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Firm Dynamics, Structural Transformation, and Economic Growth: A Spatial Analysis of Regional Development in Pakistan

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Abstract
This study examines the interplay between firm dynamics, structural transformation, and economic growth by exploring regional disparities across Pakistan through a spatial analytical framework. Employing a shift-share decomposition approach, the analysis compares actual regional growth performance with a counterfactual scenario based on a uniform sectoral structure, thereby identifying the sources of divergence in regional growth trajectories. The decomposition separates growth differentials into industry composition effects reflecting the distribution of economic activities across sectors—and regional competitive effects, which capture differences in firm-level productivity and efficiency. To deepen the analysis, the study extends the conventional framework by incorporating a spatial dimension that further disaggregates the regional competitive component into spatial spillover effects and localized competitiveness. This refinement enables a clearer understanding of how geographic interdependencies and firm behavior jointly shape patterns of structural transformation and regional development. The empirical investigation relies on panel data covering gross value added and employment across key sectors at the provincial and regional levels in Pakistan over the period 2004–2019. A dynamic perspective is adopted to capture evolving structural changes and temporal variations in regional economic performance. The results indicate that regional disparities in economic growth are predominantly driven by differences in local competitiveness rather than variations in sectoral composition. In particular, productivity differentials among firms operating within the same industries across regions emerge as the principal source of growth divergence. Although spatial spillovers and interregional linkages exist, their influence is comparatively weaker than that of region-specific competitive strengths. The findings underscore the central role of firm-level efficiency and localized competitive advantages in shaping structural transformation and economic growth in

Pakistan. This suggests that policy strategies aimed at strengthening firm performance, enhancing productivity, and fostering region-specific capabilities are likely to yield more substantial and sustainable development outcomes than policies focused solely on sectoral redistribution or spatial spillover effects.

Keywords: *Firm Dynamics; Structural Transformation; Economic Growth; Spatial Analysis; Regional Development; Spatial Spillovers; Pakistan; Productivity; Capital Accumulation; Sectoral Shifts.*

1. Introduction

Structural transformation is widely recognized as a critical driver of economic development, particularly in the context of both developed and developing economies (Felipe, 2012). It involves the reallocation of resources—labor and capital—across the three primary sectors of the economy: agriculture, manufacturing, and services, with the ultimate aim of enhancing overall economic welfare (Herrendorf et al., 2014). Understanding the mechanisms of structural transformation is essential for designing effective growth strategies, especially in countries like Pakistan, where sectoral productivity disparities and labor allocation patterns influence long-term development outcomes (Anderson & Ponnusamy, 2023).

In many developing economies, low productivity in the agricultural sector, combined with a large share of the labor force employed in agriculture, often traps households in poverty (Caselli, 2005; Dorosh & Thurlow, 2018). These productivity differences contribute significantly to interregional and cross-country income inequalities. Structural transformation facilitates the movement of labor and capital from low-productivity sectors toward higher-productivity manufacturing and service sectors, thereby increasing output, income, and overall economic efficiency. Furthermore, innovation-driven growth can enhance firm-level productivity and export potential, reinforcing structural transformation (Huang et al., 2022; Vasin, 2022). Prior research shows that in developing regions of Africa, Latin America, and Asia, patterns of structural transformation have been pivotal for sustained economic growth, though differences in labor productivity shifts explain much of the variation across countries (Lahiri & Hnatkovska, 2014).

Export-oriented structural transformation is often highlighted as a key driver of economic development. Trade liberalization expands industrialization opportunities and stimulates agricultural exports, while offering firms new avenues for scaling production (Khan, 2020; Jung, 2021; Ahmad et al., 2022; Gopalakrishnan et al., 2022). In the case of South Korea, for example, free trade policies and targeted subsidies accelerated structural transformation more effectively than trade restrictions alone (Teignier, 2018; Betts et al., 2017). Similarly, urbanization and structural transformation have contributed to China's housing market expansion, demonstrating the interaction between spatial factors and sectoral change (Garrige et al., 2023). Conversely, reductions in trade or export volumes can slow the structural transformation process, while shifts in comparative advantage can promote skill-based transformations, gradually altering the manufacturing share in global output (Cravino & Sotelo, 2019).

While East Asian economies have achieved rapid growth alongside equity gains, they have also experienced rising income inequality (Kanbur et al., 2014; Jain-Chandra et al., 2016; Piketty, 2015; Hillbom & Bolt, 2015; Khan et al., 2021). Kuznets (1955) posited an inverted U-shaped relationship between economic growth and inequality: as economies develop, initial growth may disproportionately benefit capital, widening inequality, but over time, poverty reduction occurs through sectoral shifts that absorb low-skilled labor into higher-productivity, higher-income sectors (Ravallion & Chen, 2009; Lopes, 2019).

1.1 Structural Transformation in Pakistan

Pakistan provides an illustrative case of structural transformation in a developing economy. During its first four decades, the country achieved notable growth and poverty reduction. Particularly, the 1980s saw annual growth rates of around 6%, driven by rapid expansion in the manufacturing sector, alongside a decline in poverty from 46% to 18%, low inflation, and a near doubling of per capita income. However, growth slowed in the 1990s, averaging 3–4%, with poverty rising to approximately 33% of the population. Export performance has also been weak, with the share of exports in GDP declining from 16% in the 1990s and 2000s to just 8% in the last decade. Compared to regional peers in Asia, Pakistan's pace of structural transformation has been slow, reflecting persistent sectoral inefficiencies and limited regional integration.

This study situates firm-level dynamics at the center of Pakistan's structural transformation, highlighting the spatial dimension of economic growth. By examining regional productivity differences, firm entry and exit, and the reallocation of labor and capital across provinces, this paper investigates how structural transformation interacts with local competitiveness and spatial spillovers to shape regional economic development.

Structural transformation is the reallocation of labor and capital toward more productive sectors and is central to economic growth. Firm dynamics—particularly entry, exit, and productivity heterogeneity—play a key role in determining how efficiently resources are allocated.

The study examines regional disparities in economic growth in Pakistan by applying a shift-share decomposition method to analyze structural changes across regions. This approach allows for the identification of deviations in regional growth rates from expected outcomes under the assumption of a uniform sectoral structure. The deviation is further decomposed into sectoral composition (industry-mix) and regional competitiveness effects, following the classical framework of the method.

Incorporating a spatial perspective, the regional growth deviations are further separated into contributions arising from local competitiveness and potential spatial spillovers. Key indicators of economic activity, including gross value added and the average annual employment across sectors, are employed to capture the dynamics at the provincial level. The analysis, covering 2004–2019, demonstrates that differences in local competitiveness—stemming from variations in productivity within the same industry across regions—play a dominant role in explaining growth differentials. Spatial decomposition allows the isolation of own competitiveness effects from those due to neighboring regions, revealing that regional growth is largely shaped by intrinsic local factors rather than external spillovers.

These findings underscore the importance of firm-level productivity and regional competitiveness in driving structural transformation and economic growth, while highlighting that spatial spillovers, although present, exert a secondary influence on regional development patterns in Pakistan.Regional policies play a critical role in addressing spatial disparities and fostering sustainable economic growth, particularly in developing countries such as Pakistan (Rodríguez-Pose, 2018).

These policies are designed to stimulate economic activity, reduce interregional inequalities, and enhance overall welfare by supporting less-developed regions to achieve growth levels comparable to more advanced areas (Floerkemeier et al., 2021). However, the effectiveness of such policies often depends on external factors, including cross-regional economic linkages, environmental dynamics, and global capital flows (Andersen & Dalgaard, 2011).

In the context of firm dynamics and structural transformation, spatial spillover effects have emerged as a key consideration in development economics. Economic actions and policy interventions in one region can influence growth patterns and firm behavior in neighboring regions, shaping the spatial distribution of productivity and structural change (LeSage, 2014). Recognizing these spillover effects is essential when designing regional development strategies, as they can amplify the impact of policy measures, affect firm-level interactions, and contribute to a more balanced and inclusive regional economic development across Pakistan.

Research Objectives and Significance

The study aims to achieve the following objectives:

- Examine the spatial spillover effects of external economic and environmental factors on regional economic growth in Pakistan.
- Assess the impact of regional development policies in fostering positive spillovers and reducing spatial disparities.
- Formulate policy recommendations to promote sustainable, inclusive, and balanced regional development.

This research contributes academically, practically, and policy-wise by providing a comprehensive analysis of how Pakistan’s economic growth is shaped by cross-border and regional spillovers, such as industrial emissions from India, infrastructure investments from China, remittances from Saudi Arabia, high-tech exports from Malaysia, and environmental challenges in Indonesia.

By integrating multiple spillover channels within a spatial economics framework, the study advances the literature while addressing methodological gaps through robust econometric and spatial modeling. The findings have important policy implications, guiding regional development strategies, enhancing cross-border economic cooperation, and supporting sustainable growth.

Moreover, the research offers valuable insights for businesses, investors, and international organizations operating in Pakistan and contributes to broader discussions on South Asian economic integration and climate-resilient development. By highlighting research gaps and informing development planning, the study serves as a key resource for promoting inclusive and sustainable economic growth both within Pakistan and in the wider region.

This study focuses on:

1. How firm-level behaviors aggregate into macroeconomic outcomes.
2. The role of spatial factors in shaping growth and inequality.
3. Policy levers for enhancing structural transformation and regional development.

Recent empirical evidence shows that regions with dynamic firm entry and high productivity growth experience faster GDP growth and reduced regional inequality (Hsieh & Klenow, 2009; McMillan & Rodrik, 2011). However, spatial dependencies and local institutional constraints can significantly moderate these outcomes.

2. Literature Review

The concept of spatial spillovers has become a central theme in development economics, particularly in understanding how economic activities in one region influence outcomes in neighboring areas. Since the foundational contributions of Krugman (1991), scholars have emphasized the role of geographic interactions in shaping regional growth dynamics. Spatial spillovers, as conceptualized by LeSage and Pace (2009), refer to the transmission of economic effects—such as growth, policy impacts, and externalities—across regions through channels like trade, investment flows, and environmental linkages. These spillovers can manifest as positive externalities, including technological diffusion and infrastructure benefits, or as negative consequences such as environmental degradation and resource competition, as highlighted by Fujita et al. (2001).

In the context of developing and emerging economies, Rodríguez-Pose (2018) argues that regional development strategies often overlook the importance of cross-regional externalities, leading to inefficient and uneven growth outcomes. This issue is particularly evident in Pakistan, where persistent spatial inequalities are reinforced by weak regional integration and uneven policy implementation (Zaidi, 2015). While provinces such as Punjab have experienced relatively rapid growth driven by industrial expansion, regions like Balochistan and Khyber Pakhtunkhwa continue to lag behind due to infrastructural deficiencies and governance challenges (Cheema et al., 2019). Initiatives such as the China-Pakistan Economic Corridor (CPEC) aim to address these disparities; however, their success largely depends on the extent and nature of spatial spillover effects across regions (Ali et al., 2020).

Building on this framework, recent empirical studies have explored the broader linkages between economic growth, environmental sustainability, and globalization. For instance, Ali et al. (2022) find a bidirectional relationship between economic growth and environmental degradation, indicating that while growth contributes to pollution, renewable energy adoption can mitigate such effects. Similarly, Kostakis (2024), in the context of ASEAN countries, provides partial support for the Environmental Kuznets Curve (EKC) hypothesis and underscores the importance of renewable energy in reducing emissions, while also noting that financial openness may exacerbate environmental pressures.

In Pakistan's case, foreign direct investment (FDI), particularly under CPEC, has been identified as a critical driver of economic growth. Ullah et al. (2022), using an ARDL framework, reveal that economic growth attracts Chinese investment, suggesting a demand-driven relationship between FDI and growth. Complementing this, Ahmad (2022) demonstrates that Chinese FDI—especially in renewable energy—has a significant positive impact on Pakistan's economic performance, reinforcing the role of external capital in supporting structural transformation.

Furthermore, regional studies in South Asia highlight the complex interaction between economic development, energy consumption, and environmental outcomes. Ali et al. (2022) provide evidence of a nonlinear relationship between growth and CO_2 emissions, consistent with the EKC hypothesis, emphasizing that economic expansion initially reduces but eventually increases environmental degradation beyond a certain threshold. These findings underline the necessity of integrating sustainability considerations into growth strategies.

Bakhsh et al. (2017) investigate the relationship between foreign direct investment (FDI), environmental pollution, and economic growth in Pakistan using annual data from 1980 to 2014 within a simultaneous equation framework. Their results indicate that both capital accumulation and labor contribute positively to economic growth, whereas environmental degradation exerts a detrimental effect. While FDI and economic growth enhance capital formation, FDI is also associated with increased pollution levels, suggesting a trade-off between growth and environmental sustainability.

Zafar et al. (2020) explore the link between industrialization and carbon emissions across 46 Asian economies over the period 1991–2017 using panel regression and FMOLS techniques. Their findings reveal that industrial expansion significantly raises CO_2 emissions in the long run, although the magnitude of this effect differs across sub-regions. The study emphasizes the need for context-specific industrial policies that balance economic growth with environmental considerations.

Umair and Waheed (2017) analyze the influence of external economic conditions, particularly Saudi Arabia's growth, on remittance inflows to Pakistan. Their findings show that remittances increase during periods of domestic economic downturn in Pakistan and during economic expansion in Saudi Arabia. Specifically, a decline in Pakistan's output leads to a substantial rise in remittance inflows, while higher growth in Saudi Arabia further amplifies these flows. The study also notes that trade enhances remittance inflows, whereas financial deepening may reduce them, highlighting the external dependency of remittance dynamics.

Riaz and Zaidi (2023) examine the contribution of remittances to Pakistan's economic growth using World Bank data from 2001 to 2019. Their analysis demonstrates that remittances play a significant role in driving both short- and long-term growth, as measured by GDP per capita.

The rapid increase in remittance inflows in recent years further underscores their importance as a key source of external financing and economic stability.

Afridi et al. (2024) extend this discussion by evaluating the moderating role of financial development in the remittance-growth nexus across developing countries. Using System GMM techniques, they find that the impact of remittances on growth depends on the nature of financial development. While expansion in financial size and depth may weaken the growth-enhancing effects of remittances, improvements in financial efficiency tend to strengthen this relationship by facilitating better resource allocation and attracting higher inflows.

Earlier work by Iqbal and Sattar (2010) also confirms the positive contribution of workers' remittances to Pakistan's economic growth over the period 1972–2003. Their findings highlight the importance of both public and private investment as growth drivers, while identifying inflation, external debt, and unfavorable trade conditions as constraints. The study stresses the need for stable macroeconomic policies to maximize the benefits of remittance inflows.

Finally, Sojoodi and Baghbanpour (2024) examine the relationship between high-technology exports and economic growth across a large sample of developed and developing countries. Their results suggest that, on average, high-tech exports do not exert a significant direct impact on GDP growth. However, country-specific analyses reveal some evidence of positive causality in selected cases, indicating that the growth effects of technological exports depend heavily on national conditions and structural factors.Charutawephonnukoon et al. (2021) analyze the contribution of high-technology exports, research and development (R&D) spending, and patent activity to economic growth in Thailand using a 26-year dataset. Applying a range of econometric techniques—including unit root and cointegration tests—the study finds that both high-tech exports and R&D investments significantly enhance economic performance, highlighting the importance of innovation-driven growth.

Aijaz et al. (2023) examine the role of R&D activities and intellectual property rights (IPRs) in shaping innovation, competitiveness, and economic growth in Pakistan. Utilizing a mixed-methods approach that combines firm-level data from 544 companies listed on the Pakistan Stock Exchange with qualitative insights from industry stakeholders, the study reveals low levels of R&D investment and weak adoption of IPR frameworks among Pakistani firms. Despite these limitations, the findings confirm a positive association between knowledge creation, innovation, and economic growth. Comparative evidence from trading partner countries suggests that stronger IPR enforcement promotes higher R&D expenditure and innovation, consistent with Schumpeterian growth theory.

Muhammad (2024) investigates the relationship between R&D expenditures, macroeconomic indicators, and GDP growth across Asian economies, focusing on ASEAN-5 and South Asian countries. Using panel data and vector error correction models (VECM) over the period 1990–2019, the study finds that R&D investment significantly and positively influences economic growth both at the regional and individual country levels. These results align with endogenous growth theory, emphasizing the critical role of innovation and technological progress in sustaining long-term economic development.

Tanveer et al. (2024) explore the interaction between environmental factors and economic activities in Pakistan by examining the effects of greenhouse gas emissions and ecological footprint on deforestation, urbanization, and growth. Using an ARDL framework with data from 1990 to 2017, the study finds that carbon emissions are positively associated with deforestation, agricultural expansion, globalization, and urbanization, contributing to environmental degradation over time. The ecological footprint similarly exhibits a long-run positive relationship with economic growth and land-use changes, while nitrous oxide shows mixed effects across environmental and economic variables.

Amar et al. (2024) assess the joint impact of foreign direct investment, external debt, fossil fuel consumption, governance quality, and trade on environmental degradation, poverty, and economic growth in middle-income ASEAN countries. Employing a simultaneous equation approach, the study demonstrates that economic growth, FDI, and fossil fuel use contribute significantly to environmental degradation, while environmental conditions and macroeconomic factors, including foreign debt, also influence poverty level.

Research Gaps

Despite extensive scholarship on regional development and spatial spillovers, several important gaps remain that this study aims to address in the context of Pakistan's economic growth:

I. Limited Focus on Pakistan's Cross-Border Spillovers in Asia

While research on spatial spillovers is well-established in developed economies (LeSage & Pace, 2009; Rodríguez-Pose, 2018), there is a lack of empirical evidence on how Pakistan's economic growth is affected by external influences from neighboring Asian economies, including India, China, Saudi Arabia, Malaysia, and Indonesia. Most prior studies emphasize domestic regional disparities (Hill, 2000) and do not systematically account for transnational spillover effects.

II. Insufficient Integration of Multiple Spillover Channels

Previous work often examines spillover effects in isolation, focusing separately on foreign direct investment (FDI), environmental impacts, or remittances (Calderón & Servén, 2014; Chami et al., 2009). Few studies integrate multiple channels simultaneously. This research addresses this limitation by assessing five interconnected spillover mechanisms—industrial, infrastructural, financial, technological, and environmental—that collectively influence Pakistan's regional economic performance.

III. Lack of Policy-Oriented Analysis of Spatial Spillovers

Although initiatives such as the China-Pakistan Economic Corridor (CPEC) have been studied (Rizvi, 2014), limited research explores how Pakistan can strategically leverage or manage spillovers from neighboring countries through policy interventions. This study contributes actionable insights for designing spatially-targeted development policies to enhance regional growth outcomes.

3. Methodology

This study uses shift-share decomposition and spatial econometric models to analyze regional growth.This study employs panel cross-sectional data from 2004 to 2019 to empirically examine Pakistan's economic growth, focusing on key determinants such as gross domestic product (GDP), CO_2 emissions in India, Chinese foreign direct investment (FDI), remittances from Saudi Arabia, Malaysian high-technology exports, and Indonesian forest area. The analysis also considers the broader implications of regional development on Pakistan's growth trajectory during this period. All data are secondary and the sources and descriptions are detailed below.

3.1. Time Series Data

Time series data consist of observations recorded sequentially over time, often at regular intervals. This type of data enables identification of trends, cycles, and temporal relationships among variables, which is essential for understanding how Pakistan's growth evolves over time in response to regional and international influences.

3.2. Cross-Sectional Data

Cross-sectional data capture information from multiple entities (such as regions, firms, or households) at a single point in time. This data type allows for the assessment of differences, correlations, and patterns across units, providing a snapshot of regional disparities, firm dynamics, or sectoral characteristics within Pakistan during a specific year.

3.3. Panel Data

Panel data track the same entities over multiple time periods, combining both time series and cross-sectional dimensions. This approach facilitates the analysis of dynamics, structural transformations, and causal relationships by controlling for unobserved heterogeneity across regions or firms. While more complex to collect, panel data allow for robust inferences about trends and policy impacts on Pakistan's economic growth.

3.4. Cross-Panel or Spatial Data

Spatial panel data, also called longitudinal cross-sectional data with a geographic dimension, link observations across both time and space. These datasets enable the study of spatial patterns, interactions, and spillover effects, which are crucial for analyzing how neighboring regions or external economies influence Pakistan's growth through firm dynamics, trade, investment, or environmental factors.

This dataset provides a comprehensive framework for investigating firm dynamics, structural transformation, and regional economic growth in Pakistan, incorporating both temporal evolution and spatial interactions.

3.5. Model Specification

To align the empirical framework with the study of firm dynamics, structural transformation, and spatial economic growth in Pakistan, the model is reformulated to incorporate both internal structural factors and external spatial spillovers. The baseline panel model is specified as follows:

$GVA\_Growth_{it} = \alpha + \beta_1 Share\_Agri\_it + \beta_2\, Share\_Manu_{it} + \beta_3\, Share\_Serv_{it} + \beta_4\, FirmDyn_{it} + \beta_5\, X_{it} + \varepsilon_{it}$

Where:

GVA_Growth_it represents regional economic growth (proxy for GDP growth) in region i at time t.Share_Agri, Share_Manu, and Share_Serv capture structural transformation across sectors.FirmDyn denotes firm dynamics, including firm entry, exit, and productivity.X_it is a vector of control variables (e.g., capital, labor, external spillovers such as FDI, remittances, and trade linkages).ε_it is the error term.

To explicitly account for spatial interdependencies and spillover effects, the model is extended into a Spatial Autoregressive (SAR) framework:

3.6 Econometric Methodology

3.6.1 Unit Root Testing

In analyzing firm dynamics, structural transformation, and regional economic growth in Pakistan, it is essential to first examine the statistical properties of the data. A key requirement in time-series and panel econometrics is stationarity, which implies that the mean, variance, and covariance of a series remain constant over time.

Non-stationary variables can produce spurious regression results, leading to misleading inferences about the relationship between firm behavior, regional development, and economic growth. This issue is particularly relevant for macroeconomic and regional datasets, where structural changes, policy shifts, and spatial heterogeneity often induce persistent trends.

To address this, unit root tests are employed to determine the order of integration of each variable. A variable is considered:

- **I(0)** if it is stationary in levels
- **I(1)** if it becomes stationary after first differencing
- Yi=F(X1i,X2i,X3i,…,Xmi)
- Ordinary Least Square method helps to find out the estimated value of model.

In this study, standard panel unit root tests such as the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests are applied to ensure robustness. Establishing stationarity is a necessary step before proceeding to spatial econometric modeling and long-run estimation.

3.6.2 Augmented Dickey-Fuller (ADF) Test

The Augmented Dickey-Fuller (ADF) test is utilized to examine the presence of unit roots while addressing potential **serial correlation** in the error terms. Unlike the basic Dickey-Fuller test, the ADF specification incorporates lagged differences of the dependent variable, thereby improving the reliability of the results.

The general ADF specification includes:

- A constant and/or deterministic trend (if required)
- Lagged differences to eliminate autocorrelation
- An optimal lag structure determined through information criteria such as the Akaike Information Criterion (AIC) or Schwarz Bayesian Criterion (SBC).

This approach ensures that the residuals are white noise, enhancing the validity of statistical inference. The ADF test is particularly suitable in this study, given the dynamic nature of firm entry, exit, and productivity changes across regions.

4. Empirical Results and Discussion

In macroeconomic and regional analyses, economic variables frequently exhibit non-stationarity or unit root behavior, meaning their mean and variance may change over time. Non-stationary variables, characterized by a non-zero mean and time-varying variance, can lead to spurious regression results and misinterpretation of relationships among variables. Therefore, verifying stationarity is a crucial step to avoid model misspecification and to ensure the reliability of empirical analysis. A variable is considered stationary if it maintains a constant mean and variance over time.

4.1 Unit Root Test Results

To examine the stationarity properties of the variables, Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests were conducted. The results, summarized in Table 2, indicate the order of integration and the associated probability values for each variable.

Table 2: ADF/PP Unit Root Test Results

Variable	Order of Integration	Probability Value
GDP	1st Difference	0.002
CO2 Emissions	1st Difference	0.040
FDI	1st Difference	0.030
Remittances	1st Difference	0.001
High-Tech Output	1st Difference	0.000
Forest Area	1st Difference	0.010

Source: Author's own calculations

The results reveal that all variables become stationary after first differencing, with p-values below the 0.05 significance level. This confirms that the null hypothesis of a unit root can be rejected, establishing that the series are integrated of order one, I(1). These findings satisfy a fundamental prerequisite for subsequent regression analyses, including Ordinary Least Squares (OLS), ensuring that spurious correlations are minimized.

4.2 Results of OLS Estimation

Before applying OLS, it is essential to verify that the classical assumptions of regression are satisfied. One key diagnostic is the Breusch-Godfrey Lagrange Multiplier (LM) test, which detects the presence of serial correlation in the residuals of regression equations. Serial correlation violates the OLS assumption of independently distributed errors and can bias standard errors, leading to unreliable inference. Table 3 reports the LM test results, which confirm whether the OLS assumptions hold, thereby validating the use of OLS for estimating the relationships among firm dynamics, structural transformation, and regional economic growth.

4.3 Diagnostic Tests for OLS Assumptions

To ensure the reliability of the Ordinary Least Squares (OLS) estimates, several diagnostic tests were conducted to verify key assumptions, including serial correlation, heteroskedasticity, and normality of residuals.

4.3.1 Breusch-Godfrey Lagrange Multiplier (LM) Test for Serial Correlation

The Breusch-Godfrey LM test was applied to detect potential serial correlation in the residuals of the regression models. Serial correlation, if present, can bias standard errors and compromise the validity of statistical inference. Table 3 summarizes the LM test results:

Table 3: Breusch-Godfrey LM Test Results

Test Statistic	Estimated Value	Probability
F-statistic	0.71	0.50
Obs*R-squared	1.97	0.37

Source: Author's calculations

The results show that all p-values are above the 0.05 threshold, meaning the null hypothesis of no serial correlation cannot be rejected. This confirms that the OLS assumption of independent errors is satisfied, indicating that the model residuals are free from autocorrelation.

4.3.2 Breusch-Pagan-Godfrey (B-P-G) Test for Heteroskedasticity

To assess whether the variance of residuals is constant (homoscedasticity), the Breusch-Pagan-Godfrey (B-P-G) test was employed. Heteroskedasticity can lead to inefficient estimates and invalid inference if uncorrected. Table 4 presents the results

Table 4: Breusch-Pagan-Godfrey Test Results

Test Statistic	Estimated Value	Probability
F-statistic	0.73	0.60
Obs*R-squared	4.96	0.54

Source: Author's calculations

Since the p-values exceed 0.05, the null hypothesis of constant variance cannot be rejected. This indicates that the residuals are homoscedastic, and the OLS model satisfies the homoscedasticity assumption.

4.3.3 Jarque-Bera Test for Normality of Residuals

The Jarque-Bera (J-B) test was conducted to evaluate whether the residuals follow a normal distribution, which is critical for the validity of t-tests and F-tests in regression analysis. The results of this test are reported in Table 5.

The findings from these diagnostic tests collectively confirm that the OLS model assumptions—independence of errors, constant variance, and normality—are adequately satisfied. Therefore, the regression estimates provide a reliable basis for analyzing the role of firm dynamics and structural transformation in shaping regional economic growth in Pakistan.

4.4 Normality and Cross-Panel Regression Results

4.4.1 Normality Test of Residuals

The Jarque-Bera test was conducted to examine whether the residuals from the regression are normally distributed—a key assumption of classical linear regression models. Table 5 presents the test results:

Table 5: Jarque-Bera Normality Test Results

Test	Statistics	Estimated Value	Probability
Jarque-Bera	–	1.24	0.53

Source: Author's calculations

The p-value exceeds 0.05, indicating that the null hypothesis of normality cannot be rejected. This confirms that the residuals are approximately normally distributed, satisfying one of the fundamental assumptions of OLS regression.

4.4.2 Cross-Panel Regression Estimates

The cross-panel regression results, summarized in Table 6, reveal the effects of various regional and international economic factors on Pakistan's GDP growth.

Table 6: Cross-Panel Regression Estimates

Variable	Coefficient	t-Statistic	Probability
Constant	41.453	5.290	0.000
Ln(IND_CO2)	1.462	5.292	0.000
Ln(CHN_FDI)	0.172	3.681	0.001
Ln(SAUD_REMIT)	-0.507	-3.411	0.003
Ln(MAL_HIGHTECH)	-0.723	-1.632	0.120
Ln(INDO_FORESTAREA)	-1.301	-1.092	0.289
R^2	0.982	–	–
Adjusted R^2	0.977	–	–

Source: Author's calculations

4.4.3 Interpretation of Results:

The regression analysis demonstrates that most explanatory variables exert statistically significant impacts on Pakistan's GDP growth. Exceptions include Malaysia's high-tech exports and Indonesia's deforestation, which show no significant effects. These findings are consistent with the literature on spatial econometrics and regional development (LeSage & Pace, 2009; Evangelista et al., 2018; Aqdas et al., 2023), while also providing new insights into Pakistan's economic interactions with key Asian neighbors.

- India's CO_2 Emissions: A 1% increase in India's per capita CO_2 emissions is associated with a 14% increase in Pakistan's GDP, highlighting a positive spillover effect. This supports the Environmental Kuznets Curve (EKC) hypothesis (Krueger & Grossman, 1995), which posits that industrialization initially drives economic growth despite environmental costs. Positive spillovers arise due to:

1. Robust trade linkages between India and Pakistan, valued at $2.4 billion in 2021 (World Bank, 2022).
2. Regional integration facilitating investment flows and knowledge diffusion (Fujita & Hamaguchi, 2008).
3. Shared infrastructure and informal cross-border economic activities (Srinivasan, 2012).

- China's Outward FDI: A 1% increase in Chinese FDI correlates with a 17% rise in Pakistan's GDP. This finding aligns with endogenous growth theory (Romer, 1990) and infrastructure-led development studies (Calderón & Servén, 2014). The China-Pakistan Economic Corridor (CPEC) has contributed significantly through investments exceeding $25 billion in transportation and energy, creating over 75,000 direct and 200,000 indirect jobs (Pakistan Ministry of Planning, 2022), improving trade links with Central Asia by 37% since 2015 (State Bank of Pakistan, 2022). Advanced construction techniques and management practices from China have further enhanced efficiency (Zou et al., 2007). However, scholars warn of potential debt sustainability risks (Peyrouse & Raballand, 2015).
- Saudi Remittances: Contrary to expectations, remittances from Saudi Arabia negatively affect Pakistan's GDP growth, supporting the "Dutch Disease" hypothesis (Jafarey et al., 2024). Factors include currency appreciation reducing export competitiveness, high consumption shares of remittances (~78%), human capital outflows, and reduced incentives for structural reforms (Adams & Page, 2005; UNDP, 2021).

Overall, the high R^2 value of 0.977 indicates an excellent model fit, explaining 97% of the variation in Pakistan's GDP. This underscores the importance of spatial spillovers and regional interdependencies in shaping the country's growth dynamics.

5. Conclusions and Policy Recommendations

This study investigated the spatial spillover effects of regional development policies on Pakistan's economic growth by employing a spatial regression framework with annual data spanning 2000 to 2023. The analysis focused on how external shocks—including industrial emissions, infrastructure investment, remittance inflows, and environmental changes—affect Pakistan's GDP, while also considering the role of firm dynamics and structural transformation across regions.

The results indicate that most explanatory variables significantly influence Pakistan's economic growth, with the exception of Malaysia's high-tech exports and Indonesia's deforestation, which were statistically insignificant. Key findings include:

- India's CO_2 Emissions: A 1% increase in India's per capita CO_2 emissions corresponds to a 14% rise in Pakistan's long-run GDP. This highlights a positive spillover effect from India's growth, driven by trade access, investment flows, and regional economic cooperation.

- China's Outward FDI: Chinese infrastructure investment, particularly under the China-Pakistan Economic Corridor (CPEC), significantly boosts Pakistan's GDP. A 1% increase in China's FDI translates to a 17% growth in Pakistan's GDP, reflecting improvements in infrastructure, job creation, technology transfer, and regional connectivity.
- Saudi Remittances: Contrary to conventional expectations, remittances from Saudi Arabia exert a negative impact on Pakistan's GDP. This supports the "Dutch Disease" hypothesis, where large remittance inflows lead to currency appreciation, lower export competitiveness, consumption-driven growth, and reduced incentives for productive investment.
- Malaysia's High-Tech Exports and Indonesia's Deforestation: Both variables showed no significant influence, likely due to limited trade volumes, geographic distance, and structural differences between the economies.

These findings underscore the importance of leveraging positive spillovers from neighboring economies while mitigating the adverse effects of remittance dependence and environmental challenges.

5.1 Policy Recommendations

Based on the empirical results, the following policy measures are recommended to enhance Pakistan's economic growth and strengthen regional resilience:

1. Enhance Regional Economic Integration
   Pakistan should deepen economic ties with India and China to maximize the positive spillovers of their growth. Initiatives could include improved trade agreements, joint infrastructure projects, and coordinated regional development programs to increase access to neighboring markets.
2. Ensure Effective Implementation of CPEC Projects
   The government must prioritize the timely and transparent execution of CPEC initiatives. Focus areas should include infrastructure development in underdeveloped regions, industrialization to create jobs, and promotion of technology transfer and skill development to boost productivity and competitiveness.
3. Reduce Dependence on Remittances
   To mitigate the negative effects of remittance reliance, Pakistan should diversify its economy by strengthening agriculture, industry, and technology sectors. Structural reforms are needed to attract private investment, increase export competitiveness, and reduce the trade deficit.
4. Promote Sustainable Environmental Policies
   Although Indonesian deforestation did not directly impact GDP, environmental sustainability remains critical. Pakistan should invest in renewable energy, address soil erosion, air and water pollution, and adopt climate adaptation strategies to ensure long-term sustainable growth.
5. Expand High-Tech Trade Opportunities

Even though Malaysia's high-tech exports were not significant, Pakistan should explore trade expansion with technology-driven economies. This can be achieved by forming strategic partnerships, upgrading trade infrastructure, and creating an investor-friendly environment for high-tech industries.

6. Strengthen Financial Inclusion and Social Protection

   To counter the volatility and negative effects of remittance flows, policies should enhance access to credit, encourage savings, and provide targeted support for vulnerable groups, thereby improving economic resilience and reducing inequality.

References

Aguiar, A., Narayanan, B., & McDougall, R. (2016). An overview of the GTAP 9 data base. *Journal of Global Economic Analysis, 1*, 181–208. https://doi.org/10.21642/JGEA.010103AF

Ahmad, S., Khan, M. A., & Mustafa, U. (2022). Agricultural trade and ultra-poor in Pakistan: An application of CGE model. *Millennial Asia, 13*, 491–512.

Ahson, T., & Khan, M. A. (2024). Research in globalization, 8, 100190.

Ahson, U., Siddiqi, M. W., & Mirza, F. (2017). Structural change and economic progress: Empirical evidence from selected Asian countries. *Pakistan Journal of Social Sciences (PJSS), 37*, 549–565.

Anderson, K., & Ponnusamy, S. (2023). Structural transformation away from agriculture in growing open economies. *Agricultural Economics, 54*(1), 62–76.

Andersson, M., & Palacio Chaverra, A. (2016). Structural change and income inequality–Agricultural development and inter-sectoral dualism in the developing world, 1960–2010. OASIS No. 23. https://ssrn.com/abstract=2809669

Armington, P. S. (1969). A theory of demand for products distinguished by place of production. *Staff Papers, 16*, 159–178.

Baek, S. J. (2018). *Political economy of neo-modernisation*. Berlin, Germany: Springer.

Betts, C., Giri, R., & Verma, R. (2017). Trade, reform, and structural transformation in South Korea. *IMF Economic Review, 65*, 745–791.

Beyers, W. B. (1976). Empirical identification of key sectors: Some further evidence. *Environment and Planning A, 8*, 231–236.

Cai, J., & Leung, P. (2004). Linkage measures: A revisit and a suggested alternative. *Technological Analysis & Strategic Management, 16*, 63–83.

Caselli, F. (2005). Accounting for cross-country income differences. In P. Aghion & S. N. Durlauf (Eds.), *Handbook of economic growth* (Vol. 1, pp. 679–741). Amsterdam, Netherlands: Elsevier. https://doi.org/10.1016/S1574-0684(05)01009-9

Asian Development Bank. (2022). *Pakistan: Input-Output economic indicators*. Manila, Philippines: ADB/ERCD.

Chen, Y., Zhang, S., Miao, J., et al. (2023). The negative effects of the US-China trade war on innovation: Evidence from the Chinese ICT industry. *Technovation, 123*, 102734.

Chenery, H. B., & Watanabe, T. (1958). International comparisons of the structure of production. *Econometrica, 26*, 487–521.

Cravino, J., & Sotelo, S. (2019). Trade-induced structural change and the skill premium. *American Economic Journal: Macroeconomics, 11*, 289–326.

Dorosh, P., & Thurlow, J. (2018). Beyond agriculture versus non-agriculture: Decomposing sectoral growth–poverty linkages in five African countries. *World Development, 109*, 440–451. https://doi.org/10.1016/j.worlddev.2016.08.014

Fagerberg, J. (2000). Technological progress, structural change and productivity growth: A comparative study. *Structural Change and Economic Dynamics, 11*, 393–411.

Felipe, J. (2012). *Inclusive growth, full employment, and structural change: Implications and policies for developing Asia* (2nd ed.). London, UK: Anthem Press.

Garriga, C., Hedlund, A., Tang, Y., Wang, P., et al. (2023). Rural-urban migration, structural transformation, and housing markets in China. *American Economic Journal: Macroeconomics, 15*(2), 413–440.

Ghosh, S., Doğan, B., Can, M., Shah, M. I., & Apergis, N. (2023). Does economic structure matter for income inequality? *Quality & Quantity, 57*(3), 2507–2527.

Gollin, D. (2021). Agricultural productivity and structural transformation: Evidence and questions for African development. STEG Pathfinding Paper. https://steg.cepr.org/sites/default/files/2022/8/PP04%20AgriculturalProductivity%20Gollin%2020210401.pdf

Gollin, D., Parente, S. L., & Rogerson, R. (2007). The food problem and the evolution of international income levels. *Journal of Monetary Economics, 54*, 1230–1255. https://doi.org/10.1016/j.jmoneco.2006.04.002

Gopalakrishnan, B. N., Chakravarthy, S. L., Tewary, T., & Jain, V. (2022). Isolating China: Deglobalisation and its impact on global value chains. *Foreign Trade Review, 57*(4), 390–407.

Hasan, R., Lamba, S., & Sen Gupta, A. (2013). Growth, structural change, and poverty reduction: Evidence from India. Manila, Philippines: Asian Development Bank. http://hdl.handle.net/11540/2060

Herrendorf, B., Rogerson, R., & Valentinyi, Á. (2014). Growth and structural transformation. In P. Aghion & S. N. Durlauf (Eds.), *Handbook of economic growth* (Vol. 2, pp. 855–941). Amsterdam, Netherlands: Elsevier. https://doi.org/10.1016/B978-0-444-53540-5.00006-9

Hertel, T. W., & Tsigas, M. E. (1997). Structure of GTAP. In T. W. Hertel (Ed.), *Global trade analysis: Modeling and applications* (pp. 13–73). Cambridge, UK: Cambridge University Press