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Impact of Gas as Energy Sector on Economic Growth of Pakistan

Aleena Khalil[1], Muhammad Niamat Ullah Babar[1], Muhammad Waqar[1], Muhammad Ehsan Elahi[1], Shehla Mazhar[1], Saima Munir[1], Ruqia Naaz[1] & Bushra Zaman[1]

[1]*Department of Economics, Institute of Social Sciences, Gomal University, Dera Ismail Khan*

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Corresponding Author:
Aleena Khalil
Email:
aleneeto3@gmail.com

ABSTRACT

This study looks at how Pakistan's energy sector in terms of Gas has affected the country's economic development, with a particular emphasis on the connection between GDP growth, energy output, and energy consumption. The study finds a strong correlation between economic development and the performance of the Gas as energy industry in the short and long term using time-series data and econometric methods including Granger-causality analysis and co-integration. The findings show that industrial output, employment, and general economic productivity are all significantly influenced by a steady and adequate supply of energy. Furthermore, it has been discovered that the sector's inefficiencies and energy limitations limit growth. The results highlight the necessity of investing in sustainable gas as energy infrastructure, diversifying energy sources, and implementing comprehensive energy reforms in order to support Pakistan's long-term economic objectives. Recommendations for policies are given to improve the gas as energy sector's ability and effectiveness as a driver of sustainable growth.

Introduction

Natural Gas has been prominently playing a role in accelerating economic growth and development in Pakistan. It has far-reaching effects and a long-lasting impact on Pakistan's economic growth. It also serves as a key contributing factor in accomplishing set objectives through the integrated process of planning, monitoring, and evaluation, supported by elements of cohesion. This study specifically delves into the impact of both the service and gas energy sectors on Pakistan's economic growth (GDP) from 1994-95 to 2020-21. Understanding this dynamic relationship is paramount for effective policy-making, particularly when considering the mounting challenges facing Pakistan's gas sector, such as depleting domestic reserves, increasing reliance on expensive LNG imports, and persistent circular debt. Therefore, the efficient management and strategic utilization of natural gas resources, coupled with thoughtful policy interventions, are

essential to ensure its continued positive contribution to Pakistan's sustained economic development.

Due to its adaptability, affordability, and cleaner burning characteristics than other fossil fuels, natural gas is essential to contemporary economies. Its effects on the economy are multifaceted and can affect industrial competitiveness as well as macroeconomic stability. Particularly in nations with large reserves, natural gas is frequently less expensive than coal and oil, which lowers expenses for both people and businesses. It provides dependable and adaptable power to electrical systems, frequently enhancing sporadic renewable energy sources like wind and sun. Energy output per unit of fuel is improved by the excellent thermal efficiency (up to 60%) of contemporary combined-cycle natural gas plants. Natural gas, especially liquefied natural gas (LNG), is a major export source for nations including the United States, Qatar, and Russia. Natural gas availability can improve national energy security by lowering reliance on foreign energy sources or oil. Strategic dependence may result from the economic influence of gas-exporting countries (such as Russia's gas shipments to Europe). When switching from coal or oil to renewable energy sources, natural gas is frequently referred to as a "bridge fuel" since it helps lower emissions temporarily. Natural gas has an economic edge over coal due to its comparatively lower emissions profile as carbon pricing and environmental laws tighten.

Background of the Study

Natural gas is a pivotal component of Pakistan's energy landscape, supplying approximately 35% of the country's primary energy needs. It forms the backbone of three critical economic sectors: industrial production, electricity generation, and household consumption. Key industries like textiles and fertilizers, significant contributors to Pakistan's exports, are highly reliant on stable gas supplies. Moreover, the power sector uses gas for about 25% of its electricity generation, and over 9 million households depend on it for daily cooking and heating. The gas sector plays a substantial role in Pakistan's economic growth through various avenues, directly contributing an estimated 2.5-3% to the GDP and generating employment throughout its value chain. By providing affordable energy, it enhances the competitiveness of industries in international markets. Furthermore, the availability of gas is crucial for maintaining household welfare, particularly for low and middle-income families who rely on it as their primary energy source. Domestic gas reserves are depleting rapidly, at an alarming annual rate of about 9%, forcing Pakistan to become a net importer of LNG. These LNG imports currently constitute approximately 15% of the total import bill, exerting significant pressure on foreign exchange reserves. The sector also experiences chronic supply-demand gaps, especially during winter, leading to industrial shutdowns and household shortages. Financial mismanagement has resulted in a circular debt exceeding PKR 1.5 trillion, compounded by aging infrastructure that causes 12-15% transmission losses.

To address these challenges and maximize its economic potential, Pakistan must implement comprehensive reforms. These include accelerating the exploration of indigenous reserves, including untapped shale gas potential, modernizing pipeline networks and LNG terminals, and rationalizing tariff structures to tackle circular debt. Additionally, implementing demand-side management through energy efficiency measures and gradually transitioning to renewable-gas hybrid models could enhance the sector's sustainability. The future trajectory of Pakistan's gas sector holds far-reaching implications for the country's economic stability. Its performance directly influences the balance of payments, industrial productivity, energy security, and social welfare. With appropriate reforms and investments, the sector has the potential to increase its GDP contribution by 1-1.5% annually while ensuring long-term energy security. Given its strategic importance, effective management of the gas sector is paramount for Pakistan's macroeconomic stability and sustainable development.

Significance of the Study

A clear understanding of the gas sector's impact on Pakistan's GDP is vital for several reasons. First, it informs policymakers about the direct and indirect contributions of natural gas to economic output, allowing for the optimization of resource allocation and energy policies. Second, it helps identify potential vulnerabilities, such as the negative impacts of circular debt and inefficient gas utilization, which can hinder economic growth. Finally, this knowledge enables the formulation of targeted policies to address these challenges, promote sustainable energy practices, and maximize the gas sector's positive influence on Pakistan's economic trajectory. This study aims to provide empirical evidence to guide such crucial policy decisions.

Objectives of the Study

To check the Impact of the Services and Gas as Energy Sector on Economic Growth in Pakistan

Research Hypothesis

The Research Hypothesis will be as follows.

H_0: No impact of Services on economic growth in Pakistan.

H_1: Impact of Services on economic growth in Pakistan.

H_0: No impact of Gas as Energy Sector on economic growth in Pakistan.

H_1: Impact of Gas as Energy Sector on economic growth in Pakistan.

Review of Literature

This review synthesizes existing research on the contributions of the gas sector and services to Pakistan's Gross Domestic Product (GDP). It examines studies, both within Pakistan and globally, that employ econometric analysis to assess these impacts.

The primary objective is to present a comprehensive overview of prior work on this topic. By analyzing findings from various authors, the review aims to provide a broad perspective on the complex relationships between the gas sector, the services sector, and GDP in Pakistan. This analysis of past research is crucial for establishing a foundation for further investigation, pinpointing areas that require more detailed study, and building upon the existing body of knowledge to enhance understanding of Pakistan's economic dynamics.

The literature on Gas and economic growth is extensive. While many studies, including those in Congo, Bangladesh, and Pakistan, show a positive correlation and various causal relationships (unidirectional/bidirectional), others report negative impacts in specific sectors or due to inefficient practices. In Pakistan, research yields mixed results, with some indicating a positive link and others finding insignificant or negative impacts. This highlights the need for a nuanced understanding of Pakistan's gas sector dynamics, considering consumption patterns, pricing, and increasing LNG reliance. This study contributes by analyzing the gas sector's recent impact on Pakistan's GDP to inform energy policy and sustainable development.

Ngwu *et al* (2024) in their study investigated the effect of gas utilization, specifically the Domestic Gas Market (DGM) and Export Gas Market (EGM), on Nigeria's economic growth (GDP) (1999 to 2021). Utilizing data from NNPC and OPEC, the research employed descriptive statistics, correlation analysis, and multiple regression to analyze the relationship between these variables. The findings revealed a significant positive impact of both DGM and EGM on Nigeria's GDP. They concluded that gas has a substantial positive effect on Nigeria's economic growth.

Malik (2023) investigated the financial burden of circular debt and reliance on LNG imports. Circular debt, rising LNG costs, and delays in tariff adjustments are creating financial strains. Inefficient gas consumption policies, including artificial demand creation and subsidies, hinder optimal economic productivity. Conversely, proposed reforms like deregulation, market-based pricing, and shifting domestic consumption from gas to electricity are expected to positively impact GDP by enhancing efficiency, reducing costs, and alleviating the sector's financial strain. Hence, negative impact of gas on GDP is observed.

In their study, Hasan and Raza (2022) examined the relationship between Bangladesh's economic growth (EG) and natural gas consumption (NGC) between 1990 and 2019. The study discovered a short- and long-term cointegration between natural gas use and economic growth using ARDL and vector error correction models. This indicates that EG influences NGC and NGC influences EG, proving that natural gas utilization boosts Bangladesh's economy.

Munir and Nadeem (2022) investigated how natural gas affected industries such as cement, power, and fertilizer. They discovered that while gas use had a long-term favorable effect on the power and fertilizer industries, it had a detrimental effect on the cement industry because of inefficiency. In the medium term, there is a unidirectional causal relationship between economic growth and industrial sector gas consumption. According to these findings, policymakers should encourage the use of natural gas in industries like power and fertilizer while reassessing its usage in the cement industry if Pakistan is to see sustained economic growth.

In their study, Sohail et al. (2022) examined the asymmetric impacts of natural gas consumption on Pakistan's economic growth from 1965 to 2019 while taking financial development into account. The results show a short-term benefit: rising natural gas use spurs economic expansion. This relationship is symmetric over the long term: growth is boosted by positive changes in gas consumption and slowed by negative changes. Additionally, the study supports the energy consumption-led growth phenomenon by confirming that natural gas consumption in Pakistan has a direct impact on economic growth. The study makes policy recommendations to increase natural gas usage in order to support Pakistan's future economic growth in light of these findings.

Thalassinos *et al* (2022) declared Natural gas as a key "bridge fuel," contributing to GDP growth as the world transitions to cleaner energy. This Research across 14 G20 nations (1994-2018) demonstrated a positive long-term relationship between natural gas consumption and GDP. Thanks to technology and unconventional sources, expanded gas reserves further support economic activity.

Ahmad *et al*. (2021) examined the role of natural gas in power generation between 1987 and 2019, highlighting that natural gas consumption significantly boosts industrial productivity and GDP. Suggested prioritizing gas for power generation due to its cost-effectiveness compared to oil.

Azam *et al* (2021) investigated the top ten CO2-emitting countries from 1990-2014, utilizing panel co-integration, FMOLS, and heterogeneous Dumitrescu and Hurlin causality assessments aimed to determine the effect of various clean energy sources, including natural gas, on economic growth (GDP). The key finding, specifically regarding natural gas's impact on GDP, was that natural gas does not contribute to economic growth in these high-emitting countries. This contrasts with nuclear energy and renewable energy, which were found to be vital for promoting economic growth. The study concludes that while natural gas is a fossil fuel that produces less CO2 than others and is considered a cheap option, its consumption in these nations did not show a positive long-run impact on GDP.

Itoua *et al* (2021) investigated the impact of gas on the economic growth (GDP) of the Republic of Congo between 2006 and 2019. Key findings indicated that gas utilization significantly stimulates GDP, suggesting a positive contribution of consumed gas to the nation's economic output.

Awodumi and Adewuyi (2019) in their research study precisely analyzed the impact of natural gas consumption on economic growth (GDP) in Africa's top oil-producing nations (1980-2015). Using an NARDL technique, it identified an asymmetric effect of natural gas on GDP in most countries. Specifically, increased natural gas consumption promoted economic growth in Gabon, fostered economic growth in Egypt, and contributed to economic growth in Angola. Algeria was an exception. The research implies that while natural gas drives GDP, concurrent investment in carbon-reducing technologies is crucial for sustainable development. These findings highlight that for these African nations, strategically leveraging their natural gas resources can be a driver of economic expansion.

Han Cheng *et al* (2019) in their study using panel quantile regression on data from 30 Chinese provinces (2000-2014) based on a modified Cobb-Douglas function, reveal a positive correlation between natural gas consumption and economic growth.

In his research, Aydin (2018) found a strong and favorable correlation between natural gas use and economic expansion in the top ten nations that use natural gas between 1994 and 2015. In particular, the frequency domain Granger causality analysis revealed a variety of short-term and long-term correlations. Germany showed a short-term correlation with natural gas use and economic growth, whereas Thailand and the UK showed long-term correlations. Together, these results imply that boosting natural gas use can be extremely important for maintaining energy security, cutting carbon emissions, decreasing dependency on other energy sources, and eventually promoting economic growth.

Using data from 1977 to 2013, Hassan et al. (2018) used the Granger causality tests and the Johansen maximum likelihood technique. The analysis supported the energy-led growth theory by finding a positive and statistically significant long-term association between Pakistan's economic growth and its use of natural gas.

According to Destek (2016), who used a multivariate production model to evaluate 26 OECD nations between 1991 and 2013, natural gas consumption increases GDP growth in the near term and has a strong positive long-term association with GDP growth. The study, which used panel Fully Modified Ordinary Least Squares (FMOLS) and panel Dynamic Ordinary Least Squares (DOLS) methods, shows that rising natural gas consumption has a long-term positive impact on economic growth in these developed countries and is correlated with it.

In "Natural Gas Consumption and Economic Growth in Pakistan," Shahbaz et al. (2013) employed the Autoregressive Distributed Lag (ARDL) bounds testing technique. verified that there is a long-term positive correlation between Pakistan's GDP growth and natural gas use. Restrictive gas policies may hinder economic growth, the study also noted.

In their research, Apergis et al. (2010) examined the connection between real GDP growth and natural gas consumption in a sample of 67 nations between 1992 and 2005. The panel vector error correction model's findings showed that there is both short- and long-term bidirectional causality between natural gas consumption and economic growth. This implies a two-way interaction in which economic growth is fueled by increased natural gas use, and economic expansion in turn fuels increased natural gas use. By looking at a wider range of nations within a production model, this study adds to the scant body of knowledge on the relationship between natural gas consumption and economic development to the global level.

Asghar (2008) used error correction models and the Toda-Yamamoto technique to examine the causal relationship between natural gas consumption and GDP in five South Asian nations: Bangladesh, Nepal, India, Pakistan, and Sri Lanka. The main conclusion on natural gas's effect on GDP was unique to Bangladesh, where a unidirectional Granger causal relationship between GDP

and gas consumption was found. This implies that rising natural gas use in Bangladesh directly supports economic expansion. No clear causal relationship between natural gas use and GDP was found for the other research nations.

Using data from 1972 to 2007, Khan and Ahmad (2008) discovered that Pakistan's economic growth is a direct result of the Granger consumption of natural gas. The "natural gas consumption-led growth hypothesis" is supported by this.

In their study on Pakistan, Aqeel and Butt (2001) looked at the relationship between economic growth and different types of energy use, such as electricity, coal, oil, gas, and total energy. There was no long-term cointegrating link between these variables, according to their findings. Rather, they found a one-way causal relationship between economic growth and power use. They also discovered that changes in overall energy and oil consumption were a direct result of economic growth. The study failed to identify a clear causal link between economic growth and gas use.

As a result, different studies have produced different findings for both the South Asian region and the world's industrialized nations. Thus, using a few methods and EViews, we have investigated the connection between Pakistan's energy and economic growth.

Material and Methods

Methodology (Location, Data Range, Data Sources, and Variables)

●Location: Pakistan (national-level data).

●Data Range: 1994-95 to 2020-21.

● Data Sources: Pakistan Economic Survey 1994-95 to 2020-21

●Variables:

Dependent: GDP growth rate (LogY).

Independent:

X1: Quality of Services (Infrastructure Index).
X2: Gas as Energy Production/ Consumption

Modeling/ Factor Analysis/ Input-Output Analysis/ Profitability Analysis

To conduct the empirical analysis, this study utilized several quantitative methods. It employed Ordinary Least Squares (OLS) regression and an Auto-Regressive Distributed Lags (ARDL) model to assess how Services and Gas impact GDP growth.

Before applying these models, Unit Root Tests (specifically the ADF Test) were performed to ensure the data's stationarity. Additionally, the Error Correction Mechanism (ECM) was used to estimate both the short-term adjustments and the long-term equilibrium relationships between the variables.

Model Estimation

The specific regression Models may be used to assess the impact of gas and services on economic growth in Pakistan, which can be assessed symbolically in log-linear form.

LogY = a*+a1X1+ a2X2+ µ

GDP=a*+ a1S+ a2G+ µ

Where,

LogY=GDP= Dependent variable in study area.

a*= Constant

a1= Slope of S

S= Impact assessment of Services on GDP in Pakistan

G= Impact assessment of Gas as Energy Sector on GDP in Pakistan

µ = Random Number

Results and Discussions

This study evaluates the impact of Pakistan's service sector and the gas energy sector on the nation's economic growth (GDP), covering the period from 1994-95 to 2020-21. It specifically analyzes the distinct contributions of the gas sector as a key energy source to Pakistan's economic expansion.

The econometric equation to assess the impact of the Service Sector and the Gas as Energy Sector on the Economic Growth of Pakistan over the period 1994-95 to 2020-21 is symbolically presented equation i as follows;

$$GDP_t = \alpha_0 + \alpha_1 S_t + \alpha_2 GAS_t + e_t \quad \text{(i)}$$

Where,

GDP_t = GDP Growth Rate of Pakistan in year t.

α_0 = Constant Coefficient.

α_1 *and* α_2 = Slopes Coefficients

S_t = Service Sector (% of GDP) in year t.

GAS_t= Gas as Energy Sector (% of GDP) in year t.

e_t = Stochastic term in year t.

Log-Linear Model is specified in equation ii when the logarithm (Log) of the dependent variable is modeled using a linear combination of independent variables as;

$$LGDP_t = \alpha_0 + \alpha_1 S_t + \alpha_2 GAS_t + e_t \quad \text{(ii)}$$

Unit Root Tests for Tested Variables: The Unit Roots of the tested variables (LGDPt, St, and GASt) have been evaluated using the Augmented Dickey-Fuller (ADF) Test, which has verified the integration order of stationary at the I(0) level for the variables (LGDPt, St) and at the I(1) level for the variables (GASt), as shown in Table 1.

Table 1: Unit Root Test for Tested Variables (*$LGDP_t$, S_t, GAS_t*)

Variables	ADF (Levels)		ADF in 1st/2nd Differences		Integration order through differencing approach I( )
	Intercept	Intercept & Trend	Intercept	Intercept & Trend	
$LGDP_t$	-3.59	-3.52	-5.11	-4.99	I(0)
TR_t	-2.50	-3.34	-6.25	-6.31	I(1)
TXR_t	-0.01	-1.28	-6.50	-6.64	I(2)
NTR_t	-3.17	-3.11	-6.54	-4.94	I(0)

Note: All tested variables are estimated in log-linear form.

Critical values at 95 percent = -2.96 (without constant without trend); and

Critical values at 95 percent = -3.57 (with constant and trend)

Table 2: Ordinary Least Squares (OLS) for variables (*LGDPt, St, GASt*)

Response Variable: Log(GDP)				
Method: **Least Squares**				
Sample data set: 1994-95 to 2020-21				
Counted observations after adjustments: 27				
Variables	**Coefficients**	**Standard Error**	**t-Statistics**	**Probability***
SERVICES	0.981	0.103	9.520	0.000*
GAS as ENERGY	-0.000	0.000	-1.019	0.318
C	0.438165	0.838	0.522531	0.606
R2	0.790	Durbin Watson Statistics		2.430
Adjusted R2	0.774			
F-Statistics	45.403			
Probability (F-Statistics)	0.000			

Significant at 1%

Table 2 showed that the Services Sector had a major impact on Pakistan's GDP Growth Rate from 1994–1995 to 2020–21, while the Services Sector had a negligible impact. With an R2 value of 0.79, independent variables like St and GASt are able to predict 79% of the variation in the dependent variable, LGDPt. The model's overall fitness and total combined effects are revealed by the calculated F value of 45 ($P<0.05$).

Table 3: Autoregressive Distributed Lags Model for Tested Variables (*LGDPt, St, GASt*)

Response Variable: Log(GDP)				
Method: **ARDL** (1, 0, 1)				
Sample data set: 1994-95 to 2020-21				
Included observations after adjustments: 26				
Variables	**Coefficients**	**Standard Error**	**t-Statistics**	**Probability***
GDP(-1)	-0.053	0.1045	-0.507	0.616
SERVICES	0.900837	0.128837	6.992	0.000*
GAS as ENERGY	0.005436	0.004327	1.256	0.222
GAS as ENERGY(-1)	-0.005566	0.003993	-1.393	0.177

C	0.275708	0.933095	0.295477	0.770
R2	0.809	Durbin Watson Statistics (DW)		2.288
Adjusted R2	0.773			
F-Statistics	22.245			
Probability (F-Statistics)	0.000			

**Significance level at 1%*

The Auto-Regressive Distributed Lags Model (ARDL) was applied using the lags of both dependent and independent variables as regressors, as shown in Table 3. Since Table 1 contains both the order of integration at level I(0) and the first difference I(1) conditions, the results of the ARDL approach showed that the Service Sector's ARDL values had a positive and significant impact on Pakistan's GDP Growth Rate. As a result, ARDL looked at co-integrating relationships between the variables that were tested in the model. As can be seen from Table 3, the R2 value is 0.81 (81%), meaning that independent variables like St and GAStare predict 81% variation in the dependent variable, as the LGDPt F value is calculated to be 22 ($P<0.05$), demonstrating the model's total combined effects and efficiency.

Table 4: Bound Test for estimating long run relationships among Variables (*LGDPt, St, GASt*)

ARDL Bounds Test		
Sample data set: 1994-95 to 2020-21		
Counted observations after adjustments: 26		
HO: Non existence of long-run relationships		
Test Statistics	Value(s)	k
F-statistics	7.994	2
Critical Value Bounds		
Sig. levels	I(0) Bound	I(1) Bound
10%	3.17	4.14
5%	3.79	4.85
2.5%	4.41	5.52
1%	5.15	6.36

Perusal of Table-4 provided the value of F statistics as 7.99, which is greater than both lower and upper limits; hence, the Model indicated long run relationships among variables.

Table 5: Error Correction Mechanism for estimating short-run relationships and long-run adjustment among tested variables (*LGDPt, St, GASt*)

Response Variable: DLog(GDP)				
Method: **Error Correction Mechanism**				
Sample data set: 1994-95 to 2020-21				
Counted observations after adjustments: 26				
Variable(s)	**Coefficients**	**Standard Error**	**t-Stat.**	**Probability***
C	-0.122194	0.207	-0.589	0.561
D(SERVICES)	0.973	0.084	11.451	0.000*
D(ENERGY)	0.003	0.003	1.153	0.261
ECT(-1)	-1.276	0.214	-5.949	0.000*
R^2	0.869	Durbin Watson Statistics		1.884

		(DW)	
Adjusted R^2	0.868		
F-Statistics	0.000		

Significance level at 1%

Cointegration and a long-term relationship are indicated by the fact that all tested variables are stationary at I(1) and the error term at I(0). According to Table 5, there is convergence from short-run dynamics towards long-run equilibrium. The short-run relationships between the tested variables (LGDPt, St, and GASt) are shown by the negative and significant (P<0.01) value of the co-integrating equation, which also provides the speed of adjustment. Furthermore, DW (1.88), which indicates that there is no autocorrelation in the model, falls within the permissible range of 1.5 to 2.5.

Summary of Research Findings

The empirical analysis, employing Ordinary Least Squares (OLS) regression and the Auto-Regressive Distributed Lags (ARDL) model on Pakistan's data from 1994-95 to 2020-21, yielded significant insights into the impact of the service sector and gas as an energy sector on economic growth (GDP).

Unit Root Tests: The Augmented Dickey-Fuller (ADF) test confirmed that LGDPt (GDP growth rate) and St (Service Sector % of GDP) are stationary at I(0) level, while GASt (Gas as Energy Sector % of GDP) is stationary at I(1) level.

OLS Regression Results: The OLS regression indicated that the Services Sector has a positive and significant impact on GDP growth (p-value = 0.0000), while the influence of Gas as Energy on GDP growth was found to be statistically insignificant (p-value = 0.3180) during the studied period. The model demonstrated a strong explanatory power with an R-squared value of 0.79, meaning the independent variables explain 79% of the variation in GDP growth. The F-statistic of 45 confirmed the overall fitness of the model.

ARDL Model Results: The ARDL (1, 0, 1) model further supported the significant positive influence of the Services Sector on GDP growth (p-value = 0.0000). For Gas as Energy, neither its current nor lagged values showed a statistically significant impact on GDP growth in the short run. The ARDL model also exhibited a high R-squared of 0.81, indicating that Services and Gas variables predict 81% variation in GDP growth. The F-statistic of 22 confirmed the model's overall fitness.

ARDL Bounds Test and Co-integration: The F-statistic value of 7.99 from the ARDL Bounds Test, being greater than the upper critical bound, confirmed the existence of long-run relationships among the variables (LGDPt, St, GASt).

Error Correction Mechanism (ECM): The ECM results confirmed the short-run relationships and long-run adjustment. The negative and significant coefficient of the Error Correction Term (ECT(-1) = -1.276439, p-value = 0.0000) indicates a high speed of adjustment towards long-run equilibrium, suggesting that any short-run deviations converge quickly. The Durbin-Watson statistic of 1.88 further confirmed the absence of autocorrelation in the model.

These findings, particularly from the OLS and ARDL models, suggest that while the Services Sector plays a significant role in Pakistan's economic growth, the direct contribution of the Gas as Energy Sector to GDP growth was not statistically significant in this study, aligning with some of the mixed results found in the broader literature review (e.g., Azam et al., 2021; Asghar, 2008; Aqeel and Butt, 2001; Malik & PIDE, 2023). However, the literature also indicates positive impacts in other studies or specific sectors within Pakistan. The study's specific context focuses on the aggregate contribution of "Gas as Energy Sector (% of GDP)" as an independent variable, which differs from disaggregated or sector-specific analyses in some cited literature.

Conclusion and Recommendations

Conclusions: This study carefully examined the influence of Pakistan's Services Sector and its Gas as Energy Sector on the nation's economic growth (GDP) from 1994-95 to 2020-21. Researcher findings indicated that the Services Sector consistently provided a significant and positive impact on GDP growth, evident in both the short and long run.

However, the direct aggregate contribution of the Gas as an Energy Sector to GDP growth was found to be statistically insignificant within the models used. This suggests a more complex relationship, possibly where the broader economic impact of gas is not fully captured by its simple percentage share, or where existing challenges are counteracting its direct positive influences.

While natural gas has historically been a cornerstone of Pakistan's economy, it now confronts significant headwinds. These include declining domestic reserves, increasing reliance on expensive imported LNG, and persistent structural issues such as circular debt and governance problems. Looking ahead, Pakistan's economic prosperity will largely depend on its ability to strategically manage gas resources, diversify its energy mix, and implement crucial reforms in the gas sector's pricing and regulatory framework to ensure a stable and affordable energy supply. Failing to address these critical challenges could diminish the gas sector's positive impact and potentially impede sustainable economic development. Ultimately, this research highlights the profound influence these independent variables have on Pakistan's economic trajectory.

Policy Recommendations and Implications

Based on the findings and the identified challenges within Pakistan's gas sector, the following policy recommendations and their implications are proposed to enhance the sector's positive contribution to economic growth:

1. Gas Sector Reforms and Circular Debt Resolution

Recommendation: Implement comprehensive reforms to address the gas sector's circular debt, including rationalizing tariff structures, improving billing and collection efficiencies, and reducing Unaccounted-For-Gas (UFG) losses.

Implication: Resolving circular debt will free up capital, reduce financial strains on utilities, and attract investment, thereby improving the sector's stability and indirect contributions to GDP. It will also prevent the sector from acting as a drag on the overall economy.

2. Strategic Gas Resource Management and Diversification

Recommendation: Accelerate the exploration and development of indigenous gas reserves, including untapped shale gas potential. Simultaneously, implement demand-side management through energy efficiency measures and strategically diversify the energy mix by transitioning towards renewable-gas hybrid models.

Implication: Reducing reliance on costly LNG imports will alleviate pressure on foreign exchange reserves and improve the balance of payments. Enhancing indigenous supply and energy efficiency will bolster energy security and provide a more stable and affordable energy supply, which is critical for industrial productivity and household welfare, ultimately boosting GDP.

3. Market-Based Pricing and Sector Deregulation

Recommendation: Deregulate the natural gas sector and implement a transparent, market-based pricing system that passes on the actual costs of LNG to all consumers, including households, and eliminates cross-

subsidies. Encourage third-party access for LNG imports and increase private sector involvement in the LNG supply chain to foster competition.

Implication: This will prevent artificial demand, promote efficient gas use, eliminate the subsidy burden, and ensure the financial viability of gas companies. Competition in the LNG market can lead to smoother procurement and reduced costs, benefiting overall economic efficiency and growth.

4. Optimized Gas Allocation and Inter-Fuel Substitution

Recommendation: Eliminate political bias in gas allocation, prioritizing supply based on economic factors rather than artificial demand. Implement a moratorium on further gas expansion to the household sector and instead provide affordable electricity for heating and cooking.

Implication: Redirecting indigenous gas to more efficient industrial or power generation sectors can significantly increase overall energy efficiency and reduce the cost of electricity, directly lowering consumer burdens and supporting industrial output. This shift can free up valuable gas resources for high-impact economic activities, contributing more effectively to GDP.

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