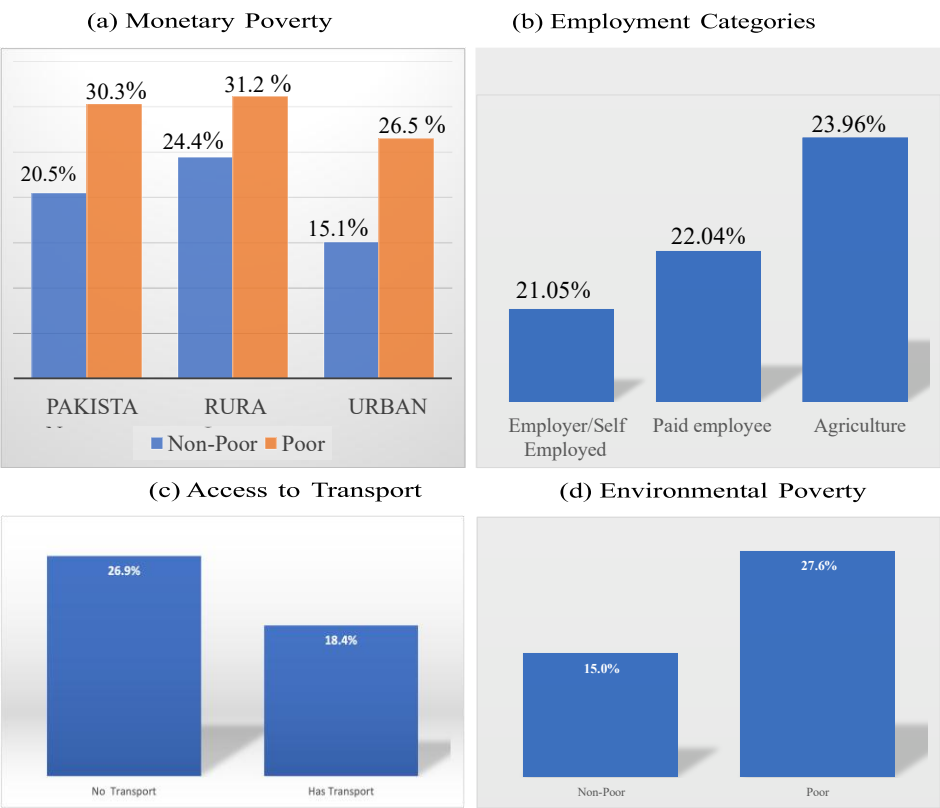
Unit of Analysis	HH in debt (%)	Mean Debt	Number of HHs	Total Debt
Pakistan	22.1%	72158	3834056	2767
Province KP	56.0%	217246	5883007	1278
Punjab	18.8%	60431	2026742	1225
Sindh	12.9%	24510	9871620	242
Balochistan	6.3%	11843	2318519	27
Region Rural	25.9%	79778	23300079	1859
Urban	15.9%	59722	15040487	898
Income Group Poorest (Bottom 20%)	30.4%	74942	7668113	575
2nd	26.7%	77211	7668113	592
3rd	24.3%	73587	7668113	564
4th	19.4%	66963	7668113	513
Richest (Top 20%)	12.3%	69311	7668113	531

Note: Author's calculation based on the Household Integrated Economic Survey (HIES) 2018/19 data. The total debt at the household level is scaled to the national level by adjusting for inflation as reported by the State Bank

of Pakistan. The population and total household estimates are based on the 2023 Census, with 241.5 million individuals and 38.3 million households.

Appendix Figure A2 shows borrowing patterns across different socioeconomic groups. Poor households are more prone to take loans, as shown in Figure 2A, and those working in informal sectors also depend more on debt, as illustrated in Figure 2B. Households with fewer assets, such as lacking personal transportation, tend to borrow more (Figure 2C) and households that lack access to adequate environmental services, labeled as environmentally deprived, also show a higher tendency to take out loans (Figure 2D).

Appendix Figure A2: Distribution of Household Debt Across Various Socioeconomic Dimensions



Notes: Author formulation based on HIES 2018-19 data.

Book Review

Our Dollar, Your Problem: An Insider's View of Seven Turbulent Decades of Global Finance, and the Road Ahead by Kenneth Rogoff, Published by Yale University Press, 2025, 360 pages.

Different currencies have been at the center of the world stage in different eras, this book dwells upon the dominance of the dollar at the world stage. The author traces the challenges faced by the dollar in the past, contemporary threats to it, and the potential challenges to its hegemony. The author's strong academic background, combined with practical experience, results in an analysis that is both theoretically sound and practically relevant, is a key strength of the book. The book is divided into sections exploring past and present challenges, global monetary issues, alternative currencies, the costs and benefits of dominance, and the peak of dollar supremacy. A limitation of the book is that occasionally author drifts away from the main topic, making the book more voluminous; otherwise, the content could have been reduced without losing important information.

The book begins with an analysis of the factors that make a currency dominant, highlighting that it is a slow process either to attain it or even to lose it. Innovation, conflict, inflation, debt levels, the size of the economy, real and financial openness, share in the world trade, size of the financial markets and military strength are the key factors that determine whether a currency becomes dominant. The main conclusion of the book is that current state of affairs and the way the American economy is being run is the biggest threat to the dollar.

The threat either from within or from outside has always been a source of discontent for each entity, and the USA is no exception. The first actual or perceived challenge that struck Washington emanated from the Soviet Union. Particularly, the Soviet achievement in space travel enthralled USA that this sophisticated technology may transfer into an economic technological edge and potentially endanger dollar's dominance in future. However, the economists were divided: Samuelson and Rostow were of the view that Soviet is a threat, whereas Friedman was sceptic that socially planned economy would ever compete the market economy. I agree with Friedman and opine that to become a dominant currency trade openness and financial openness are essential.

The other threat comes from the Yen. The 'yes' by the Japanese authorities in the Plaza Accord to appreciate Yen forced by the USA is considered a major cause of Japan's collapse by many, but the author disagrees with this simplistic interpretation. The genesis of Japan's decline can be attributed to the imprudent financial market regulations the author maintains. However, the housing bubble, depreciation of Yen, red tape in Japanese bureaucracy, the subsequent overvaluation of Yen, labour force contraction, decreasing returns to investment, banking crisis, debt to GDP ratio as high as 251 percent were the main culprits for keeping the Yen away from being a dominant currency at the world stage.

Euro was introduced in 1999, and the euro zone was going to be a single unit, another threat to dollar was emerging, however, my opinion is that "unit of countries" is

not ‘a country’ when it comes to economic might. The heterogeneity of Europe, particularly, Greece, and the lack of fiscal authority is a constant threat to the very existence of Euro, not to speak the threat from it to the dollar, the author highlights. The once worrisome factor for USA from Europe was stock market capitalisation. The market capitalization in Europe and the US remained very close most of the time, however, around 2013, there is a clear departure, and USA left the Europe far behind. When it comes to the GDP per capita, European countries per capita GDP never crossed 85 percent of USA per capita GDP. The author highlights that the lack of European dynamism, institutional quality, fragile banking system along with the lack of fiscal authority were the factors in the way of euro to become the most dominant currency in the world.

Coming to the present-day challenge, the author talks about the well-known China threat. The size of the economy, share in the international trade, vibrant financial market along with military might are major influencing factors in making a currency capable to replace or threaten the existing dominant one, and China is performing reasonably well on most of these fronts. China’s per capita income relative to the USA on PPP basis increased almost five times, from 5percent in 1980 to 22 percent in 2019. China’s economy is bigger than the USA on PPP basis, however, on market exchange rate the USA is still far ahead. Besides the military might, the other factor that has been identified by the author as a threat to the dollar from the Renminbi is the floating of Renminbi. It would weaken the hegemony at least in the Asian dollar block. But the move is not that simple, so far, China has been successful in managing dollar-centric exchange rate policy that benefitted China in economic growth.

The author is of the view that despite well-crafted urbanization policy, the real-estate problem could not be avoided. Within this broader context, the US authorities occasionally threatened China to declare “currency manipulator”, and finally in August 2019, the Trump administration did so. However, till then, China had gathered lot of flesh and could not be coerced to repeat the “plaza accord” episode as was done by Japan. In addition, “And unlike Japan, China does not need U.S. military protection, so the United States does not have anywhere near the same degree of leverage”, the book states. This also highlights the connection between military power and currency dominance. It is worth mentioning that the author is skeptical about the data released by official authorities about growth rate and bad loans etc.

The points that can make it difficult for Renminbi to attain center stage are diminishing return on investment, slowdown in export growth, demographic problems, centralized decision making. If China can tackle these challenges, then, down the road, renminbi can be a successful threat to US dollar.

After this the author describes the fascination with the fixed exchange rate regime albeit highlighting that its end is inevitable, particularly in this age of open capital markets, and that a country can import credibility to tame inflation by fixing with the a currency but ultimately it has to face the challenge of building a castle on the fragile foundations, and the hyperinflation erupts.

After talking about Ruble, Yen, Euro and Renminbi, and fascination with the fixed exchange rate regime, the author turns towards alternative currencies, which, in my view, are not a real threat but serve as a valuable intellectual exercise. Here the author talks about Special Drawing Rights (SDRs) which fundamentally is an accounting unit with 43percent weight of US Dollar in the basket. The other currency discussed is cryptocurrency, but today most of the crypto is being used for underground activities, author maintains. The missing boon of lender of the last resort and credibility in case of crypto make it a no-threat for the dollar. Yet another contender in this intellectual list is

Central Bank Digital Currency (CBDC), however, “the threat that any foreign CBDC poses to U.S. markets is small”, the author opines.

The second last part of the book talks about perks and burdens of being a dominant currency. The perks include fiscal sustainability available despite huge debt to GDP ratio, privileged borrowing status that is dollar debt sells at premium, and then there is exorbitant privilege. The burden includes high military expenditures, that is, it is difficult to sustain the role of dominant currency without being one of world’s geopolitical superpowers, and it is difficult to be in the list of superpowers without spending a lot on military needs. Another cost is to provide insurance to the world in case of severe global downturns. Yet another cost could be “weaponisation of dollar reserves” by other countries in a coordinated way, or by China particularly.

The author closes the book with the discussion of ‘peak dollar dominance’. The points raised in this part of the book are: central bank independence, (future) level of interest rate, high debt to GDP ratio, and author’s verdict about ‘end of dollar era?’. The greatest vulnerability to dollar comes from within, that is, if central bank independence is diluted by taking many goals into account like response to climate change or income redistribution, the Fed may lose its prime goal, and there is no guarantee that the low inflation will remain there for longer time. Similarly, high debt to GDP ratio would create further fiscal problems for the government if interest rate does not remain low for longer period. If the “great moderation” can come to an end, the expectations that inflation and interest rate in future will remain low can also embrace an end. The author is of the opinion that dollar has reached its peak era, but it does not mean that the sun will set in the decade to come.

The author traces the challenges to the dollar in a very fitting manner; however, he could have stated his view more clearly regarding the starting point (year), the peak, and the end of the threat posed by different currencies. The book’s objective could be achieved in relatively shorter volume by avoiding unnecessary details, while still providing in-depth analysis and incorporating more graphs and data tables to highlight peak points and turning points in the threat. Nonetheless, the book reminds that in a dollar-dominated global system, external shocks from the United States are transmitted quickly and significantly to developing economies.

The book makes a significant contribution by offering a clear, policy-relevant, and analytically grounded explanation of dollar dominance and its global implications, particularly for developing economies facing external vulnerabilities.

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