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Investment Dynamics and Capital Formation in Pakistan: Financial Intermediation, Industrial Transformation and Macroeconomic Stability: A VECM Analysis

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Abstract

Pakistan continues to experience persistently low levels of capital formation, constraining long-term economic growth and productive capacity. This study examines the macroeconomic determinants of Gross Fixed Capital Formation (GFCF) in Pakistan within the framework of financial intermediation, industrial performance, and macroeconomic stability over the period 1991–2024. Annual time-series data are analysed using the Augmented Dickey–Fuller (ADF) unit root test, the Johansen cointegration approach, and the Vector Error Correction Model (VECM). The results indicate that all variables are integrated of order one, I(1), and the Johansen tests confirm the existence of a long-run equilibrium relationship among the variables. The long-run estimates reveal that national savings positively influence capital formation, whereas the exchange rate has a significant effect on investment. Industrial performance demonstrates a statistically significant long-run association with capital formation, while inflation and bank credit to the private sector do not exhibit statistically significant long-run effects. The error correction term is negative and statistically significant, indicating that approximately 70.4% of short-run disequilibrium is corrected annually. Impulse response analysis suggests that shocks to national savings and industrial performance support capital accumulation over time. The findings underscore the importance of strengthening financial intermediation, mobilising domestic savings, promoting industrial development, and maintaining macroeconomic stability to achieve sustainable capital formation and long-term economic growth in Pakistan.

Keywords: *Capital Formation, Financial Intermediation, Industrial Performance, Macroeconomic Stability, VECM, Pakistan.*

1. Introduction

Capital formation plays a key role in the economic growth and development process, increasing productive potential, fostering technological progress, and helping to achieve long-term economic sustainability (Challoumis, 2024). Capital formation is particularly important in developing economies, where resource scarcity and structural issues can constrain growth opportunities and hinder economic transformation and improvements in living standards (Mulugeta, 2024). Yet, mobilising productive investment continues to be a significant challenge in many developing nations given macroeconomic instability, institutional inadequacies, and monetary constraints (Abaidoo & Agyapong, 2024).

Pakistan has been witnessing extended periods of investment activity fluctuations and low capital formation rates relative to many emerging economies, leading to concerns about the country's growth prospects in the long run (Khan et al., 2025).

The economy of Pakistan over the past 30 years has undergone significant structural changes, some of which have had a significant impact on investment patterns and capital formation (Amin et al., 2021).The financial liberalization reforms of the 1990s were designed to boost financial intermediation by deregulating financial institutions, privatizing state-owned banks, and improving the marketization of financial systems (Raza et al., 2024). The reforms were followed by a series of Banking Sector Reforms by the State Bank of Pakistan (SBP) during the 2000s to enhance financial stability and credit allocation and to increase financial access. These policies helped to strengthen the financial system but whether the policy measures led to additional productive investment is an empirical issue that is important to address (Sijabat, 2023). Since 2013, Pakistan has also experienced significant macroeconomic and structural changes that have influenced the investment climate, such as exchange rate regime shifts, currency depreciations, frequent inflationary pressures, and large-scale infrastructure projects related to the China–Pakistan Economic Corridor (CPEC) (Qureshi et al., 2021). All these developments have changed the incentives, costs, and financing factors of the investors, which affect the process of capital formation (Sarker & Khan, 2020). Therefore, it should be understood that there are interdependencies between finance intermediation, industrialization, and macroeconomic stability that affect investment behavior and impact Pakistan’s future development prospects.

At the macroeconomic level, factors affecting capital formation include financial, industrial, and policy factors (Abaidoo & Agyapong, 2024). Growth theories from classical economics and Keynesian economics are based upon rates for capital formation and economic growth rates that depend upon savings, investments, and macroeconomic stability (Mulugeta, 2024). Domestic savings are the source of investment, and investor confidence and long-term planning are fostered by stable macroeconomic conditions (Jolo & Koç, 2023). Similarly, an increase in productive investment due to industrialization helps reinforce capital accumulation (Rimtip et al., 2025). Therefore, we need to describe the investment behavior of developing countries.

As such, it is crucial to explain investment behavior in developing economies by understanding how financial and industrial sector variables interact (Nguyen, 2022). In the last 30 years, Pakistan has experienced considerable economic structural transformation, like reform in the financial sector, liberalization of trade, exchange rate policies, and initiatives to boost industrialization. These reforms were designed to improve economic efficiency and boost investment but have not always been successful. High inflation, exchange rate fluctuation, low savings rate, insufficient financial intermediation, and differential growth of industries are all continuing problems in the economy. All of this has tempered investment activity and lowered the economy's capacity to continue to invest at high rates. This has resulted in an ongoing investment deficit in the country, which is hampering the productive capacity and is impeding economic development.

The subdued rate of investment accumulation is significant for economic growth. Infrastructure development is constrained by insufficient investment. Industrial growth is also limited. Job creation is adversely affected. Technological development is likewise restricted (Li & Gong, 2023).

In addition, macroeconomic uncertainty has increased. Volatility in GDP growth, interest rates, and exchange rates has contributed to this uncertainty. Private investment has been discouraged. Investor confidence has been weakened. Expected returns have also been reduced (Javed & Abbas, 2023; Ahmad, 2024). The importance of macroeconomic determinants of capital formation has therefore increased. A clear understanding of these determinants is required for effective policy formulation. Sustainable economic growth and development may thereby be supported.

Despite the extensive literature on capital formation, several important research gaps remain. Existing studies have mainly focused on individual macroeconomic determinants. National savings have been widely examined. Inflation has also received considerable attention. Exchange rates have been investigated. Bank credit has likewise been analysed. Industrial performance has also been explored. Their combined effects have rarely been examined within a single analytical framework (Javed & Abbas, 2023; Pervaiz et al., 2025).

Relatively short sample periods have been used in many previous studies. Major structural changes in Pakistan’s economy have not been fully captured in previous studies. Financial liberalisation has received limited attention. The banking sector reform is not well studied enough. The changes to exchange rates are not fully covered. The post-CPEC investment environment has also remained underexplored and not comprehensively incorporated. The post-CPEC investment environment has also remained underexplored (Ahmad et al., 2025). Traditional econometric methods are commonly applied to previous research works. Nevertheless, there is no adequate examination of long-term equilibrium relations. Short-run adjustment dynamics have also received limited empirical attention. Consequently, there is little evidence available. Financial intermediation, macroeconomic stability, and industrial performance have not been studied together under one empirical model (Javed & Abbas,

2023; Ahmad et al., 2025). Their combined effects have also received limited attention under the Johansen cointegration and Vector Error Correction Model (VECM) framework.

The above-mentioned gap has been addressed by this research paper. Gross Fixed Capital Formation (GFCF) determinants of Pakistan are studied. Data from 1991 to 2024 are used. National savings are taken as part of this study. Inflation is also considered. The exchange rate is examined. Bank credit to the private sector is incorporated. Large-scale manufacturing is also included. All variables are examined within a unified empirical framework. Financial factors are therefore represented. Macroeconomic conditions are also captured. Industrial performance is incorporated separately. A broader explanation of capital accumulation in Pakistan is consequently provided.

Several contributions are made to the existing literature. First, an integrated framework of investment behaviour is developed. Previous studies have often examined national savings, inflation, exchange rates, bank credit, and industrial performance separately. In the present study, these factors are examined simultaneously. Financial intermediation is incorporated. Industrial performance is also considered. Macroeconomic stability is included in the same framework. Their combined role in determining capital formation is therefore assessed.

Second, the Johansen Cointegration Technique and the Vector Error Correction Model (VECM) are employed. Long-run equilibrium relationships are identified through this approach. Short-run adjustment dynamics are also estimated. The long-run effects of the selected determinants can therefore be distinguished from their short-run effects. The adjustment of capital formation towards its long-run equilibrium is also examined.

Third, an extended study period from 1991 to 2024 is used. Several phases of Pakistan's economic development are covered during this period. Major changes in the financial and macroeconomic environment are also represented. A broader assessment of investment behaviour is therefore provided. Evidence from a longer period also extends previous studies based on relatively shorter samples.

Finally, integrated policy implications are derived from the empirical findings. Sustainable capital formation in Pakistan cannot be supported through isolated policy measures. Greater coordination across financial, industrial, and macroeconomic policies is required. Financial intermediation needs to be strengthened. Industrial development needs to be promoted. Domestic savings should be encouraged. Macroeconomic stability should also be maintained. A broader empirical basis for long-term investment policy in Pakistan is therefore provided. The findings may also offer useful implications for other developing economies facing similar investment constraints.

2. Literature Review

Understanding the factors that sustain productive investment remains one of the most enduring questions in development economics. Productive investment is widely recognized

as a prerequisite for long-run economic growth (Soava et al., 2020; Jolo & Koç, 2023). However, the mechanisms that influence capital formation remain inconclusive. Capital formation results from the interaction of multiple economic conditions rather than a single macroeconomic factor (Ofosu-Mensah Ababio et al., 2022; Abaidoo & Agyapong, 2024). Financial development has been identified as an important determinant of capital formation (Verma & Giri, 2022; Vo & Ho, 2025). Macroeconomic stability has also been recognized as a key determinant of capital formation (Abaidoo & Agyapong, 2024; Mulugeta, 2024). Industrial performance is widely regarded as another important determinant of capital formation (Jolo & Koç, 2023; Ahmad et al., 2025). Institutional conditions are considered essential for creating an environment that supports productive investment (Abaidoo & Agyapong, 2024). Greater attention has therefore been directed toward identifying the conditions required to sustain Gross Fixed Capital Formation (GFCF). The issue has become particularly important in developing economies (Ofosu-Mensah Ababio et al., 2022; Ahmad, 2024).

Early growth theories have consistently identified investment as the engine of economic expansion. Capital accumulation was viewed by classical economists as the foundation of industrial development and productivity growth. Sustained investment is regarded by the neoclassical growth model as a mechanism for expanding the stock of productive capital. Labour productivity is expected to increase through sustained investment. Long-run income levels are also expected to rise as productive capital expands (Soava et al., 2020; Jolo & Koç, 2023; Ahmad, 2024).

Investment is viewed by endogenous growth theory as extending beyond the accumulation of physical assets. Technological innovation is generated through sustained investment. Knowledge spillovers are also promoted through investment activities. Productivity improvements are further supported by continuous investment. Long-run economic growth is strengthened through technological progress and productivity gains (Li & Gong, 2023; Pervaiz et al., 2025; Ahmad et al., 2025).

Capital formation is therefore recognized as both a consequence and a catalyst of economic development (Jolo & Koç, 2023; Soava et al., 2020; Ahmad, 2024).

Recent empirical literature has increasingly examined the conditions that support productive investment. Domestic resource mobilisation has been identified as an important determinant of capital formation. Financial intermediation has also been recognised as a key contributor to investment performance (Ofosu-Mensah Ababio et al., 2022; Verma & Giri, 2022; Vo & Ho, 2025). Industrial competitiveness is widely regarded as an important driver of productive investment. Macroeconomic stability has likewise been identified as a fundamental condition for sustained capital formation (Jolo & Koç, 2023; Abaidoo & Agyapong, 2024; Ahmad, 2024). Investor confidence is jointly influenced by domestic resource mobilisation, financial intermediation, industrial competitiveness, and macroeconomic stability. Financial resources are transformed into productive capital assets more efficiently under favorable economic conditions. A favorable investment climate is created through the interaction of multiple

economic factors. An unfavorable investment climate can also emerge when economic conditions are weak (Sethi et al., 2022; Abaidoo & Agyapong, 2024; Taghizadeh-Hesary et al., 2022). Capital formation is therefore recognised as a multidimensional economic process (Ofosu-Mensah Ababio et al., 2022; Vo & Ho, 2025).

Domestic savings are widely regarded as the primary source of investment financing. The importance of domestic savings is particularly evident in developing economies where access to international capital markets is often limited. Higher savings are considered by neoclassical theory to increase the supply of loanable funds available for productive investment. Capital accumulation is expected to be facilitated through a larger supply of investment funds (Ahmad, 2024; Ahmad et al., 2025). The relationship between domestic savings and capital formation has been found to depend on the effectiveness of financial intermediation. Institutional quality has also been identified as an important condition influencing the savings–investment relationship (Abaidoo & Agyapong, 2024; Verma & Giri, 2022). Productive sectors receive greater financial support when savings are efficiently mobilised and allocated. Capital formation is strengthened through efficient financial intermediation (Darakhshan, 2024; Vo & Ho, 2025). Available financial resources are frequently diverted towards consumption in economies with weak institutions. Available financial resources are also diverted towards speculative activities in shallow financial markets. Public-sector financing often receives priority over productive investment under inefficient financial systems. The relationship between domestic savings and capital formation is therefore weakened by inefficient financial institutions and underdeveloped financial markets (Abaidoo & Agyapong, 2024; Khan et al., 2025; Darakhshan, 2024).

The banking sector is widely recognised as an important source of investment finance. Bank credit is regarded by financial intermediation theory as a mechanism for relaxing liquidity constraints. Investment projects are enabled through greater access to bank credit. Investment opportunities that exceed internally generated funds can therefore be undertaken (Darakhshan, 2024; Verma & Giri, 2022; Vo & Ho, 2025). Bank credit's contribution depends upon quantity and allocation. Generally speaking, higher levels of investment have been linked with more money being lent out for industrial purposes. Productive credit also supports infrastructure development. Greater access to investment finance is provided to productive enterprises (Darakhshan, 2024; Vo & Ho, 2025). On contrary to this, lower rates of capital formation are linked with loans given out for government securities. Consumer finance offers little assistance for productive investment. Speculative lending is also considered less effective in promoting capital formation (Khan et al., 2025; Darakhshan, 2024).The effectiveness of bank credit is therefore influenced by financial sector efficiency. The effectiveness of bank credit is also determined by the institutional incentives governing credit allocation (Abaidoo & Agyapong, 2024; Verma & Giri, 2022).

Macroeconomic stability is widely recognised as a critical determinant of investment behavior. Production costs are directly influenced by inflation. Investment risk is also affected by inflation. Financing conditions are influenced by inflationary pressures. Expected profitability is shaped by inflation and price stability (Abaidoo & Agyapong, 2024; Javed &

Abbas, 2023; Ahmad, 2024). Limited adverse effects are generally associated with moderate and predictable inflation. Greater uncertainty is created by persistent inflation. Inflation volatility further increases investment uncertainty. Purchasing power is reduced by sustained inflation. Contractionary monetary policies are frequently adopted in response to persistent inflation. Borrowing costs are increased under contractionary monetary policies (Suleman & Touqeer, 2024; Mulugeta, 2024). Exchange rate stability is recognised as an important condition for productive investment. Greater predictability of investment returns is provided by exchange rate stability. Investment uncertainty is increased by excessive exchange rate volatility. Long-term investment is discouraged by unstable exchange rate movements. Imported machinery becomes more expensive under currency depreciation in import-dependent economies. Intermediate production inputs also become more costly following currency depreciation. Firms' incentives to expand productive capacity are reduced by higher import costs (Javed & Abbas, 2023; Abaidoo & Agyapong, 2024; Ahmad, 2024).

Industrial performance is closely associated with capital formation. Capital stock expansion is explained by accelerator theory as a response to rising demand. Higher capacity utilisation encourages additional investment. Manufacturing growth supports investment in machinery. Manufacturing growth also encourages technological upgrading (Jolo & Koç, 2023; Ahmad, 2024; Ahmad et al., 2025). Infrastructure investment is promoted through sustained industrial expansion. Industrial productivity is strengthened through capital accumulation. Industrial competitiveness is also enhanced by greater capital formation. Industrial expansion and capital formation are therefore regarded as mutually reinforcing processes (Jolo & Koç, 2023; Ahmad et al., 2025). Reliable infrastructure is required to sustain industrial investment. Industrialization needs technological capabilities to be fulfilled. Policy stability is considered important for sustaining investment over an extended period. Firms' investment decisions are influenced by the combined availability of infrastructure, energy, technology, and policy stability. Evidence from developing nations shows that there are interdependencies between elements of capital formation (Challoumis, 2024). The evidence of developing countries shows that factors contributing to capital formation are interrelated.

Financial intermediation influences the allocation of investment resources. Macroeconomic stability affects investor confidence and financing conditions. Exchange rate conditions influence investment costs and expected returns. Industrial performance determines the demand for productive capital. Institutional quality shapes the effectiveness of all investment determinants (Ofosu-Mensah Ababio et al., 2022; Abaidoo & Agyapong, 2024; Sethi et al., 2022). The overall investment climate is formed through the interaction of these economic conditions. Limited improvements in capital formation are often observed when progress occurs in only one area. Productive investment may remain weak despite abundant financial resources under conditions of macroeconomic instability. Productive investment may also remain constrained under weak property rights. Sound macroeconomic policies may produce limited investment outcomes when financial institutions face structural rigidities (Abaidoo & Agyapong, 2024; Vo & Ho, 2025). Private sector investment may also be constrained when lending is concentrated in the public sector. Different levels of capital formation are therefore

observed among countries with similar levels of savings or bank credit (Khan et al., 2025; Darakhshan, 2024; Ofosu-Mensah Ababio et al., 2022).

Pakistan provides an appropriate setting for examining the multidimensional determinants of capital formation. Gross Fixed Capital Formation has remained persistently low relative to Gross Domestic Product. The GFCF-to-GDP ratio has generally fluctuated between 14% and 15%. Higher investment rates have been maintained by several regional economies in South Asia. Investment rates above 30% have frequently been recorded by regional peers. (World Bank, 2025) Structural vulnerabilities have been identified as a major cause of weak capital formation in Pakistan. A chronically low domestic savings rate has been observed in the economy. The domestic savings rate has been constrained by a large undocumented informal sector. The domestic savings rate has also been constrained by a high marginal propensity to consume. A persistent savings–investment gap has resulted from weak domestic savings (Ahmad, 2024; Javed & Abbas, 2023). Capital formation has therefore become increasingly dependent on volatile external financial flows. Capital formation has also relied heavily on distortionary domestic borrowing (Khan et al., 2025; Darakhshan, 2024).

Deep inefficiencies have been observed in the allocation of credit within Pakistan's financial sector. Bank lending has been concentrated largely in government securities. Fiscal deficits have therefore been financed through the banking system. Private sector access to investment finance has consequently remained limited (Ahmad, 2024; Ahmad et al., 2025; Sethi et al., 2022). Long-term industrial projects have received comparatively less bank credit. Infrastructure investment has also been constrained by limited productive lending. Financial intermediation has therefore remained less effective in supporting capital formation (Darakhshan, 2024; Vo & Ho, 2025). The effectiveness of financial intermediation has further been constrained by institutional and structural inefficiencies within the financial system (Abaidoo & Agyapong, 2024).

Double-digit inflation has increased uncertainty in the investment environment. Exchange-rate has raised the cost of imported capital goods. Higher import costs have reduced firms' incentives to expand productive capacity. Persistent energy shortages have weakened industrial production. Capacity expansion has also been constrained by inadequate energy availability. Investment incentives have therefore been adversely affected by prolonged macroeconomic instability (Javed & Abbas, 2023; Ahmad, 2024; Suleman & Touqeer, 2024; Abaidoo & Agyapong, 2024).

Institutional bottlenecks have further constrained productive investment. Policy inconsistency across successive political regimes has increased uncertainty for investors. Bureaucratic procedures have delayed investment decisions and project implementation. Higher investor risk premiums have been associated with institutional uncertainty. Productive investment has therefore been discouraged by institutional weaknesses (Abaidoo & Agyapong, 2024; Tiep et al., 2021; Taghizadeh-Hesary et al., 2021).

Investment behaviour in Pakistan cannot be adequately explained by a single macroeconomic determinant. Financial development represents one important dimension of investment behaviour. Macroeconomic volatility represents another important dimension of investment behaviour. Industrial performance also contributes to variations in capital formation. An integrated empirical framework has therefore been developed in the present study. Financial development, macroeconomic volatility, and industrial output are examined simultaneously within the empirical framework. Short-run investment dynamics are evaluated through the proposed framework. Long-run equilibrium relationships governing Gross Fixed Capital Formation (GFCF) in Pakistan are also investigated (Ofosu-Mensah Ababio et al., 2022; Abaidoo & Agyapong, 2024; Darakhshan, 2024; Vo & Ho, 2025).

Conceptual Framework

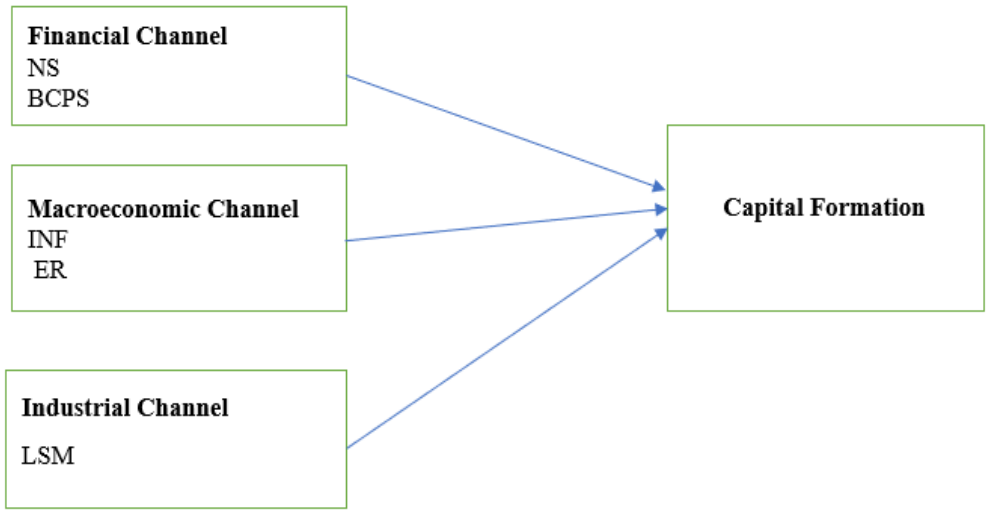

Figure 1: Proposed Conceptual Framework of the Model

Research Hypotheses

H1: *National savings significantly influence capital formation in Pakistan.*
H2: *Inflation significantly influences capital formation in Pakistan.*
H3: *Bank credit to the private sector significantly influences capital formation in Pakistan.*
H4: *Exchange rate significantly influences capital formation in Pakistan.*
H5: *Large-scale manufacturing significantly influences capital formation in Pakistan.*

3. Research Methodology

The empirical investigation was conducted using annual time-series data covering the period from 1991 to 2024. Secondary data were obtained from official publications of the State Bank of Pakistan (SBP) and the Pakistan Bureau of Statistics (PBS). Data on GFCF, national savings (NS), (BCPS), and the exchange rate were obtained from SBP. Information about large-scale manufacturing (LSM) and inflation was obtained from PBS.

The monetary variables were expressed in Pakistani Rupees (PKR), where applicable. The natural logarithm function has been used for this variable. Scale differences were minimized. The coefficient interpretation has been enhanced. The inflation rate is retained as a percentage change per year. The average annual PKR/USD exchange rate is given.
The final data set included all-year records. There are no missing data points were found. Stationarity was tested with the Augmented Dickey-Fuller (ADF) unit root test. All variables were found to be integrated of order one, I (1). The optimal lag length is found by means of a criterion for information value. Johansen's cointegration method is used next. The Vector Error Correction Model (VECM) was subsequently estimated. Long-run equilibrium relationships were examined. The short-term adjustment process is studied here. All estimates were made with EViews 9.

Model Specification

The relationship between Gross Fixed Capital Formation (GFCF) and its determinants is specified as follows:
Functional Form

$$\ln GFCF_t = f(\ln NS_t,\ INF_t,\ \ln ER_t,\ \ln BCPS_t,\ \ln LSM_t) \qquad (1)$$

The corresponding econometric model is expressed as:

$$\ln GFCF_t = \beta_0 + \beta_1 \ln NS_t + \beta_2 INF_t + \beta_3 \ln ER_t + \beta_4 \ln BCPS_t + \beta_5 \ln LSM_t + \mu_t \qquad (2)$$

Where:

- $GFCF_t$ = Gross Fixed Capital Formation
- NS_t = National Savings
- INF_t = Inflation Rate
- ER_t = Exchange Rate
- $BCPS_t$ = Bank Credit to the Private Sector
- LSM_t = Large-Scale Manufacturing
- β_0 = Intercept
- $\beta_1 - \beta_5$ = Estimated coefficients
- μ_t = Error term
- ln = Natural logarithm of the respective variables.

If all variables are integrated of the same order, I(1), the Johansen cointegration test confirmed the existence of a long-run equilibrium relationship; the Vector Error Correction Model (VECM) was estimated. Short-run interactions and long-run equilibrium adjustment

are jointly evaluated using the VECM technique. The general form of the estimated VECM is presented below.

$$\Delta \ln GFCF_t = \alpha_0 + \sum_{i=1}^{k} \alpha_i \Delta X_{t-i} + \lambda ECT_{t-1} + \varepsilon_t \quad (3)$$

3.1 Unit Root Analysis

Table 1: Stationarity Analysis Using ADF Unit Root Tests

Variable	At Level	p-score	At First Difference	p-score	Order
LGFCF	-0.3404	0.9080	-6.1417***	0.0000	I(1)
LNS	-0.2412	0.9232	-7.9384***	0.0000	
INF	-1.5038	0.5192	-6.3228***	0.0000	
LER	0.3163	0.9757	-5.0185***	0.0003	
LBCPS	-1.0373	0.7281	-7.1338***	0.0000	
LLSM	-0.9773	0.7497	-4.9082***	0.0004	

Note: **** denotes statistical significance at the 1% level.*

The stationarity results presented in Table 3.1 show that none of the variables satisfied the stationarity requirement at their original levels, as the associated p-values exceeded the conventional level of statistical significance. This indicates that all series contained unit roots. After first differencing, however, each variable became stationary at the 1% significance level under the applied unit root tests. Consequently, Gross Fixed Capital Formation (GFCF), National Savings (NS), Inflation (INF), Exchange Rate (ER), Bank Credit to the Private Sector (BCPS), and Large-Scale Manufacturing (LSM) were all classified as integrated of order one, I(1). The common order of integration provided the basis for employing the Johansen cointegration technique and the Vector Error Correction Model (VECM) to examine the long-run equilibrium relationship together with the short-run adjustment process.

3.2 Optimal Lag Length Selection

Table 2: Optimal Lag Length Selection Criteria

Criterion	Selected Lag
LR	2
FPE	2

AIC	2
SC (Schwarz/BIC)	2
HQ	2

The appropriate lag length was determined within the Vector Autoregressive (VAR) framework using a range of standard lag selection criteria. As shown in Table 3.2, the Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Criterion (SC), and Hannan–Quinn Criterion (HQ) were evaluated for lag selection. The results consistently favored a lag length of two across the majority of the criteria. Accordingly, lag two was adopted for estimating the Johansen cointegration model and the subsequent Vector Error Correction Model (VECM).

3.3 Johansen Cointegration Test

Following confirmation that all variables were integrated of order one, I(1), the Johansen cointegration technique was employed to determine whether a stable long-run equilibrium relationship existed among Gross Fixed Capital Formation (GFCF), National Savings (NS), Inflation (INF), Exchange Rate (ER), Bank Credit to the Private Sector (BCPS), and Large-Scale Manufacturing (LSM). Johansen maximum likelihood model is suitable as it has a common level for integration of variables so that they can be estimated together over time periods simultaneously.

Table 3 Johansen Cointegration Test Results

No. of Generated Cointegrating Equations	Trace Statistic	5% Critical Value	p-value	Max-Eigen Statistic	5% Critical Value	p-value
None	122.024	95.754	0.0003***	41.792	40.078	0.0318**
At most 1	80.232	69.819	0.0059***	30.035	33.877	0.1344
At most 2	50.198	47.856	0.0296**	23.642	27.584	0.1477
At most 3	26.556	29.797	0.1129	18.303	21.132	0.1189
At most 4	8.253	15.495	0.4388	8.160	14.265	0.3627
At most 5	0.093	3.841	0.7608	0.093	3.841	0.7608

Note: ****, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.*

Johansen cointegration test showed the existence of a persistent relationship between these variables. Although the Trace statistic indicated the presence of three cointegrating equations, the Maximum Eigenvalue statistic supported the existence of a single cointegrating equation. Given this difference, one normalized cointegrating vector (CointEq1) was retained for estimating the Vector Error Correction Model (VECM), consistent with the model specification used in the subsequent analysis. These results show that these parameters have an equilibrium relationship over time and are therefore suitable to estimate a VECM model.

3.4 Long-Run Equilibrium Relationship

The long-run cointegrating equation derived from the Johansen framework is presented in Table 3.4. The estimated coefficients describe the long-run equilibrium relationship between Gross Fixed Capital Formation and its explanatory variables. The sign and statistical significance of each coefficient provide evidence regarding the direction and magnitude of the long-run influence exerted by the selected macroeconomic variables on capital formation in Pakistan.

Table 4 Long-Run Cointegration Results

Variable	Coefficient	Standard Error	t-Statistic
lnNS	0.656	0.081	8.13***
INF	-0.001	0.002	-0.43
lnER	-0.385	0.118	-3.27***
lnBCPS	0.032	0.024	1.33
lnLSM	-0.438	0.162	-2.70***
Constant	1.775		

Note: *The reported coefficients are obtained from the normalized cointegrating equation estimated under the Johansen–VECM framework. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.*

$$\ln(\text{GFCF}) = 1.775 + 0.656\ln(\text{NS}) - 0.001\,\text{INF} - 0.385\ln(\text{ER}) + 0.032\ln(\text{BCPS}) - 0.438\ln(\text{LSM}) \quad \textbf{(4)}$$

The estimated long-run coefficients indicate that national savings have a positive and statistically significant association with gross fixed capital formation, suggesting that higher domestic savings support long-term investment activity. In contrast, the exchange rate exhibits a statistically significant negative relationship, implying that currency depreciation discourages capital formation by increasing the cost of imported capital goods and creating greater investment uncertainty. Large-scale manufacturing demonstrates a positive and significant long-run contribution to capital formation, highlighting the importance of industrial expansion in sustaining investment. Although the estimated coefficients for inflation and bank credit to the private sector display the expected signs, their long-run effects are not statistically significant. Overall, the results provide evidence of a stable long-run equilibrium relationship among the variables, indicating that they move together over time despite temporary short-run fluctuations.

3.5 Vector Error Correction Model (VECM) Results

Following confirmation of cointegration among the study variables, the Vector Error Correction Model (VECM) was estimated to examine the short-run responses of gross fixed

capital formation while accounting for deviations from the long-run equilibrium. The estimated results for the gross fixed capital formation equation are presented in Table 3.5.

Table 5 Vector Error Correction Model (Dependent Variable: ΔlnGFCF)

Variable	Coefficient	t-Statistic
ECT(-1)	-0.704	-2.575***
ΔlnGFCF(-1)	0.003	0.012
ΔlnGFCF(-2)	-0.335	-1.622
ΔlnNS(-1)	-0.458	-2.068**
ΔlnNS(-2)	-0.049	-0.285
ΔINF(-1)	0.009	1.670*
ΔINF(-2)	0.003	0.485
ΔlnER(-1)	-0.052	-0.188
ΔlnER(-2)	0.075	0.226
ΔlnBCPS(-1)	0.043	1.731*
ΔlnBCPS(-2)	0.001	0.039
ΔlnLSM(-1)	-0.767	-1.949*
ΔlnLSM(-2)	-0.040	-0.108
Constant	0.243	2.926***

Note: *Δ denotes the first-difference operator, while ln indicates the natural logarithm. ECT(-1) represents the lagged error correction term. GFCF = Gross Fixed Capital Formation; NS = National Savings; INF = Inflation; ER = Exchange Rate; BCPS = Bank Credit to the Private Sector; and LSM = Large-Scale Manufacturing. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.*

The coefficient of the error correction term (ECT) is negative and statistically significant, providing evidence that deviations from the long-run equilibrium are gradually eliminated over time. Its estimated value of −0.704 means that nearly 70.4% of any disequilibrium arising in one period is corrected during the following year, indicating a relatively rapid return towards the long-run path.

Short-run coefficient estimates show that there was an increase in gross fixed capital formation during the initial period due to savings lag.

Conversely, the first lag of inflation has a positive effect that is significant only at the 10% level. The coefficient of the first lag of large-scale manufacturing is negative and statistically significant, indicating a temporary contractionary effect on investment in the short run. None of the other explanatory variables have statistically significant short-term effects and therefore they do not have any immediate impact on investment behavior. These results indicate that there is a major change to capital accumulation over time and not just immediate changes within a given period.

The estimated model explains approximately 60.3% of the variation in changes in Gross

Fixed Capital Formation, indicating that the selected explanatory variables provide a satisfactory level of explanatory power for short-run investment behaviour.

3.6 Diagnostic Tests

Table 6: The Diagnostic Tests Results

Diagnostic Test	p-value	Decision
Residual Heteroskedasticity Test	0.3071	No Heteroskedasticity
Residual Serial Correlation LM Test	0.1708	No Serial Correlation
Residuals are normally distributed	0.4023	Residuals are normally distributed

Diagnostic test results show that the estimated VECM meets the key diagnostic requirements. There is no heteroskedasticity or serial correlation, so it's well specified to estimate the parameters of this model, which will help us understand both immediate and future developments concerning investment activities within Pakistan.

Table 7: The Variance Inflation Results

Variable	VIF	Interpretation
D(LNS)	**2.27**	No multicollinearity
D(INF)	**1.29**	No multicollinearity
D(LER)	**1.57**	No multicollinearity
D(LBCPS)	**1.26**	No multicollinearity
D(LLSM)	**1.36**	No multicollinearity

Table 7 is Variance Inflation Factor (VIF) statistics for the first-differenced variables. The centered VIF values are between 1.26 and 2.27, which are well below the commonly accepted threshold of 5, and also below the more conservative threshold of 10. The findings show there are no multicollinearity issues with these variables as their predictors. Thus, these variables can be used to conduct a Johansen cointegration test and a VECM analysis later on.

3.7 Stability Check (CUSUM and CUSUMSQ)

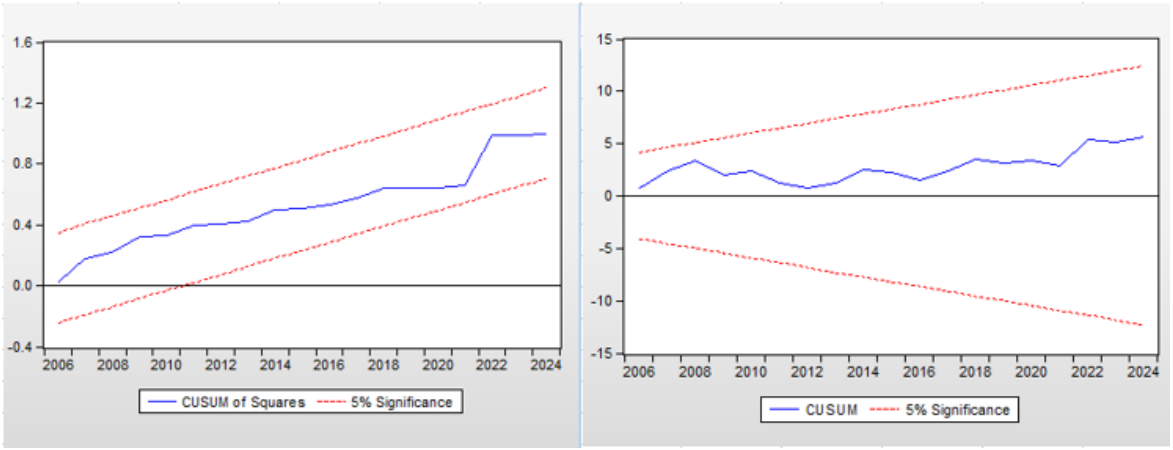

Figure 2: CUSUM and CUSUM of Squares (CUSUMSQ)

The stability of a model was evaluated with respect to the CUSUM and CUSUMSQ tests. The results, shown in Figure 2, show that both test statistics are within the 5% critical limits over the entire sample period. This shows stability of parameter estimates and no structural change during this time frame. Therefore, the VECM estimates are reliable for interpreting both the long-run and short-run relationships among the variables studied.

3.7 Impulse Response Function

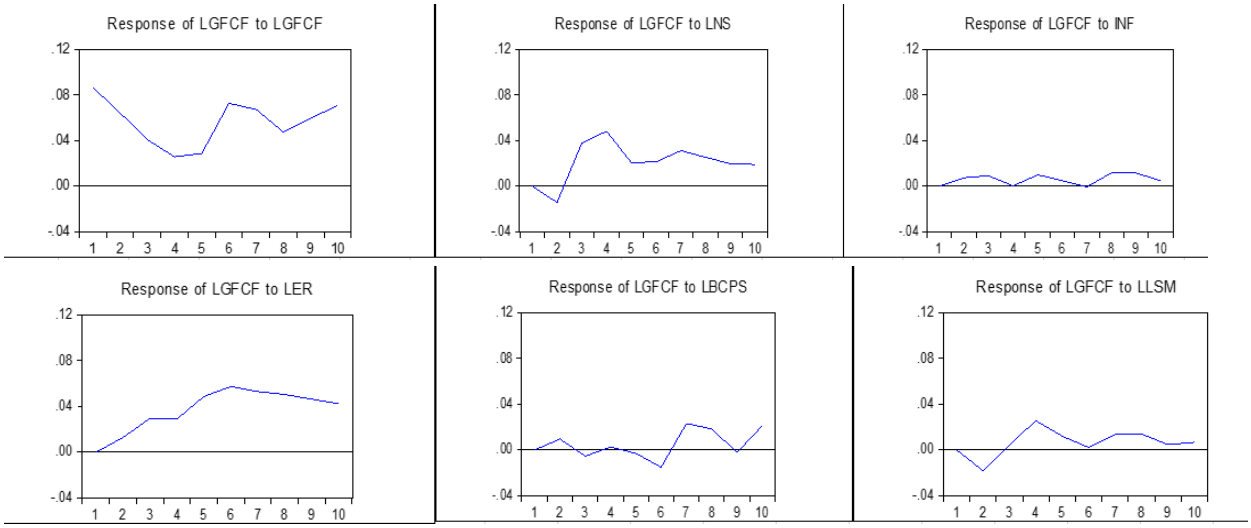

Figure 3: Impulse Response Functions of Gross Fixed Capital Formation (GFCF) to One Standard Deviation Shocks in Macroeconomic Variables

To further examine the dynamic effects of macroeconomic shocks on Gross Fixed Capital Formation (LGFCF), impulse response functions (IRFs) were estimated over a ten-period horizon. The results indicate that LGFCF exhibits a persistent positive response to its own shocks, reflecting the inertia in investment behaviour. A positive shock to national savings generates a favourable response in capital formation after a brief initial adjustment, suggesting that domestic savings support long-term investment.

Inflation and private-sector credit shocks produce relatively small fluctuations, indicating limited short-run effects on capital formation. Exchange-rate shocks initially increase capital formation before gradually stabilising, while shocks to large-scale manufacturing generate a moderate positive response that gradually converges towards equilibrium over time. Overall, the impulse response analysis indicates that the effects of macroeconomic shocks diminish over time, supporting the stability of the estimated VECM and confirming a stable long-run adjustment process.

3.9 Granger Causality Test

Table 8: Granger Causality Test Results

Dependent Variable: ΔlnGFCF	Chi-square	p-value	Decision
ΔlnNS	5.359	0.069	Weak causality (10%)
ΔINF	2.793	0.247	No causality
ΔlnER	0.097	0.952	No causality
ΔlnBCPS	3.721	0.156	No causality
ΔlnLSM	4.670	0.097	Weak causality (10%)

Note: *Weak causality indicates statistical significance at the 10% level ($p < 0.10$). ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.*

The VEC Granger causality (Block Exogeneity Wald) test results presented in Table 8 indicate limited short-run causal relationships. Weak Granger causality from national savings (ΔlnNS) to gross fixed capital formation (ΔlnGFCF) was observed at the 10% significance level ($p = 0.069$).

Weak Granger causality from large-scale manufacturing (ΔlnLSM) to gross fixed capital formation (ΔlnGFCF) was also identified at the 10% significance level ($p = 0.097$). These findings suggest that fluctuations in national savings and industrial activity have only a limited predictive influence on capital formation in the short run. No short-run Granger causality was found for inflation (ΔINF).

No short-run Granger causality was observed for the exchange rate (ΔlnER). No short-run Granger causality was also detected for bank credit to the private sector (ΔlnBCPS). The corresponding p-values exceeded the conventional significance levels. Overall, only weak evidence of short-run causal effects on capital formation was obtained. These results imply that investment adjustments are driven primarily by long-run equilibrium relationships rather than by immediate changes in the explanatory variables.

4. Discussion

Important insights for the determinants of capital formation in Pakistan were provided by the empirical findings. There is an extended cointegration relationship among these variables. Cointegration proved to be a sign that banking intermediation, economic stability, and industrial productivity had an impact on investments over a period of time. National saving contributed positively towards capital formation. It is consistent with theory on how to mobilize resources within countries for sustainable investment funding. This type of funding is especially critical for developing countries with limited foreign investment opportunities available. Negative long-term impact on exchange rate devaluation has been found. The persistent instability of currency prices increases import costs for capital goods. Higher volatility of exchange rates is associated with greater investment risks. Consequently, it was not encouraged to invest productively. Bank credit to the private sector and capital formation imply that the amount of credit is not necessarily a major issue. Rather than wasteful use of funds on unproductive projects, it seems that there is an even bigger problem here. Capital formation has a strong relationship with industrial productivity. This paper discusses how manufacturing expansion contributes to promoting productive investments. Financial development was supported as an important determinant of capital formation. Macroeconomic stability was also supported. The role of industrial growth was equally confirmed. The findings suggest that improvements in investment performance in Pakistan require coordinated policy measures. Greater financial sector efficiency should be promoted. Domestic savings should be encouraged. Industrial development should be supported. A stable macroeconomic environment should also be maintained.

5. Conclusion & Policy Implications

The empirical analysis demonstrates that the selected macroeconomic variables maintain a stable long-run relationship with gross fixed capital formation in Pakistan. National savings exert a positive and statistically significant long-run influence, highlighting the importance of domestic resource mobilisation for sustaining investment. By contrast, exchange rate depreciation adversely affects capital formation, while improvements in large-scale manufacturing contribute positively to long-term investment. Inflation and bank credit to the private sector do not exhibit statistically significant long-run effects. The estimated error correction term is negative and statistically significant, indicating that deviations from the long-run equilibrium are corrected at a relatively rapid rate, with approximately 70.4% of short-run disequilibrium eliminated within one year. In the short term, there are few variables with statistically significant effects, so investments are mainly driven by future adjustments rather than current economic cycles.

These results emphasize increasing national saving rates; stabilizing foreign exchange rates; and promoting industry development for sustainable investment growth. Also, they point out that there should be measures to enhance the efficiency of the banking system and maintain stability of macroeconomic conditions, which are conducive to investments. This paper provides empirical evidence from Pakistan over the period 1991-2024 to broaden the understanding of the macroeconomic factors influencing capital formation and offers insights

that may assist policymakers in designing strategies aimed at promoting long-term investment and economic development.

6. Limitations of the study

The research has some limitations. This study is based upon yearly time series information. Short term changes to investments may not have been fully reflected. The adjustment dynamics might not have been fully reflected either. Empirical models are restricted by certain macroeconomic factors only. Some elements affecting capital development are not considered here. More frequent data may be used for future studies. Broader empirical frameworks may also be adopted. More knowledge about investments may be obtained from this.

7. Future Recommendations

The investment behaviour framework presented in this study should be further expanded in future research. Additional structural and institutional factors should be incorporated into future models. Institutional quality should be considered. Governance effectiveness should also be included. Financial market development should be examined. Technological advancement should be incorporated. Digitalisation should also be considered. Investment climate should be examined. Policy uncertainty should also be incorporated. A more comprehensive explanation of long-term investment behaviour may thereby be provided.

The relationships among the determinants of capital formation may also be asymmetrical. Different investment responses may be observed during periods of economic expansion. Different responses may also be observed during periods of economic contraction. Variations may also occur during periods of economic uncertainty. Potential nonlinearities should therefore be explored. Threshold effects should also be investigated.

Structural break cointegration models may be employed in future studies. Nonlinear time-series models may also be adopted. Regime-switching approaches may be utilised. Time-varying parameter models may also be applied. Changing relationships during policy shifts or economic shocks may thereby be captured.

The causal transmission mechanisms between macroeconomic conditions and productive investment should also be examined. Particular attention should be given to the mediating role of financial sector efficiency. Comparative cross-country analyses of emerging economies may also be conducted. Sector-specific investigations may likewise be undertaken. The generalisability of Pakistan's investment dynamics may thereby be assessed. The theoretical understanding of capital formation would thereby be enhanced. More robust empirical evidence for investment-related economic policies would also be provided.

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