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The Impact of Supply Chain Disruption on total factor Productivity, A study from Oil & Gas Sector in Pakistan.

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Abstract

This study's primary objective is to assess the impact of Supply chain disruption on Total factor productivity . A study from Oil & Gassector of Pakistan. This study examines the profound effects of supply chain disruption on total inputs in a dynamic environment of oil and gas sector in Pakistan Supply chain disruptions, with technology internal failures, market fluctuations, inflation and political environmental issues among others which are affecteing the greater efficiency and overall productivity of companies in this critical sector. This study aims to identify the complex relationship between these concerns and their collective impact on overall production. A total of 250 people were contacted from Oil & Gas Sector in Pakistan, the data was analyzed using statistical method and SPSS software. In descriptive analysis, table and their analysis were employed, while in inferential analysis, the regression approach was employed to evaluate the hypothesis. This study will help the policy makers to improve their processes in supply chain, by using the studied variables Oil & Gas sector could be more efficient and accountable for everything they do to undo the effects that causes disruption in supply chain, and that will help them to gain more trust. It will also help the policy makers which functions and areas should be focused more to achieve max level of performance.

Keywords:

Supply Chain Disruption, Technological Failures, Market Volatility, Inflation, Political and Environmental Issues,Oil & Gas.

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CHAPTER 1

INTRODUCTION

1.1 Background

Supply chains serve as the backbone of industries in the dynamic landscape of the global economy, orchestrating the intricate dance of resources, information, and services. The oil and gas sector, which is critical to a country's economic development, is heavily reliant on the efficiency and resilience of its supply chains. However, as these networks become more complex, they become more vulnerable to disruption, posing both challenges and opportunities. This study delves into a pressing issue confronting Pakistan's oil and gas industry.Understanding the intricate interplay between disruptions and productivity becomes critical as the industry grapples with the consequences of disruptions ranging from geopolitical tensions to disasters. This research aims to unravel the multifaceted relationships through a focused lens on the Pakistani context, providing valuable insights that not only contribute to the academic discourse but also offer actionable strategies for industry stakeholders navigating the unpredictable terrain of supply chain dynamics in the oil and gas sector (Zhang, M et al .,2020).

This sector is an essential component in Pakistan's energy landscape, playing a critical role in protection of the country's energy security and economic stability. The disruption or interruption of the flow of goods, services, and information along the entire supply chain of the industry is referred to as supply chain disruption. Natural disasters, geopolitical events, market fluctuations, technological failures, and political or environmental issues are all potential causes of disruption.In 2019, the country produced 4.3 million metric tons of crude oil, enough to meet only 20 percent of the country's total petroleum requirements. The remaining 80 percent was met through imports of crude oil and refined petroleum products worth $15-$16 billion annually(Chen, L et al., 2022).The supply chain in the oil and gas industry includes the exploration, extraction, transportation, refining, and distribution of oil and gas products. Disruptions at any point in this complex and interconnected supply chain can have serious ramifications for production schedules, distribution networks, and overall industry operations. Its significance reverberates across the country's energy infrastructure and reaches into the broader spheres of the national economy.

Pakistan, because of its position in South Asia, has an abundance of natural resources. To meet the rising economy's energy needs, three major energy sources—oil, gas, and hydro power are now being employed (Saleh, 2015).The oil and gas business, being the world's largest economic sector, is critical to every country, but especially to growing economies like Pakistan and others. In Pakistan, the transportation sector utilizes the most petroleum products (about 48%), followed by power generation (36%), industrial (12%), and residential (12%) (Dr. A.R. Memon, 2018). Understanding the intricate dynamics of the oil and gas sector is critical as Pakistan strives to fulfill its expanding energy demands and boost economic growth.Understanding the impact of supply chain interruptions on total factor productivity (TFP) within this essential industry is a critical component of this understanding.Pakistan's oil and gas business is a crucial sector in the

country's energy portfolio, fueling the country's economic engine and providing the energy needed for both local consumption and export. In terms of energy security, the sector's function

is critical, and its performance influences the nation's economic stability. The sector spans a wide range of activities, from exploration and extraction to refining, distribution, and export, creating a complex and diverse landscape (Sahi, 2019).

The supply chain is the linchpin in this complexity, ensuring the seamless flow of oil and gas resources from production to consumptionPakistan Petroleum Limited (2022).Supply chain disruption has been shown to have a modest chance of occurrence, the effects on businesses are large, making the problem noteworthy.

Total factor productivity (TFP) is an economic concept that quantifies the proportion of a company's improved output that cannot be explained by increasing capital or labor inputs, and is thus seen as a measure of operational efficiency. Total Factor Productivity (TFP) has emerged as the preferred productivity metric (Ren et al., 2022). TFP is frequently referred to as the Solow residual. TFP is the portion of output that cannot be explained by the amount of inputs used in manufacturing. The following definition covers the measurement and significance of TFP for growth, variation, and development, as well as its expected future research directions. TFP refers to the portion of output that cannot be explained by the number of inputs used in manufacturing. As a result, its quantity is determined by how efficiently and intensively inputs are used in manufacturing. Supply networks are more globalized and more vital in recent years. They operate in a dynamic business climate that requires organizations to collaborate with suppliers and distributors from many areas and nations. The oil and gas business is a good example. Exploration, production, and distribution are all part of the global supply chain (Parast, 2020).

A sophisticated and interwoven supply chain is crucial thing in global sector because it facilitates the efficient flow of supplies, machinery, and services. The whole operations of the sector are greatly impacted by the stability and effectiveness of this supply chain, which also affects pricing dynamics, output levels, and geopolitical ties (Elm Valle Global Director | Business Leader | US Army Veteran | Published Author Published Jun 1, 2023)

Over the course of the seven and half decades since Pakistan's independence and the individual years within each decade, the country's economy has expanded at an average yearly pace of 5%, with significant variations. When compared to other developing countries, Pakistan exhibits a comparatively low incremental capital-output ratio, with an average growth rate of 5% and an average yearly ratio of 17–18% of investment to GDP. Thus, the significance of productivity research is obvious. Nonetheless, estimates of Pakistan's productivity growth have been comparatively slowed down, and there have been even fewer attempts to investigate the macroeconomic factors that influence productivity (Chang et al,.2013)

The October 2011 Catastrophic Thailand Flood, which affected computer SC manufacturers, as well as Japanese automakers with production plants Bangkok, Thailand (Sahi, 2019.). There are many reasons which effects the supply chain one of the most important reason for Pakistan is that it has a history of political upheaval Pakistan's political, institutional, and democratic systems have been relatively unstable and marginally degraded since independence (DAWN,

2016). These disturbances have greatly delayed economic progress and jeopardized Pakistan's democratic future in underdeveloped markets. The World Bank recognizes the importance of this issue, reporting that sit-ins organized by political parties have cost Pakistan approximately 2.1 percent of its GDP (The World Bank, 2014). As a result, this research takes to investigate the factors that are causing supply chain disruptions in the oil and gas sector in Pakistan.

These factors causes insecurity discourages international investors who want to invest in Pakistan to seek new business prospects in underserved markets. An unforeseen incident that interferes with the regular flow of commodities within a supply chain is referred to as a supply chain disruption (Craighead et al., 2007). Researchers are investigating how a company can develop supply chain resilience, defined as the ability to tolerate and recover from supply chain disruptions due to the negative consequences of these disruptions (e.g., Kleindorfer and Saad, 2005; Wagner and Bode, 2006). Previous research has found that the more central a company is, the more likely it is to experience a supplier-induced disruption (Bode and Wagner, 2015).

1.2 Research Gap

Previously this study was conducted in developed countries but this time it is going to study in the context of developing country like Pakistan. whereas scholars have only recently focused on the Interdependence of volatility in the oil and gas sector and its disruption, as well as its total factor of productivity market returns, primarily in terms of volatility spillovers (Malik et al,. 2007). It's worth noting that, until recently, the use of firm-level data to investigate the aforementioned relationship had been overlooked in the literature. Recent studies that focus solely on volatility and supply chain disruption in the supply chain market include (Boyer et al,. 2007). There is still much to be done (Alomran, A. A. 2022).

Uncertainty is increasing in the sector, owing in part and causing an increased globalization. As a result, the industry is vulnerable to a variety of risks, including Political and Environmental instability, Economic disasters, violence, and wars (Calida et al, 2015).

1.3 Research Problem

The impact of supply chain disruption on total factor productivity in the oil industry of Pakistan is very critical study. Several factors, including technology failures, market volatility, inflation, political and environmental issues, and reduced innovation, play a significant role in determining the sector's overall productivity and efficiency. Technology failures can lead to operational delays and inefficiencies, affecting the utilization of resources and ultimately reducing productivity (Juttner et al., 2013).The problem at hand is the lack of comprehensive empirical research addressing the specific challenges and dynamics of supply chain disruptions in the oil and gas sector in Pakistan, and how these disruptions impact the sector's total factor productivity. Despite the strategic importance of the oil and gas industry to the national economy, there is a notable research gap concerning the unique contextual factors such as security concerns, technological failures, market volatility, inflation, and political and environmental issues within the Pakistani landscape. This research gap hinders the development of targeted strategies to

enhance supply chain resilience and mitigate disruptions, posing a critical problem that needs to be addressed to ensure the sustainable growth and efficiency of the oil and gas industry in Pakistan(Ren et al., 2022).

Market volatility, driven by global oil price fluctuations, influences the sector's performance and its ability to plan and execute projects effectively. Inflation raises costs across the supply chain, impacting profitability and, consequently, total factor productivity. Political and environmental issues can lead to regulatory changes, which can disrupt operations and create uncertainties, further affecting productivity. Lastly, a lack of innovation within the sector can result in process inefficiencies and hinder the adoption of new technologies, reducing the industry's overall competitiveness and, consequently, its total factor productivity. The main Purpose of this study is to know how these supply chain disruptions impact the total factor productivity in Pakistan's oil and gas sector, highlighting areas for potential improvement and resilience.In Pakistan's oil and gas sector, supply chain disruptions are a critical concern. Technology failures, like malfunctioning equipment and outdated software, result in production interruptions and maintenance delays (Khan and Saqib, 2011). Market volatility, often driven by global oil prices, creates demand uncertainties. Inflation raises costs across exploration, extraction, and transportation. Political and environmental factors, such as regulatory changes and environmental concerns, can disrupt the supply of oil and gas resources. Reduced innovation in the sector leads to inefficiencies in production and distribution, affecting competitiveness in Pakistan's energy market.

1.4 Research questions.

i. Do technology failures have negative relationship with total factor productivity oil and gas in Pakistan?
ii. Does market volatility have negative relationship with total factor productivity oil and gas in Pakistan?
iii. Does inflation have negative relationship with total factor productivity oil and gas in Pakistan?
iv. Do political and environmental issues have negative relationship with total factor productivity oil and gas in Pakistan?
v. Does reduce innovation have negative relationship with total factor productivity oil and gas in Pakistan?

1.5 Research Objective

1 To assess the impact of technological failures on total factor productivity in Pakistan's oil and gas sector.

2 To assess the impact of market volatility on total factor productivity in Pakistan's oil and gas sector.

3 To assess the impact of inflation on total factor productivity in Pakistan's oil and gas sector.

4 To assess the impact of political and environmental issues on total factor productivity in Pakistan's oil and gas sector.

5 To assess the impact of reduced innovation on total factor productivity in Pakistan's oil and gas sector.

1.6 Research significance

1.6.1 Theoretical Significance

The theoretical importance of the study on "The Impact of Supply Chain Disruption on Total Factor Productivity: A Study from the Oil & Gas Sector in Pakistan" is multifaceted. Firstly, it contributes to the broader field of supply chain management theory by examining how disruptions affect the total factor productivity in a specific sector, the oil and gas industry (Ivanov 2018). Understanding the mechanisms through which supply chain disruptions influence overall productivity can help refine existing supply chain models and theories, making them more context-specific and practical (Jain 2018).

1.6.2 Practical significance

The research examining "The Impact of Supply Chain Disruption on Total Factor Productivity: A Study from the Oil & Gas Sector in Pakistan" is of profound significance on multiple levels. First and foremost, Pakistan's oil and gas sector plays a pivotal role in the nation's economy, and this study helps unveil how supply chain disruptions can permeate through the sector, shedding light on how these disruptions might affect not only individual companies but also the broader economic stability of the country. By identifying and quantifying the impact of disruptions on productivity, this research contributes essential insights into the sector's overall economic contribution.

Furthermore, the study addresses the critical need for enhanced operational resilience within the sector. Supply chain disruptions in the form of technology failures, market volatility, inflation, and political and environmental issues are a common challenge faced by businesses in the field of oil and Gas (Parast and Shekarian 2019). Understanding the specific dynamics of these disruptions allows companies to develop robust strategies for bolstering their operational resilience, enabling them to better anticipate, manage, and recover from disruptions, thus minimizing downtime and financial losses.This research also carries significant policy implications. Policymakers and government authorities must be informed about the sector's challenges and vulnerabilities. The research findings can serve as a guide for the formulation of well-informed policies and regulations that support the sector's growth and sustainability .Given the sector's strategic importance for energy security and economic development in Pakistan, these insights are invaluable.

Chapter 2

LITERATURE REVIEW

2.1 Total factor productivity

Total factor productivity (TFP) is an economic concept that quantifies the proportion of a company's improved output that cannot be explained by increasing capital or labor inputs, and is thus seen as a measure of operational efficiency(Diego Comin, 2022).Total Factor Productivity (TFP) is a measure of the overall efficiency with which inputs are used to generate output in the manufacturing process. Unlike labor or capital productivity, TFP considers the combined contribution of all inputs e.g., labor, capital, and technology to production output. It reflects a firm's or industry's ability to produce more output from the same level of inputs over time, or the same output with fewer inputsSun,(X., & Geng, D.2023).

Total factor of Productivity (TFP) has emerged as the preferred productivity metric. TFP is the portion of production that cannot be clarified by the amount of efforts used in manufacturing. TFP definition that covers the measurement as well as significance of total factor productivity enhancement, variations, and progress, and also its expected directions in the future. In the oil and gas sector, total factor productivity (TFP) refers to the efficiency and effectiveness with which all inputs (labor, capital, technology, and other resources) are employed to generate oil and gas. It is a critical statistic for assessing the sector's overall performance and output. TFP analysis evaluates how efficiently the industry converts these inputs into energy resources without attributing output changes to the expansion of any particular factor, such as labor or capital (Hahn 2021).

An industry's total factor productivity (TFP) can be measured in a variety of ways. The various approaches can be broadly divided into two categories: parametric and non-parametric approaches TFP analysis in the oil and gas business can provide useful insights into technological improvements, innovation, and managerial strategies. TFP growth suggests that the sector is producing more energy for a given set of inputs, which can be attributed to improved technology, better management, or innovation (Max D. 2021).

TFP captures the effects of technological, institutional, and other productivity shocks, but it provides little insight into what happens inside the black box of technologyTFP monitoring in the oil and gas industry is critical for determining the industry's overall productivity and competitiveness. It can aid in determining the impact of supply chain disruptions, regulatory changes, or technological advancements on the industry's ability to extract and produce oil and gas efficiently. Given the industry's strategic importance in many economies, including Pakistan, TFP analysis is particularly important in assessing national energy security and economic stability (Prescott, Edward C. 1998) .TFP has a significant impact on economic volatility, growth, and cross-country per capita income inequalities. TFP is closely linked with output and hours worked at business cycle frequencies. Kydland and Prescott (1982) took action based on this observation the literature on the real business cycle (RBC).

The disruption or interruption of the flow of goods, services, and information along the entire sector is referred to as supply chain disruption. Natural disasters, geopolitical events, market fluctuations, technological failures, and political or environmental issues are all potential causes of disruption (Chen, et al**,**2022).The supply chain in the oil and gas industry includes the exploration, extraction, transportation, refining, and distribution of oil and gas products. Disruptions at any point in this complex and interconnected supply chain can have serious ramifications for production schedules, distribution networks, and overall industry operations.

Disruptions in the oil and gas supply chain can have a major impact on total factor productivity (TFP) by impacting resource efficiency and overall industry performance.Production Delays and Downtime: Supply chain disruptions, such as equipment or material delivery delays, can cause production downtime and lower operating efficiency. This can have a direct impact on TFP by lowering industry output during such disruptions (Pickett, 2006). When the supply chain is disrupted, equipment, labor, and other resources may be idle or underutilized, lowering their productive capability (Christopher and Peck,2004). Disruptions can cause quality issues, impacting the end product's quality and resulting in rework or waste. This has an influence on TFP by lowering the industry's effective output (Choi and Bendavid, 2009).Cost escalation can occur as a result of disruptions due to accelerated delivery, overtime labor, and other unforeseen charges. Cost increases without a corresponding rise in output can affect TFP (A. Norrman et al,2004).

2.2 Technology Failures

The malfunction, breakdown, or failure of critical equipment, systems, and technologies that are integral to examination, extraction, making, refining and distribution of these oil and gas resources is referred to as technology failure in the oil and gas sector. The sector is strongly reliant on sophisticated technology, and when these technologies fail, the consequences for operations, safety, and productivity can be severe (Matar, et al, 2018).Failures of Drilling Equipment can also be a reason towards and This can include issues with drilling rigs, drill bits, and other apparatus utilized in the exploration and exploitation of oil and gas resources (Ha, M. 2018). Failures in equipment such as distillation towers, heat exchangers, pumps, and reactors used in crude oil refining and processing can disrupt the production of refined products (McElroy, W. 2013).Failures in control systems used to monitor and manage numerous activities in the industry, such as wellhead operations and safety systems, can result in safety concerns and operational disruptions(Johnson, 2018).

Failures in communication systems, data management, and information technology can result in misunderstandings, decision-making delays, and supply chain interruptions(Butt et al., 2021). Equipment failures in transportation and distribution systems, such as pipelines, tankers, storage facilities, and loading/unloading systems, can occur(Mills &Mwasambili, 2022). Safety and monitoring technology failures, such as sensors, safety systems, and environmental monitoring equipment, can jeopardize safety and environmental requirements (Kumbhakar et al, 2000).

Disruptions in the Supply Chain Caused by Technology Failures:Delays in Operations: Unplanned downtime due to technology failures can cause delays in exploration, extraction, and

production activities. These delays have the potential to disrupt the supply chain and result in resource underutilization(Cho, 2004).Repairing or replacing failing equipment might result in increased operational expenses since organizations may need to engage in emergency maintenance or replacement parts.Technology failures can pose safety and environmental risks, potentially resulting in accidents, environmental events, and regulatory compliance challenges. These hazards have the potential to disrupt the supply chain and have significant effects (Mairessee et al,2005).

Failures in communication networks and information technology can impede supply chain activity coordination, resulting in miscommunication and interruptions.Failures in technology in the oil and gas business can have numerous consequences for TFP, Production Interruptions: Unplanned downtime and operational delays can diminish the sector's overall output, resulting in lower TFP as fewer resources are generated with the same set of inputs (Lee, 2005). Inefficiencies in Operations, Technology failures can contribute to inefficiencies in operations, affecting the industry's capacity to efficiently transform inputs into oil and gas resources(Wijeweera et al., 2022).Repair and maintenance expenditures linked with technological failures might result in greater operational expenses, lowering the sector's cost-effectiveness.Accidents and environmental catastrophes caused by technological failures can result in cleanup expenses, regulatory fines, and reputational harm, all of which have a negative impact on TFP(Habib, 2022).Market Uncertainty: Inflation can cause market uncertainty, causing changes in demand and supply dynamics, threatening the oil and gas sector's stability and TFP(Komal and Abbas, 2015).

2.3 **Market volatility**

Market volatility plays a vital role in this sector refers to sudden and significant changes in oil and gas prices caused by a variety of reasons such as geopolitical events, supply and demand dynamics, economic conditions, and speculative trading.Oil and gas market volatility is generally caused by a variety of variables, including geopolitical tensions in oil-producing countries, global economic conditions affecting energy demand, environmental laws, and policy decisions by major oil-producing nations. These factors can cause rapid fluctuations in oil and gas prices, affecting the profitability and investment decisions of enterprises in the field, influencing energy policy, and influencing global economic stability(Alomran & Alsubaiei, 2022).These price fluctuations can cause uncertainty and instability in the industry, affecting the profitability and decision-making processes of enterprises who are involved in the exploration and with also of production and distribution of this oil and gas sector resources (Hamilton, J. D. 2008).

Market volatility can have a number of important effects on TFP, firstly the Investment Decisions and Sharp price volatility in the sector can inhibit long-term investment. When prices are excessively fluctuating, businesses may postpone or cancel projects, lowering capital expenditures and affecting the industry's total factor productivity (TFP) (Phan D.H.B, 2015). Secondly Risk management in businesses may shift resources away from production and efficiency and toward mitigating price risk, such as hedging measures. This resource diversion may have an impact on TFP (Kilian, L.2009).

Thirdly financial instability and Volatility can cause financial stress for oil and gas businesses, limiting their capacity to invest in technology and innovation, impacting TFP Supply Chain Disruptions and Volatile oil and gas prices can disrupt supply chains and affect the availability of resources and services, resulting in operational inefficiencies and costs (Jouini, J. 2018). Risk management methods are frequently required in response to market volatility, which can distract resources and management focus away from key operational tasks, thereby hurting TFP (Wang, Y. et al,2015). Price-Volume Relationships Price-volume impacts in the oil and gas sector may result from market volatility.

Rapid price changes can have an impact on production decisions, influencing the amount of oil and gas produced and, as a result, TFP(Hasan, M. et al, 2016). Market volatility can contribute to supply chain disruptions, reducing the availability of critical supplies and products. These disruptions can cause delays, inefficiencies, and increased expenses, all of which have a detrimental influence on TFP (Christopher, et al,2004). Market volatility can make resource allocation and strategic planning difficult. Price swings and demand fluctuations might disrupt resource allocation, impacting operational efficiency and, as a result, TFP (Narayan, et al, 2018). Oil and gas market volatility can create anxiety for investors and enterprises. Oil price fluctuations and market conditions may cause a reluctance to invest in new technologies, infrastructure, or exploration projects, affecting the industry's TFP (Li, S., Polemis, 2019).

2.4 Inflation

Inflation is defined as a long-term increase in an economy's general price level of goods and services. Inflation can have a variety of effects on the cost of producing, transporting, and distributing oil and gas resources. Increases in the values and price of goods, equipment, and services can have a significant impact on the sector's operational expenses and profitability, (R. E. Wright, 2014).Oil prices are crucial to the global economy. Numerous studies have shown that it has an impact on macroeconomic indicators such as GDP, stock markets, and unemployment rates, among others (Akinsola et al., 2021).

Key information about Pakistan Exchange Rate against USD

Pakistan Exchange Rate against USD averaged 286.584 (USD/PKR) in Jun 2023, compared with 285.486 USD/PKR in the previous month.Pakistan Exchange Rate against USD data is updated monthly, available from Jan 1957 to Jun 2023.The data reached an all-time high of 286.584 in Jun 2023 and a record low of 4.770 in Apr 1972,In the latest reports, Pakistan Short Term Interest Rate: Month End: Pakistan: Interbank Rate: Karachi Average: 3 Months was reported at 22.910 % pa in Jun 2023,Its Long Term Interest Rate (Long Term Interest Rate: Month End: Pakistan: Government Bond Yield: 10 Years) was reported at 11.000 % pa in Jun 2023(CEIC’s economic databases2023).

The cash rate (State Bank of Pakistan: Reverse Repo Rate) was set at 23.000 % pa in Jun 2023.

Different studies conducted to examine the impact of oil prices on inflation using a variety of approaches, variables, and time periods. Another group has also enlisted the help of the other

classic models. In South Asian countries, (Zakaria et al. 2021) demonstrated Grainger causation and a positive impulsive response from the oil price to inflation.Inflation can raise the prices of equipment, machinery, and materials used in the exploration, extraction, and refining processes in the oil and gas industry (Wolde-Rufael, 2009).Wages and benefits for personnel participating in various operations such as drilling, transportation, and maintenance might be affected by inflation .Inflation can cause transportation costs to rise, affecting the pricing of oil and gas products during distribution and supply chain operations (Zaman and colleagues 2015).Inflationary Supply Chain Disruptions and Cost overruns in various stages of the supply chain can be caused by inflation, affecting budgeting and planning for exploration, production, and distribution activities (Bawa et al,2016).

Budget limits: Inflationary pressures can cause budget limits for oil and gas businesses, resulting in lower investment in infrastructure, technology, and innovation (Ahmed et al. 2018). Inflation in the oil and gas industry can have a substantial impact on TFP, Profit Margin Reduction, Higher operating costs owing to inflation might lead to a reduction in profit margins (Nawaz et al. 2020).Inflation can have an impact on the oil and gas sector's competitiveness, especially when companies experience difficulties controlling costs and maintaining market pricing competitiveness (Obstfeld et al., 2016).

2.5 Political and environmental issues

Desertification, erosion, global warming, and climate change have all had a significant impact on the global social and economic situation.Changes in the equilibrium of habitats, air quality, and extreme climatic extremes will result from global warming. Observational research has conducted many evaluations of the fundamental causes and implications of global warming and climate change over the last three decades.According to energy economics research, the two most important factors influencing the climate are energy use and economic growth. The widespread use of fossil fuels throughout the course of industrialization has resulted in a significant increase in environmental deterioration, (Pomerantseva, E. 2019).

In the context of Pakistan, the oil and gas sector is significantly influenced by political dynamics, with political stability and government policies playing pivotal roles. Changes in government policies, including taxation, licensing, and environmental regulations, can have profound effects on the operational and financial aspects of companies within the industry. Security concerns stemming from political instability and geopolitical tensions pose challenges, leading to potential disruptions in the supply chain for oil and gas resources. The investment climate is closely tied to political stability, as uncertainties or shifts in government can impact investor confidence and the flow of capital into the sector. Political decisions regarding nationalization or privatization of energy assets and the formulation of energy policies, including sustainability goals, also shape the industry's landscape. As the oil and gas sector navigates these political dynamics, a comprehensive understanding of the political impact is crucial for stakeholders to make informed decisions, manage risks, and plan for the industry's sustainable development. For the latest and most specific information, it is advisable to refer to recent government publications, industry reports, and reputable news sources.

The economic and social growth of a country is a key measure of natural resource rental, but intensifying industrial and urban development, depletion of natural resources, low exploitation, and a lack of technology can all reduce a country's natural resources, as can renting natural resources. Globalization boosts the productivity of natural resource exploitation through innovative technology *Ambio* 2017, *46*, 18–29. Because Pakistan is a developing country, oil is a major source of energy production, and it also promotes economic growth.. Furthermore, the majority of the country's energy production system is based on thermal electricity (Akinci et al., 2022).The Environment and Politics in the Oil and Gas Industry, The oil and gas industry faces a number of political and environmental challenges, including concerns about the industry's impact on governments, societies, and the environment.

Here's a breakdown of the problems: Political Concerns, Changes in government laws, such as environmental standards, taxation policies, and industry-specific legislation, can cause uncertainty and compliance issues for oil and gas firms(Jiménez-Rodríguez & Morales-Zumaquero, 2022). Political Instability, Changes in leadership, government policies, and geopolitical tensions can all have an impact on the sector's operations, investment climate, and security (Salisu et al., 2017). Environmental Concerns, Climate Change, The oil and gas industry contributes significantly to greenhouse gas emissions, which contribute to climate change. Concerns about carbon emissions, global warming, and the transition to cleaner energy sources are relevant in this industry(Ambulkar et al., 2022).Exploration and extraction activities have the potential to affect local ecosystems, including land and marine environments, raising concerns about biodiversity loss and habitat damage(Koester et al., 2021). Water and air pollution, Processes like as hydraulic fracturing and the discharge of pollutants during extraction and refining can contribute to water and air pollution (Attinasi et al., 2021).Disruptions in the Supply Chain Caused by Political and Environmental Issues, Changes in environmental legislation can disrupt supply chains by requiring enterprises to adopt new technology or procedures to minimize emissions or fulfill other environmental criteria, thereby causing operational disruptions and cost increases(Benigno et al,.2022)

Political instability can disrupt the supply chain by generating resource extraction delays, transportation disruptions, and safety issues for individuals working in politically insecure regions (Mbah, et al, 2022). Environmental Compliance, Ensuring environmental compliance can cause changes in supply chain processes, thereby hurting efficiency and increasing costs. Stricter pollution limits, for example, may need costly equipment changes(Philips et al., 2022).Environmental issues and opposition from communities or environmental groups can cause project delays, protests, and legal challenges, disrupting the supply chain and causing uncertainty (Liu et al., 2022).Impact of Political and Environmental Issues on Oil and Gas Total Factor Productivity (TFP), Costs of Regulatory Compliance, Meeting new environmental requirements can result in increasing compliance costs, impacting the sector's financial performance and lowering TFP(Blackburne & Frank, 2007). Project Delays, Political insecurity, environmental opposition, and regulatory changes can all cause project delays, reducing supply chain efficiency and TFP(Blanchard, 2021).Political instability and environmental difficulties can generate safety and environmental risks, resulting in accidents, cleaning expenses, and

reputational damage, all of which have a detrimental impact on TFP (Mohammed et al. 2022).Challenges with Resource Allocation: Companies may be required to commit resources to fulfill new environmental rules, diverting expenditures away from technology and innovation that can improve TFP (Kilian and Zhou 2021).

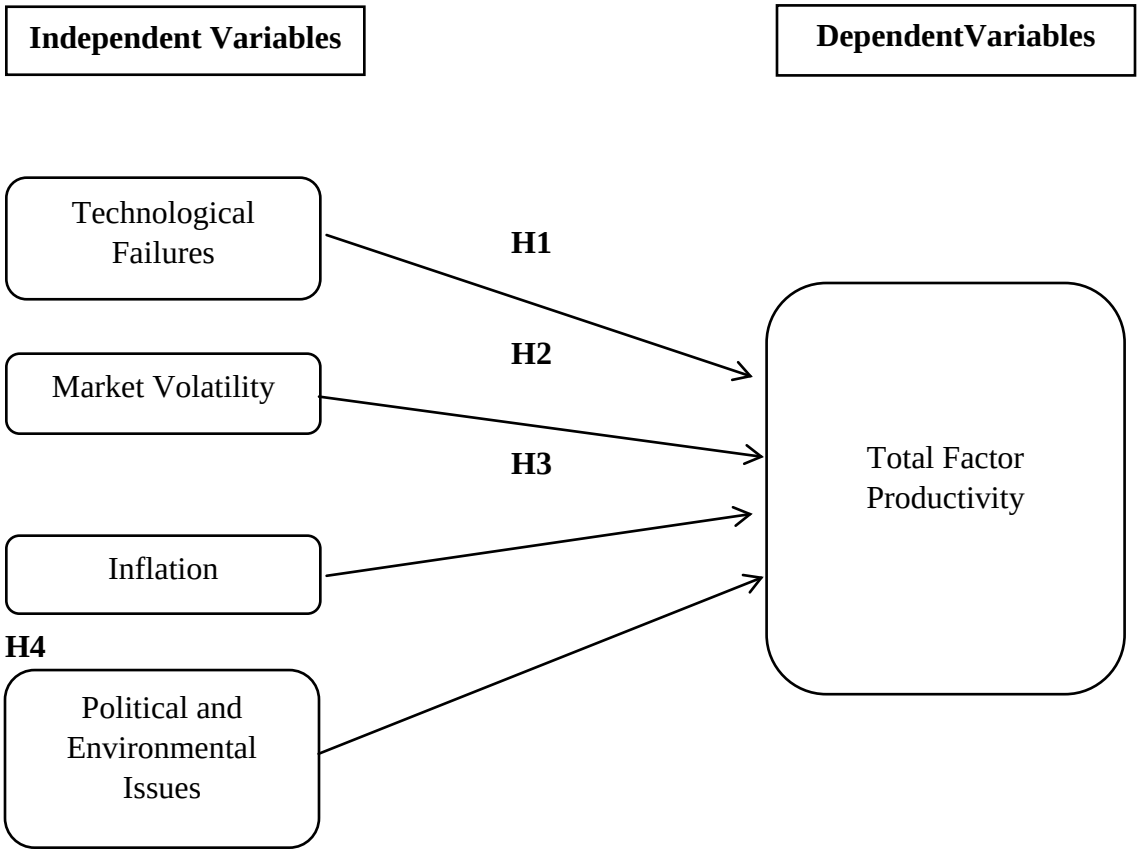
The exchange rate between the US Dollar (USD) and the Pakistani Rupee (PKR) significantly influences the dynamics of the oil and gas sector in Pakistan, bearing notable implications for the topic of supply chain disruption and total factor productivity. A depreciation of the PKR against the USD can escalate the costs incurred by the oil and gas industry for importing crucial machinery, equipment, and technology, thereby impacting overall production costs within the sector (Haque&Iqbal, 2004). Furthermore, as oil is globally traded in US dollars, fluctuations in the exchange rate can ripple through the domestic economy, influencing the cost of imported oil and, subsequently, domestic fuel prices. This dual effect can not only contribute to higher operational expenses for businesses but also influence consumer behavior (Ahmed & Malik, 2013). The exchange rate's impact extends to foreign investment and financing within the oil and gas sector, with a volatile or depreciating local currency potentially raising concerns among foreign investors about the stability of investments and financing arrangements (Mughal et al., 2018). Additionally, exchange rate movements, particularly depreciation, can contribute to inflationary pressures in the economy, thereby affecting the overall cost structure within the oil and gas industry (Haque&Iqbal, 2004). Understanding these intricate interactions is crucial for a comprehensive analysis of supply chain disruptions and their subsequent effects on total factor productivity in the Pakistani oil and gas sector.

Social network theory, which contends that a firm's structural qualities of network embedding influence its performance, is used as a theoretical lens in supply network architecture research (Adler and Kwon 2002)**.**

Resilience theory Usedin supply chain management, resilience theory used Fiksel, J., &Kapoor, A (2020)how organizations can effectively respond to, recover from, and adapt to disruption in supply chain.This study examines organizational change through a social-cognitive lens, offering a model that integrates organizational learning, cognitive processes, and change processes. It examines how organizations can proactively develop resilience to better anticipate, respond to, and recover from crises. The research uses resilience theory to understand dynamic interactions in organizations, emphasizing the importance of learning and psychological change to enhance overall resilience (Mohammed et al. 2022).
The proactive identification and anticipation of potential disruptions is emphasized in resilience theory. Understanding how organizations anticipate and prepare for disruptions in the oil and gas industry, where geopolitical tensions, natural disasters, and market fluctuations can all have an impact on the supply chain, is critical.The theory of resilience investigates how organizations can develop response and adaptation strategies to lessen the impact of disruptions. Disruptions in the supply chain can have an impact on the extraction, processing, and distribution of resources in the oil and gas industry (Pettit, 2013). Examining how organizations adapt their processes and operations in response to disruptions helps us understand resilience better.The importance of resource flexibility is frequently emphasized in resilience theory. Understanding how organizations manage and allocate resources flexibly becomes critical in the oil and gas sector,

where supply chain disruptions can affect raw material availability and production schedules (Ponomarov, S. Y., & Holcomb, M. C. 2009).

2.6 Research framework



2.7 Research Hypothesis.

H1TechnologyFailures have a negative relationship with total factor productivity in Pakistan's oil and gas sector.

H2 Market volatility has a negative relationship to total factor productivity in Pakistan's oil and gas sector.

H3 Inflation in Pakistan has a negative relationship with total factor productivity in the oil and gas sector.

H4 Political and environmental issues have a negative relationship with the total factor productivity of Pakistan's oil and gas sector.

Chapter 3

METHODOLOGY

Introduction

This chapter contains information on the technique, approach, and research design used to carry out the current study. In order to conduct the study, questionnaires that were particularly created with questions addressing the Impact of supply chain disruption due to technology failures, inflation, market volatility, political and environmental issues on total factor productivity. This chapter has been separated into portions so that each segment covers a methodology related topic in depth, such as population, data source, and study factors, as well as the methods used to analyze the data in current research.

3.1 Research Deign:

This research is quantitative in nature. The reason of using quantitative approach is that it is a systematic approach to collect information via questionnaires. The design of this research is cross sectional. In quantitative research, random sampling is used to examine how technology failures, market volatility, inflation and political and environmental issues can have an impact on total factor productivity.The research design also employs a deductive method to speculatively investigate current theories that are pertinent to the study object. Deductive method to determine whether conclusions may be drawn from a research outcome, the best method for creating a framework for determining the relationship between variables and concepts is deductive (Seliger, H.2022). E. Pomerantseva,(2019) defined the research design as an outline to gather, assess and examine the data to reach a conclusion(Qin Y-f, 2022). Further emphasized by referring it to as base of research, without it the conclusion drawn will fail to answer and fulfill the research questions and objectives. (Lubinski C. 2020) has addressed three types of methodologies when conducting a research study. The term "Qualitative methodology" refers to a methodology that gauges the emotions and sentiments of the subject. “Quantitative methodology” study statistical variations between variables and “mixed methodology” are a blend of quantitative and qualitative information. This research is being studied under quantitative methodology.

3.2 Research Type:

This research is cross-sectional. It focuses on collecting data from one group at one certain occasion. (Marsman & Rhemtulla, 2022) identified cross-sectional study as the best option when examining the prevalence of an outcome at a specific time. The type of this research is explanatory in nature as it will investigate the phenomenon that is not studied in depth in Oil and Gas sector of Pakistan. Explanatory research is appropriate for the current study since it will aid in comprehending the research topic more effectively. The problem of the study hasn't been completely investigated in underdeveloped countries like Pakistan in the past, especially in the context that this study has chosen.

3.3 Data Source:

This study's primary data source is a standardized questionnaire that was used to collect data. The primary data was chosen because it provides better accuracy in results, a higher level of control, and up-to-date information to prove the hypotheses of this research. The data is collected to investigate the relationship between variables is collected from the responses from the employees working in oil and gas sector with in the Pakistan, that they provided against specifically designed questionnaire with 5 Likert scale.

3.4 Research Philosophy

(Ryan G 2019) has proposed 4 types of research philosophy. This study uses "Positivism" Philosophy which believes that only knowledge that has been obtained by observation, including measurement, can be trusted. The basis of "Positivism" is quantitative observations that result in statistical analyses.

3.5 Data Analysis:

This research uses convenience sampling strategy to make samples and tested hypothesis with the help tool i.e., SPSS version 21.0 which is develop by IBM and data is analyze through statistical technique such as correlation and regression are used as well. This study uses Likert scale in questionnaire to gathered data and then analyze accordingly through the tool and technique. Measurement table is given below:

S no.	variables	No.of items	Design criteria	source
1	Total Factor Productivity	4	Adopted	(Hotak S, 2020)
2	Technology Failure	4	Adopted	T. R. Madanmohan (2000) Failures and Coping Strategies in Indigenous
3	Market Volatility	6	Adapted	(Wang et al., 2018)
4	Inflation	6	Adopted	("Financial resource management in the Nigerian public sector: policy measures to address loopholes" AUTHORS Adesola Victoria Adebayo

				Kehinde Damilola Ilesanmi)
5	Political and Environmental Issues	7	Adopted	International Journal of Environmental & Science Education(2014)

3.6 Population Sample:

There are 5 major oil industries are actively working in Pakistan. This research focus on top 5 oil and gas industries in Pakistan, around 5000 fulltime and contract base employees are working in these industries of Pakistan. A total of 350 questionnaires were sent to these industries, the response rate is 72.5% excluding the unfilled questionnaire. This research has utilized deductive approach which is concerned with creating a hypothesis based on a theory already in existence, and then establishing a research method to test the assumption made on base of theory (Jahn, 2011). This approach has four parts as identified by (Abdukarimova, 2021), creation, formulation, gathering, and analysis of hypotheses.

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CHAPTER 4

RESULTS & DISCUSSION

Software used
Data analysis for this study has been done using SPSS 21.

4.1 Data Analysis:

The results of the data gathered using the structured questionnaire has been reviewed in this section. The reader will have a thorough understanding of the entire body of information, including how it was organized, where it came from, and the histories and credentials of those who contributed to it, by the time this part is finished. In relation to this study

The data is tested using SPSS statistics. In this chapter, the researcher presents the data findings using the reliability test, correlation, regression, ANOVA, and coefficients approaches.

4.2 Demographic description:

To make it simpler to understand, the researcher has separated the data collected into various classifications. The sample size consists of workers from Pakistan's Oil & Gas Sector. The sector responds to this research from Islamabad and Rawalpindi. The demographics were divided into groups based on gender, age, and experience. There were three categories of responses from the 250-person sample of Oil & Gas sector employees: management, executives, and junior workers. Five companies were selected for this study.

4.2.1 Managerial Position:

Out of 250 responders representing various managerial positions from various apparel companies and divisions, Bottom level managers, Middle level managers, and Top level managers are three different levels of managerial employees. Upper-level responses made roughly 27% of the total. 34.4 percent came from lower-level managers, 38.6 percent from middle-level managers.

4.2.2 Experience:

Experience of Respondents was also categorized into 5 sections. One was below three years, second was below seven years, third was below eleven years and fourth was below the fifteen years lastly above fifteen years.

Reliability Statistics

An inner consistency metric, or how closely a group of items are related, is the Cronbach alpha. It serves as a gauge of the scale's dependability. A high alpha value does not necessarily indicate a one-dimensional computation.

4.3 Cronbach Alpha.

Importance: Cronbach's alpha ranges from 0 to 1, with higher values indicating greater internal consistency. Important: Researchers generally consider an alpha greater than 0.70 to be acceptable, but the threshold may vary depending on the context and nature of the study.

Table 1

Variables	**Cronbach's Alpha**	Number of items
Total Factor Productivity(TFP)	.829	4
Technological Failures(TF)	.758	4
Market Volatility(MV)	.701	6
Inflation(IF)	.896	6
Political and environmental issues(PE)	.781	7

The Cronbach's alpha values provided by reliability statistics are very respectable in this investigation. The precise source, the reliability coefficient, provides information on the degree to which selected items in a set have positive connections with one another. The Cronbach's alpha values clearly show that the questionnaire used for the majority of the study's research had a higher level of consistency and reliability. The independent variable Total Factor Productivity(TFP), Technological Failures(TF), Market Volatility (MV), Inflation(IF) and Political and environmental Issues(PE) all have Cronbach alpha values of .829,.758, .701, .896, and .781 respectively, indicating that they meet the standards for acceptability.

The values of Cronbach's alpha, which fall between the established standard of 0.7 and 1.00, are quite close to 1, demonstrating the reliability of the questionnaire utilized as well as the dependability of the responses provided by the respondents. This Cronbach alpha demonstrates the higher consistency in the Likert scaling and the genuine and understandable nature of the floating questionnaire used in this quantitative study.

4.4 Correlation:

Correlation is used to measure the strength and it also tells us the how two variables are linked. When there is a strong association between two variables, the correlation is considered to be high or strong in comparison to a relationship that is weak or low. When the correlation is low, it denotes that the variables are not very closely associated to one another.

Correlation analysis is the process of analyzing the strength of relationships utilizing the data that is already available.A correlation coefficient has a value between -1 and +1. When the

correlation value is negative, or -1, it means that when one variable falls in value, the other variable rises in value. When the correlation value is positive, or +1, it indicates that the value of one variable rises in tandem with the value of the other. Pearson r is the most widely used correlation coefficient. On an interval scale with increasing values, the two variables under consideration are evaluated. In this study, the Pearson correlation was also used to determine the relationship between the two variables.

Correlation Analysis

A statistical tool known as correlation analysis illustrates the strength and direction of the relationship between dependent variables (such as Total Factor Productivity) and independent factors (Technology Failures,Market Volatility, Inflation, Political and Environmental Issues).

		Total Factor Productivity	**Technology Failures**	**Market volatility**	**Inflation**	**Political and Environmental Issues**
Total Factor Productivity	Pearson correlation	1				
Technology failures	Pearson Correlation	-.270**	1			
Market Volatility	Pearson Correlation	-.341**	-.298**	1		
Inflation	Pearson Correlation	-.258**	-.271**	-.113**	1	-.223
Political and Environmental Issues	Pearson Correlation	-.268**	-.171**	-.233**	-.257**	1

.** Correlation is significant at the 0.01 (2-tailed) levels.

. The association between Total Factor Productivity and Technological Failure is significant at the 0.01 level, has a magnitude of -.270**, and is moving in the negative direction, according to the aforementioned data. Similarly, there is a significant and negative association between Market volatility and Total Factor Productivity, with a magnitude of -.298**. Additionally, there is a negative link between Inflation and Total Factor Productivity that is significant at the 0.01 level and has a magnitude of -.113**.Furthermore, the relationship between Political and

environmental issues and Total Factor productivity does exist, and it is very significant at the 0.01 level with a magnitude of -.275** and is going in the negative direction.

4.5 Regression:

Regression analysis is a different phrase used in the data analysis process. This step is crucial for figuring out if the relationships between the variables are independent or dependent, and whether they are directly or indirectly proportional. The variables in this study were subjected to a linear regression analysis. These results, when compiled from the entire procedure, can offer the most pertinent and reliable information.

Regression Analysis

A statistical tool known as regression analysis illustrates the strength of the link between dependent variables (such as Total Factor Productivity) and independent factors (Technology Failures,Market Volatility, Inflation, Political and Environmental Issues).

Table

Regression:

Hypotheses	**Regression weight**	**R**	**Beta Coefficient**	**R^2**	**Adjusted R^2**	**t-value**	**p-value**
H1	TF →TFP	.617[a]	.617	.381	.377	-5.868	.001
H2	MV →TFP	.834[a]	.834	.695	.695	-2.291	.000
H3	IF →TFP	.836[a]	.836	.699	.698	-4.091	.000
H4	PE →TFP	.734[a]	.734	.538	.539	-2.346	.000

There is weak to moderate correlation, hence the condition for regression is satisfied.

The results for investigating the relationship between TF and TFP. The calculated beta coefficient shows 61% the strength of relationship between TF and TFP. T-Value is -5.86 which shows direction of relationship. It is above -1.69 which shows Negative impact of TF on TFP. R- square shows the explained variance i.e. 38% in TFP due to change in TF. Adjusted R-square value is 37%. The P-value for TF is .001 which is less than significance level 0.05 hence shows the acceptance of H1 i.e. there is TechnologyFailures have a negative relationship with total factor productivity in Pakistan's oil and gas sector.

The results for investigating the relationship between MV and TFP. The calculated beta coefficient shows 83% the strength of relationship between TF and TFP. T-Value is -2.291shows

direction of relationship. It is above -1.69 which shows Negative impact of TF on TFP. R-square shows the explained variance i.e. 69% in TFP due to change in TF. Adjusted R-square value is 69%. The P-value for TF is .000 which is less than significance level 0.05 hence shows the acceptance of H1 i.e. Market volatility has a negative relationship to total factor productivity in Pakistan's oil and gas sector.

The results for investigating the relationship between MV and TFP. The calculated beta coefficient shows 83% the strength of relationship between TF and TFP. T-Value is -4.091 shows direction of relationship. It is above -1.69 which shows Negative impact of TF on TFP. R-square shows the explained variance i.e. 69% in TFP due to change in TF. Adjusted R-square value is 69%. The P-value for TF is .000 which is less than significance level 0.05 hence shows the acceptance of H1 i.e. Inflation in Pakistan has a negative relationship with total factor productivity in the oil and gas sector.

The results for investigating the relationship between MV and TFP. The calculated beta coefficient shows 73% the strength of relationship between TF and TFP. T-Value is -2.34 shows direction of relationship. It is above -1.69 which shows Negative impact of TF on TFP. R-square shows the explained variance i.e. 53% in TFP due to change in TF. Adjusted R-square value is 53%. The P-value for TF is .000 which is less than significance level 0.05 hence shows the acceptance of H1 i.e. Political and environmental issues have a negative relationship with the total factor productivity of Pakistan's oil and gas sector.

4.6 ANOVA

ANOVA aids in determining whether differences between groups of data are statistically significant, just like the t-test does. It functions by examining the levels of variance present within each group using samples drawn from each.

If there is a high variance (spread of data away from the mean) within the data groups, the mean of a sample drawn from the data is more likely to deviate by chance.

Model		Sum of squares	Df	Mean Square	F	Sig.
1	Regression	25.977	3	8.659	120.812	.000[b]
	Residual	7.746	247	.046		
	Total	33.723	250			

a. Depended Variable: TFP
b. Predicators: (Constant), TF, MV, IF, PE

F statistics shows model fitness the value is 120.81 so high value shows significant model fitness.

According to the ANOVA results, the model has an F value greater than 4 and a significance value less than.05. As a result, it is clear that the model has statistical significance.

4.7 Data Findings

	Significance Level	Result	Hypothesis Statement
Technological Failures	0.000	Negative Relationship with total Factor Produtivity	Hypothesis accepted
Market volatility	0.000	Negative Relationshiop With Total Factor Productivity	Hypothesis accepted
Inflation	0.000	Negative Relationship with Total Factoir Productivity	Hypothesis accepted
Political and Environmental Issues	0.000	Negative Relationship With Total Factoir Productivity	Hypothesis accepted

CHAPTER 5

DISCUSSION, CONCLUSION, RECOMMENDATIONS

5.1Discussion

According to the study, each independent variable - technological failures, market volatility, inflation, and political and environmental issues - consistently has a negative impact on total factor productivity in the oil and gas sector. The complex interactions between these variables amplify their overall negative impact on productivity. Industry-specific dynamics, such as geopolitical influences and environmental sensitivities, contribute to the oil and gas sector's increased vulnerability to supply chain disruptions. Various resilience strategies are used by companies in the sector to navigate and mitigate the negative effects of technological failures and other disruptions. This discussion emphasizes the intricate relationships within the oil and gas supply chain, shedding light on the sector's multifaceted challenges.

5.2 Conclusion

In conclusion, the study consistently demonstrates the negative impact of supply chain disruptions in Pakistan's oil and gas sector. Each independent variable, such as technological failures, market volatility, inflation, and political and environmental issues, reduces total factor productivity. The findings have significant implications for industry stakeholders, emphasizing the importance of taking proactive measures to mitigate identified risks. The study adds valuable insights to the existing body of knowledge on supply chain disruptions, particularly in the context of Pakistan's oil and gas industry.

The study's conclusion on the impact of supply chain disruption on total factor productivity in Pakistan's oil and gas sector is a culmination of the findings, discussions, limitations, and broader implications for the industry. The study provides valuable insights into the sector's complexities and challenges, offering a nuanced understanding of the negative impact of independent variables—Technological Failures, Market Volatility, Inflation, and Political and Environmental Issues—on Total Factor Productivity.

The interactions between the independent variables highlight the complexities of the oil and gas supply chain. The occurrence of technological failures, market volatility, inflation, and political and environmental issues all occur at the same time, amplifying the negative impact on productivity. This interconnectedness emphasizes the need for a comprehensive approach to supply chain management that takes into account the multifaceted nature of disruptions. Companies in this industry must develop resilience strategies that take into account the potential compounding effects of these variables.

The study sheds light on the industry-specific dynamics that make the Oil & Gas sector more vulnerable to supply chain disruptions. The sector's unique geopolitical influences and environmental sensitivities contribute to its increased susceptibility.

Finally, the study on the impact of supply chain disruption on total factor productivity in Pakistan's oil and gas sector adds significantly to our understanding of the industry's challenges. While the study's findings are insightful, it also emphasizes the importance of ongoing research, strategic adaptations, and collaborative efforts to fortify the sector against the negative consequences of supply chain disruptions in supply chain management of oil and gas sector of Pakistan.

5.3 Practical Implications

The study's results have important practical implications for stakeholders in the Oil & Gas sector in Pakistan, revealing the significance of supply chain disruptions on overall productivity. As a strategy for increasing resilience, companies should prioritize investing in advanced technologies such as predictive maintenance and real-time monitoring. Furthermore, the study emphasizes the need for businesses to strategically diversify their supplier networks to mitigate risks related to market fluctuations and geopolitical factors. It is recommended that companies adopt flexible supply chain models that can quickly adapt to changing market conditions, given the sector's susceptibility to unpredictable demand patterns. Continuous monitoring and evaluation of supply chain performance, coupled with regular assessments, will ensure that companies remain adaptive to industry changes and evolving risk landscapes. By adopting these practical implications, companies in the Oil & Gas sector can fortify their supply chains against disruptions, fostering sustainability and operational continuity in a dynamic industry landscape.

5.4Limitation

There are some limitations to the study on the impact of supply chain disruption on total factor productivity in Pakistan's oil and gas sector. The availability and reliability of data are critical, and any limitations in obtaining accurate information about the sector may have an impact on the study's robustness. Variable measurement precision is challenged by factors such as technological failures, market volatility, inflation, and political and environmental issues, all of which can introduce measurement errors. Furthermore, the study focuses on the sector of O&G in Pakistan may limit the study's generalizability to other industries or regions. The study's temporal scope may not capture the changing nature of supply chain disruptions over time, potentially preventing a comprehensive understanding.

5.5Recommendation and Future research

To address the identified risks, the study recommends specific risk mitigation strategies for oil and gas companies. Increased investments in technology and innovation to boost resilience, with a focus on predictive maintenance and real-time monitoring, are among them. Companies are encouraged to diversify their suppliers, implement flexible supply chain models, and implement agile strategies in order to respond quickly to market changes. It is recommended that industry players, governmental bodies, and environmental agencies work together to address political and environmental challenges that affect the supply chain.

Future research should conduct a more detailed examination of each independent variable, delving into the nuances of technological failures, market volatility, inflation, and political and environmental issues. Comparative studies conducted across industries or countries may reveal patterns in the impact of supply chain disruption on total factor productivity. For capturing the temporal evolution of supply chain disruptions and determining how their impact changes over time, longitudinal analyses are recommended. To gain a better understanding of the contextual factors that influence supply chain disruptions, qualitative methods such as case studies or interviews are recommended.

Finally, the study not only sheds light on the negative impact of supply chain disruption in the oil and gas industry, but it also serves as a foundation for future research and strategic recommendations for industry stakeholders.

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Sectors selection

Selected below companies for my research, according to their share in industry a report from "Market Statistics of Supply Chain"

Top 5 Pakistani oil & gas companies

1 MARI (Mari Petroleum Company limited)

2 OGDCL (oil and gas Development Company limited)

3 POL (Pakistan oilfield limited)

4 PPL (Pakistan petroleum limited)

5 PSO (Pakistan state oil)

QUESTIONNAIRE:

Name: _____

Gender: _____

Maximum Education Level: _____

Work Experience: _____

SCALE:

1	2	3	4	5
Strongly Agree	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**

	TECHNOLOGY FAILURE	**SA**	**A**	**N**	**DA**	**SD**
		1	**2**	**3**	**4**	**5**
TF1	Inappropriate choice of technology has negative impact on Supply chain disruption.					
TF2	Inappropriate planning and support for innovation can impact negatively on Supply chain disruption.					
TF3	Supply Chain disruption is due to inappropriate processes					

TF4	Market product mismatch and inadequate market survey causes supply chain disruption.					

	MARKET VOLATILITY	**SA**	**A**	**N**	**D**	**SD**
		1	**2**	**3**	**4**	**5**
MV1	Markets have stalled cost of credit remains high, liquidity remains limited and asset prices remains low					
MV2	Government regulation or activity in the financial sector has increased significantly					
MV3	A prolonged global recession is creating widespread effects in the real economy					
MV4	Risk taking and/or risk trading by companies has declined dramatically					
MV5	Many industries have undergone significant restructuring including consolidation and new entrants					
MV6	There has been a strong social or geopolitical backlash against the free-market system					
MV7	Staff creativity improves procurement performance					

	INFLATION	**SA**	**A**	**N**	**D**	**SD**
		1	**2**	**3**	**4**	**5**
IF1	Present level of financial control capable of reducing financial misappropriation					
IF2	Internal audit performs its control as regards financial control					
IF3	Internal audit of the local government is independent of					

	management					
IF4	External auditors rely on the financial control of local government					
IF5	Local government financial control is documented					
IF6	Financial control system of local government is not cost-effective					

	POLITICAL and ENVIRONMENTAL ISSUES	**SA**	**A**	**N**	**D**	**SD**
		1	**2**	**3**	**4**	**5**
PE1	Humans have the right to modify the natural environment to suit their needs in order to mitigate disruption in Supply Chain.					
PE2	Interfere with nature it often produces disastrous consequences.					
PE3	Humans are severely abusing the environment.					
PE4	The balance of nature is very delicate and easily upset					
PE5	The balance of nature is strong enough to cope with the impacts of modern industrial nations					
PE6	Despite our special abilities to cause innovation, humans are still subject to the laws of nature that can help undo disruption in Supply chain.					
PE7	The so-called ecological crisis facing humankind has been greatly exaggerated that impacts disruption in Supply Chain					

	TOTAL FACTOR PRODUCTIVITY	**1**	**2**	**3**	**4**	**5**
TFP1	Supply chain disruptions has impact decline on total factor productivity of the Oil and Gas sector.					
TFP2	In Pakistan different organizations implemented					

	specificstrategies to mitigate the impact of supply chain disruptions on total factor productivity.					
TFP3	Do you foresee negative impact of supply chain disruptions on the total factor productivity of the Oil and Gas sector					
TFP4	Would you assess the current state of Total Factor Productivity in the Oil and Gas sector is declining ?					

Bahria University
Islamabad Campus

RC-04

MBA/BBA

1st Half Semester Progress Report

Name of Student(s)	MUHAMMAD ADNAN
Enrollment No.	01-220191-017
Thesis/Project Title	The Impact of supply Chain Disruption on Total factor Productivity, A study from oil & Gas sector in Pakistan.

Supervisor Student Meeting Record

No.	Date	Place of Meeting	Topic Discussed	Signature of Student
1	29 Sep 2023	Advisor office	Chapter 1, Discussion & Guidance	M. Adnan
2	06 oct 2023	Advisor office	Chapter 2, Discussion & chap 2, Revised	M. Adnan
3	24 oct 2023	Advisor office	Chapter 3 Discussion, 1-, 2, Review	M. Adnan
4	30 oct 2023	Advisor office	Discuss Research onion, Research methodology	M. Adnan

Progress Satisfactory ☑ Progress Unsatisfactory ☐

Remarks: The student has put it hard efforts and completed thesis in time.

Signature of Supervisor: _____ Date: 2/1/24

Name: Asima Saleem

Note: **Students attach 1st & 2nd half progress report at the end of spiral copy.**

Page 1 of 2

Bahria University
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RC-04

MBA/BBA

2nd Half Semester Progress Report & Thesis Approval Statement

Name of Student(s)	MUHAMMAD ADNAN
Enrollment No.	01-220191-017
Thesis/Project Title	The Impact of Supply Chain Disruption on Total Factor Productivity, A Study from Oil & Gas Sector in Pakistan.

Supervisor Student Meeting Record

No.	Date	Place of Meeting	Topic Discussed	Signature of Student
5	20 NOV 2023	Advisor Office	Discussion of Research Questionnaire	M. Adnan
6	22 Dec 2023	Advisor Office	Submission of Research Questionnaire Data Analysis & Interpretation	M. Adnan
7	01-01-2024	Advisor Office	Submission- Overall Review, Plagiarism Check	M. Adnan

APPROVAL FOR EXAMINATION

Candidates' Name: MUHAMMAD ADNAN Enrollment No: 01-220191-017

Project/Thesis Title: The Impact of Supply Chain Disruption on Total Factor Productivity A Study From oil and gas Sector in Pakistan.

I hereby certify that the above candidates' thesis/project has been completed to my satisfaction and, to my belief, its standard appropriate for submission for examination. I have also conducted plagiarism test of this thesis using HEC prescribed software and found similarity index at 18% that is within the permissible limit set by the HEC for thesis/ project MBA/BBA. I have also found the thesis/project in a format recognized by the department of Business Studies.

Signature of Supervisor: _____ Date: 2/1/24

Name: Asima Saleem

M Adnan Final Plag

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