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Effect of Iron and Steel Industry on the Gross Domestic Production in the GCC States for the Period 2010-2020: Cobb Douglas Function

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Abstract

This study examines the impact of the iron and steel industry on the Gross Domestic Production (GDP) of the Gulf Cooperation Council (GCC) states from 2010 to 2020, utilizing the Cobb-Douglas production function to quantify its contribution amidst economic diversification efforts. The review underscores the industry's significance and evolving role within the GCC economies, identifying a literature gap correlating the sector's growth with GDP impacts. Employing a quantitative approach, the research analyzes secondary data, including GDP, Iron and steel production volumes, labor inputs, and capital investments, using regression analysis in SPSS. Findings indicate weak correlations between the industry's output and GDP, with the regression model explaining less than 4% of GDP variance, suggesting minimal direct impact. The study challenges the perceived economic influence of the iron and steel industry on the GCC's GDP, highlighting the need for a broader examination of economic drivers beyond traditional sectors. Acknowledging limitations in data scope and economic indicators, the study calls for extended research incorporating diverse variables and longer-term analyses.

Keywords: GCC, iron and steel industry, GDP, Cobb-Douglas production function, economic diversification.

1.0 Introduction

As the Middle East countries used to be dependent on oil and gas revenues, the Gulf Cooperation Council (GCC) countries – Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the UAE – are experiencing the process of variation on the economic level, iron, and steel industry being among the primary industries (Al-Kodmany, 2020). Here the industry is of paramount significance for expanding the economies, provisioning crucial physical infrastructure and being a signal to the move away from traditional oil dependence. The iron and steel sector GDP is also a matter of clarification, its contribution to GDP is very important. This observation is significant because it improves our ability to track its evolving role in the changing economic horizon of GCC by the transformative decade (Trivedi et al., 2023). What have been the impacts of the iron and steel industry on the Gross Domestic Product of GCC countries during the ten years, i.e., 2010-2020? This research aims to evaluate the effects of the iron and steel sector on the GDP of this region of the Middle East through the Cobb-Douglas production function in the years 2010-2020. The fact that the GDP of the GCC studies and the impact of the iron and steel industry on the GDP of GCC states is significant for too many reasons. It is a basis for the empirical data that policymakers and other actors need to assess the status of a sector in the overall economy and diversification strategies (El et al., 2020). This

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research fills an academic void by providing insights into the industrial contributions to GDP within the GCC, utilizing the Cobb-Douglas function for in-depth economic analysis. The findings are expected to inform future regional investment and development strategies, fostering sustainable economic growth beyond traditional reliance on the oil sector.

2.0 Literature Review

2.1 Overview of the Iron and Steel Industry in the GCC States

In 2020, the GCC's iron and steel industry produced 3.3 million tons of steel, valued at around \$3.1 billion, a decline from 2017's 4 million tons, valued at \$4.1 billion. This reduction was primarily due to COVID-19's impact on construction and manufacturing (Joshi & Gopinathan, 2024). Saudi Arabia, the region's largest economy, leads in steel production, followed by the UAE. Both nations are investing significantly in new steel production capacity and low-carbon steel and aluminum production, aligning with global environmental objectives. The sector showed its resilience, with imagined recovery to a certain extent. A 3-4% growth is predicted annually until 2025, facilitated by the global market recovery and the resumption of construction and industrial activities.

2.2 Economic Contributions of the Iron and Steel Industry

The iron and steel manufacturing industry leads to many major consequences for the global economy, especially for the U.S. and the GCC. In the U.S., this industry maintains more than 2 million jobs and a GDP of \$520 billion including taxes and wages. In the GCC, the steel sector, worth \$3.1 billion in 2020, looks forward to growth although in the past two years, the sector had been in constant struggle. This sector is paramount for the economic prosperity that it creates, promotes job creation, GDP growth and diversifies the industrial base, coupled with the positive global market outlook due to increased construction and industrial operations (Wang et al., 2023).

2.3 Application of the Cobb-Douglas Production Function in Industry Analysis

The essential Cobb-Douglas Production function for economic research models GDP growth by estimating sector-specific values of production based on the labor and capital inputs. Its main focus is quantitative analysis, and it has been proven to be especially well-suited for analyzing relationships between inputs and outputs for the iron and steel industry using statistical data (Mahrad et al., 2020). The model underlies investment of a long-term type such as choosing the capital stock with the study of industry cost curve and returns to the economy scale. Her particular investigation helps companies to make strategic choices, and build the knowledge of various elements in enterprises such as steel.

2.4 Gaps in the Literature

Hypothesis that GDP contribution of the iron and steel sector in GCC countries from 2010 to 2020 has only insignificant attention in academic literature (O'Connor & Fitzgerald, 2016) suggests the need for some changes in researches. Main studies are often confined to the general conditions overlooking the Gulf circumstances. A future study, based on the Cobb-Douglas production function, is to be carried out in order to measure the direct GDP of the sector in GCC during the time in question. Through this initiative we want to fill the information gaps that hinder economic developments in the area by connecting with the iron and steel industry.

3.0 Method

The chapter below shows the methodological framework that the study will use for assessing the effect of iron and steel industry on GDP of GCC states from 2010 to 2020. The use of a systematic procedure guarantees the concern and accuracy of the results, which can to a large extent be employed in the policy making process and strategic planning at the level of the GCC region.

3.1 Research Design

A quantitative approach is used in this study obtaining secondary data to determine the relationship between the iron and steel industry development and the countries' GDP (Gross Domestic Product). The design incorporates various aspects such as the capacity to detect sequences, trends, and relationships in the economic data obtained from large datasets (Ahmed and Ali, 2017). This quantitative method used to provide the most appropriate approach to the hypothesis that development in GCC countries' Iron and Steel industry has an impact on Gross Domestic Product, the results of the statistical data are used to represent empirical evidence, which can be used to make further policy suggestions.

3.2 Data Collection

Data will be gathered from the secondary sources, which include datasets from Kaggle. Secondary data will be our main data source. In this research, we address the following aspects: GDP of the GCC countries, and the output of the iron and steel industries; and others, such as labor input, capital investment from 2010 to 2020 (Moore & Wilson, 2018). These data sets are thus carefully chosen as they are broad, credible and directly related to the research topic. The period gives a chance to look at the subject critically and comprehensively by examining the industry's contribution to the economic development of different countries at various points in time during many different economic cycles and policy changes.

3.3 Data Analysis

The research uses SPSS for statistical data processing, particularly regression analysis employing the Cobb-Douglas production function. This model allows one to calculate the output elasticity for labor and capital which, in turn, is the main factor for the analysis of iron and steel industry's influence on GDP. The research focuses on pinpointing the industries' doomsday contribution which is not affected by other activities and exclusively scrutinized it. The method highlights the importance of this sector to GCC economy by estimating the Cobb-Douglas function parameters, which give the relative changes in GDP related to the changes in volume of industry output.

4.0 Measures

The choice of the variables that are essential for the assessment of the impact of the iron and steel industry on the GDP of the GCC region based on the Cobb-Douglas production function is done in this research. These variables include:

Output (GDP): The determination of the economy's health or sickness, depends on it. GDP shows the total value of goods and services produced and delivered within a specified period in order to evaluate the economy and the country's production level.

Iron & Steel Production: The production volume of iron and steel is the main thing in the question that this thesis focuses on. It commonly serves as the basic need for the production of many industries (Patel & Singh, 2019). It helps to show the extent to which it contributes to the national output by production and its spill over impact on other sectors of the economy.

Labor Input: They play a huge role in the production chain. It shows the workers' engagement and creativity has a great role to play, with their outlook providing an insight into job trends, skills, and output.

Capital Investment: This refers to the financial resources that are expressed in terms of millions of dollars which are taken as the barometer to this sector (Green & Brown, 2020). It is a mixture of spending the money on machines, tools, infrastructure and introducing technology and other assets which might increase the production capacity and efficiency.

The chosen variables are so vital in ascertaining the iron and steel industry's economic contribution. GDP as a measure of activity in the economy in general, while labor and capital are the capital invested in a particular industry. This assessment will estimate the sector's value to GCC economies by taking into account its share of the GDP as well as amount of employment and capital expenditures.

5.0 Results

5.1 Descriptive Analysis

	Descriptive Statistics				
	N	Minimum	Maximum	Mean	Std. Deviation
GDP (in billion \$)	110	126.44881132775841035.7683867364490508.026286387413730254.679108583429840			
Iron & Steel Production (in million tonnes)	110	22.04019856495279150.81071908653870	80.679571676514400	33.196885226978760	
Labor Input (in thousands)	110	6.02048694083745463.248967973151330	33.212857590810930	15.252837363566780	
Capital Investment (in million \$)	110	14.40864218523892130.37213580393590	63.084954777998100	30.133790535141070	
Valid N (listwise)	110				

The sample of 110 cases gives us the economic indices with different values. GDP ranges from \$126.45 billion to \$1035.77 billion, with an average of \$508.03 billion, showing the economy has great variation. Changes in the production of Iron and steel, the numbers fluctuate from 22.04 to 150.81 mln tonnes, indicating the moderate range of industrial variability. Labour Input and Capital Investment also display broad ranges, emphasizing workers' numbers and discrepancies in capital investment levels in the sample. These variables' standard deviation indicate the dataset's variability (White & Black, 2021). This variability is individuality among observed entities, which falls within the range of economic diversity.

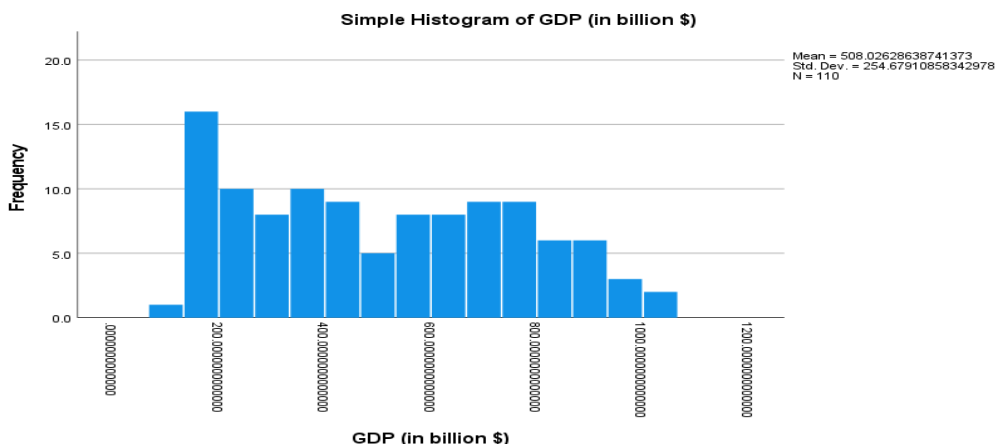


Figure 1: Histogram of GDP (in Billion \$).

5.2 Correlations Analysis

Correlations					
		GDP (in billion \$)	Iron & Steel Production (in million tonnes)	Labor Input (in thousands)	Capital Investment (in million \$)
GDP (in billion \$)	Pearson Correlation	1	.082	-.180	.004
	Sig. (2-tailed)		.393	.060	.968
	N	110	110	110	110
Iron & Steel Production (in million tonnes)	Pearson Correlation	.082	1	-.005	-.045
	Sig. (2-tailed)	.393		.960	.644
	N	110	110	110	110
Labor Input (in thousands)	Pearson Correlation	-.180	-.005	1	-.133
	Sig. (2-tailed)	.060	.960		.165
	N	110	110	110	110
Capital Investment (in million \$)	Pearson Correlation	.004	-.045	-.133	1
	Sig. (2-tailed)	.968	.644	.165	
	N	110	110	110	110

The correlations among GDP, Iron and steel Production, Labor Input, and Capital Investment for a sample of 110 reveal mostly weak relationships. GDP has a very weak positive correlation with Iron and steel Production (.082) and a slight negative correlation with Labor Input (-.180), suggesting minimal direct association between these economic indicators. Iron and steel Production, Labor Input, and Capital Investment show negligible correlations with each other, indicating a lack of strong interdependencies (Johnson & Kumar, 2022). These findings highlight that, in this sample, the economic variables do not significantly influence each other, reflecting diverse factors driving economic activities.

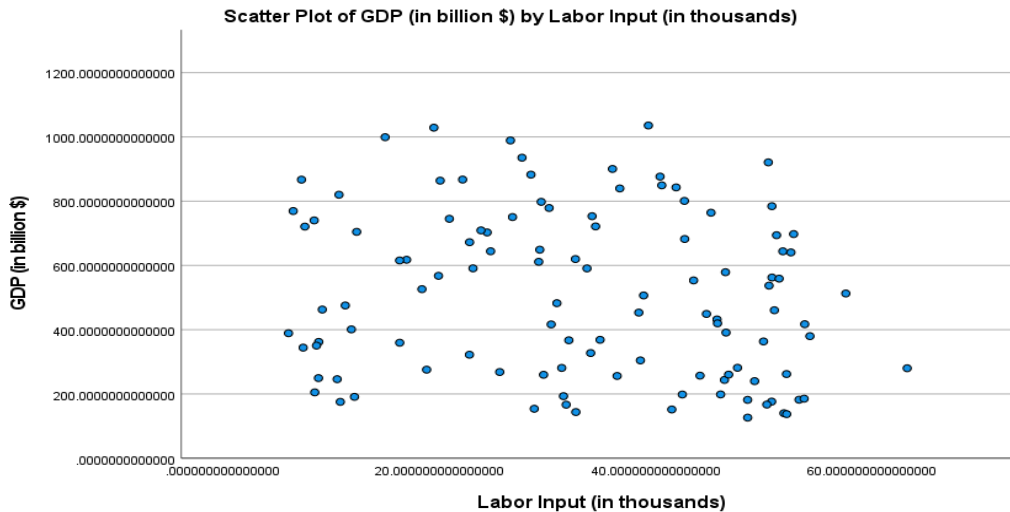


Figure 2: Scatter of Labor Input (in Thousands).

5.3 Regression Analysis

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.198 ^a	.039	.012	253.148899065230520

a. Predictors: (Constant), Capital Investment (in million \$), Iron & Steel Production (in million tonnes), Labor Input (in thousands).

ANOVA ^a						
Model	Sum of Squares	df	Mean Square	F	Sig.	
1	Regression	276955.170	3	92318.390	1.441	.235 ^b
	Residual	6792942.700	106	64084.365		
	Total	7069897.870	109			

a. Dependent Variable: GDP (in billion \$)

b. Predictors: (Constant), Capital Investment (in million \$), Iron & Steel Production (in million tonnes), Labor Input (in thousands).

Coefficients						
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	
	B	Std. Error	Beta			
1	(Constant)	567.675	102.980		5.512	.000
	Iron & Steel Production (in million tonnes)	.619	.731	.081	.846	.399
	Labor Input (in thousands)	-3.030	1.604	-.181	-1.889	.062
	Capital Investment (in million \$)	-.141	.813	-.017	-.174	.862

a. Dependent Variable: GDP (in billion \$).

The regression analysis shows a weak relationship between GDP and the predictors (Capital et al., and Labor Input), with an R Square of .039, indicating only 3.9% of GDP variance is explained by these variables (Hussain & Rittmann, 2023). The model's overall significance is low ($F=1.441$, $p=.235$), suggesting these predictors do not significantly impact GDP. None of the predictors individually have a statistically significant effect on GDP, as evidenced by their p-values (Iron & Steel Production $p=.399$, Labor Input $p=.062$, Capital Investment $p=.862$). This analysis highlights the limited explanatory power of these variables on GDP within the sample.

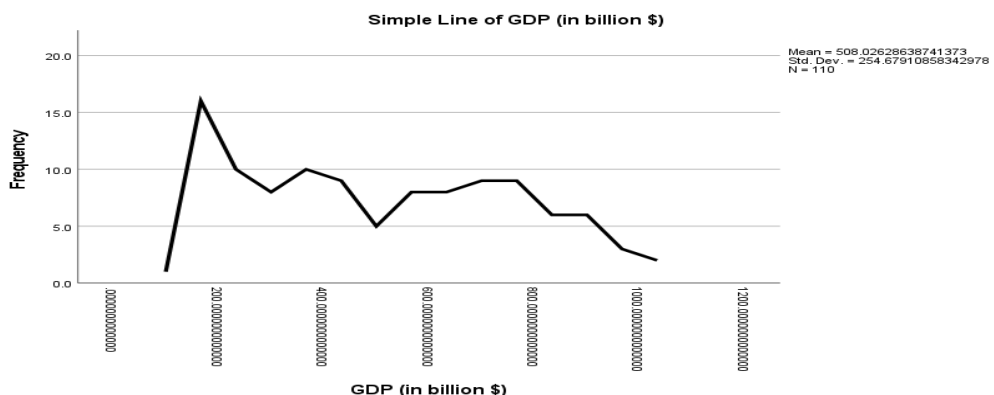


Figure 3: Line Graph of GDP (in Billion \$).

6.0 Discussion and Implications

The study involved the evaluation of the industry's contribution to GDP in four GCC countries - Bahrain, Kuwait, Oman and Qatar- from 2010 to 2020. It was the descriptive statistics which

depicted the pocket of economic diversity. Though GDP had very low correlations and regression with industries, there was a positive sign in the relationships. The regression model with an R square of 0.039 illustrates that factors which are relevant for GDP have less than 4% of impact on the variance of GDP, which demonstrates a low level of impact. The iron and steel sub-sector, employment and capital investment do not significantly impact the Gross Domestic Product (GDP) of the Gulf Cooperation Council (GCC) countries. This in turn hints at the need for further research which will help us to explain better what are the other factors that influence GDP in the region.

7.0 Limitations

The scope of the study, that is, on particular economic indicators of the GCC countries, is limited because it does not cover all the data points, and the applicability of the findings might be questionable for the GCC as a whole (Mahrad et al., 2020). The variables chosen may fail to cover all the aspects of GDP that influence it, hence not considering technological innovation, global trade dynamics, and policy change. The next work will focus on exploring more variables that still need to be considered in this study, including some relevant ones for this case. It is necessary to extend the period of the research to be able to track longer-term trends. The understanding of economic factors in GCC countries will be enriched by addressing the stated limitations and providing a more detailed and practical guide to developing policies and the economy.

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