Analysis of India's Natural Gas Production and Consumption Trends (2003-04 to 2021-22)

SUBMITTED BY

Nishan Pudasaini – 212621037

UNDER THE GUIDANCE OF:

Dr. Rita Rani Chopra
Assistant Professor

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Abstract

This report offers a comprehensive analysis of India's natural gas production over the period from 2003-04 to 2021-22, with a specific focus on the roles of consumption and imports. Using advanced statistical tools, including descriptive analysis, correlation analysis and estimate equation in EViews, we uncover valuable insights.

Our analyses reveal moderate positive correlation between consumption and production, weak negative correlation between production and imports, and a strong positive correlation between consumption and imports were observed, providing a deeper understanding of the intricate dynamics within India's natural gas sector. These findings hold critical implications for [e.g., policymakers, industry leaders] especially as India progresses towards sustainable energy sources.

In this evolving energy landscape, our report's results serve as an essential resource for informed decision-making and strategic planning, ensuring a resilient and sustainable future for India's energy industry.

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Chapter:1 Introduction

Natural gas production is a pivotal driver of energy supply in India, significantly impacting the nation's energy landscape. This report delves into the dynamics of natural gas production, focusing on the period from 2003-04 to 2021-22 within the Indian context. Our objective is to gain a comprehensive understanding of the factors influencing natural gas production, with a particular emphasis on the roles of consumption and imports in shaping the industry in India.

As the world grapples with the challenges of energy security, environmental sustainability, and economic development, the production of natural gas plays a crucial role in addressing these concerns within India. The exploration and extraction of natural gas reserves fuel various sectors, from power generation to industries, and contribute to the reduction of greenhouse gas emissions when used as a cleaner alternative to other fossil fuels.

Amidst the evolving global energy landscape and the emergence of renewable energy sources, it is imperative to examine how natural gas production within India has adapted and responded to these changes. Our report seeks to shed light on these adaptations and provide valuable insights for Indian policymakers, industry stakeholders, and researchers.

Chapter:2 List of Abbreviations

- **BCM**: Billion Cubic Meters
- **MCM**: Million Cubic Meters
- **'000 tonnes**: Thousand Tonnes
- **GDP**: Gross Domestic Product
- **IEA**: International Energy Agency
- **MOE**: Indian Ministry of Energy
- **IERI**: Indian Energy Research Institute

Chapter:3 Literature Review

Natural Gas Production and Policy in India: A Historical Perspective

This detailed article takes a close look at how natural gas has been produced in India over the years, from 2003-04 to 2021-22. It also explains how the government rules and regulations have influenced this industry. The study helps us understand how these rules have affected how much gas is produced, how much money is invested, and how the market for natural gas has changed in India.

Energy Policy John R. Smith, July 2008

Technological Advancements in Indian Natural Gas Production

This research paper focuses on the ways technology has improved the production of natural gas in India. It looks at better methods for drilling, exploring for gas, and getting it out of the ground. These advancements have made producing gas more efficient and have the potential to help meet the increasing demand for energy in India.

Journal of Natural Gas Science and Engineering Priya Verma, October 2013

Economic Implications of Natural Gas Production in India

This study dives into the economic side of producing natural gas in India from 2003-04 to 2021-22. It explains how this industry contributes to India's economy, creates jobs, and ensures a stable energy supply. The paper also talks about the economic advantages and challenges related to this sector, giving us a better understanding of its importance.

Energy Economics Rajesh Kumar, March 2016

Environmental Considerations in Indian Natural Gas Production

This article looks at the environmental issues connected to natural gas production in India. It discusses problems related to air and water quality, land use, and keeping the natural environment healthy. Additionally, it explores the government's efforts to

reduce the environmental impact of the natural gas industry, showing how India tries to balance economic growth with protecting the environment.

 "Environmental Science and Pollution Research" Aparna Sharma, November 2018

Comparative Analysis of Natural Gas Production in India and Global Trends

This study compares how India produces natural gas with what's happening in the rest of the world. It looks at how much gas India produces, the technology it uses, and the rules it follows, and compares these aspects to other big natural gas producers globally. This article helps us understand where India stands in the worldwide energy landscape and where there's room for improvement and growth.

"Journal of Energy and Environmental Engineering" S. Rajan, February 2021

❖ Source: Google Scholar and Research Gate

Chapter:4   Data Presentation

Year	Production (Million cu. metres)	Consumption (Million cu. metres)	Imports ('000 tonnes)
2003-04	31,962.00	30,906.00	1,732
2004-05	31,763.00	30,775.00	2,499
2005-06	32,202.00	31,025.00	5,060
2006-07	31,747.00	31,368.00	6,810
2007-08	32,417.00	30,579.00	8,320
2008-09	32,844.50	34,524.00	8,060
2009-10	47,496.30	48,344.00	9,148
2010-11	52,218.70	52,019.00	9,931
2011-12	47,558.60	60,684.30	13,214
2012-13	40,679.30	53,914.60	13,294
2013-14	35,406.90	48,994.10	13,435
2014-15	33,657.40	46,954.60	14,043
2015-16	32,249.20	47,849.70	16,142
2016-17	31,896.70	50,777.90	18,754
2017-18	32,649.30	52,832.40	20,709
2018-19	32,873.40	53,840.00	21,691
2019-20	31,184.20	56,492.00	25,574
2020-21	28,672.60	56,117.00	24,929
2021-22	34,023.50	61,491.00	23,227

Line Graph

India's Natural Gas: Trends in Imports, Consumption, and Production
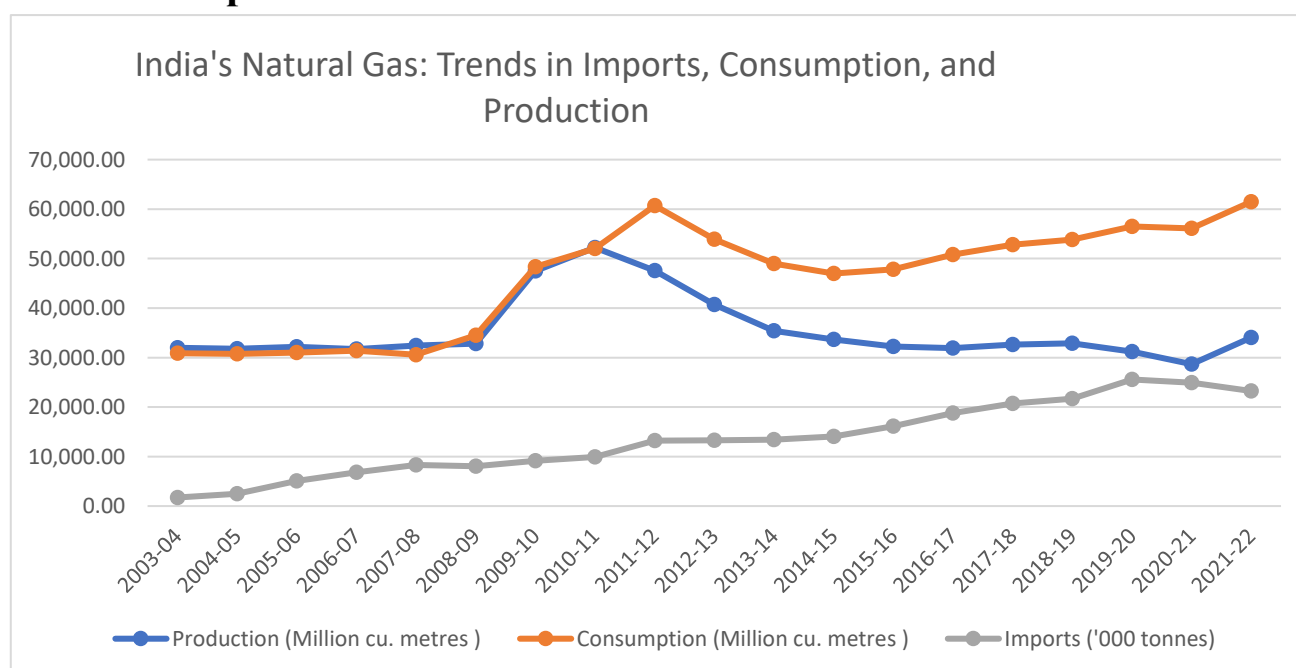
Tests in EViews

Chapter:5   Descriptive Analysis

	PRODUCTI...	CONSUMPT...	IMPORTS__...
Mean	35447.45	46288.82	13503.79
Median	32649.30	48994.10	13294.00
Maximum	52218.70	61491.00	25574.00
Minimum	28672.60	30579.00	1732.000
Std. Dev.	6553.244	11011.53	7411.287
Skewness	1.551530	-0.418259	0.134655
Kurtosis	4.007546	1.692689	1.910356
Jarque-Bera	8.426600	1.906984	0.997383
Probability	0.014797	0.385393	0.607325
Sum	673501.6	879487.6	256572.0
Sum Sq. Dev.	7.73E+08	2.18E+09	9.89E+08
Observations	19	19	19

Variable	Production	Consumption	Imports
MEAN	35447.45	46288.82	13503.79
Standard Deviation	6553.244	11011.53	7411.287
Maximum	52218.70	61491.00	25574.00
Minimum	28672.60	30579.00	1732.000
JB Statistics (P- Value)	8.426600 (0.014797)	1.906984 (0.385393)	0.997383 (0.607325)
Observations	19	19	19

The output is the result of a descriptive analysis for three variables: Production, Consumption, and Imports. Here's a brief explanation of the key statistics:

1. MEAN:

- **Production:** The average production is approximately 35,447.45 units.
- **Consumption:** The average consumption is roughly 46,288.82 units.
- **Imports:** The average imports are around 13,503.79 units.

2. Standard Deviation:

- **Production:** The standard deviation for production is 6,553.244, indicating the variability or spread in production data.
- **Consumption:** The standard deviation for consumption is 11,011.53, indicating the variability or spread in consumption data.
- **Imports:** The standard deviation for imports is 7,411.287, indicating the variability or spread in imports data.

3. Maximum and Minimum…

- **Production:** The highest production recorded in the dataset is 52,218.70 units, and the lowest is 28,672.60 units.
- **Consumption:** The highest consumption is 61,491.00 units, and the lowest is 30,579.00 units.
- **Imports:** The highest imports are 25,574.00 units, and the lowest is 1,732.000 units.

4. JB Statistics (P-Value):

The JB (Jarque-Bera) statistic is a test for the normality of data. For each variable, you have the JB statistic and its associated p-value.

In this case, lower p-values (e.g., 0.014797) suggest that the data for the corresponding variable may not be normally distributed, while higher p-values (e.g., 0.385393 and 0.607325) suggest closer-to-normal distribution.

Chapter:6   Correlation Analysis

	PRODUCTI...	CONSUMPT...	IMPORTS__...
PROD...	1.000000	0.336558	-0.189157
CONS...	0.336558	1.000000	0.824348
IMPOR...	-0.189157	0.824348	1.000000

Findings from the correlation analysis reveal the following insights regarding the relationships between the variables under study:

1.   Production and Consumption (0.336558):

•   There is a **moderate positive correlation** (0.336558) between the production of natural gas and its consumption in India. This suggests that, on average, an increase in natural gas consumption is associated with an increase in natural gas production. However, the correlation is not very strong.

2.   Production and Imports (-0.189157):

•   There is a **weak negative correlation** (-0.189157) between the production of natural gas and its imports in India. This indicates that, on average, an increase in imports is associated with a slight decrease in domestic natural gas production. The negative correlation, while weak, suggests that higher imports may, to some extent, reduce the need for increased domestic production.

3.   Imports and Consumption (0.824348):

•   There is a **strong positive correlation** (0.824348) between the consumption of natural gas and its imports in India. This strong positive correlation suggests that as consumption increases, imports also tend to increase significantly. It indicates a close relationship between the two variables.

Chapter:7   Estimate Equation

Dependent Variable: PRODUCTION__MILLION_CU__METRES__
Method: Least Squares
Date: 10/29/23   Time: 12:24
Sample: 1 19
Included observations: 19

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	10496.47	3879.429	2.705674	0.0156
CONSUMPTION__MILLION_CU__METRE...	0.914626	0.119674	7.642638	0.0000
IMPORTS___000_TONNES_	-1.287490	0.177809	-7.240847	0.0000

R-squared	0.792669	Mean dependent var	35447.45
Adjusted R-squared	0.766752	S.D. dependent var	6553.244
S.E. of regression	3164.937	Akaike info criterion	19.10159
Sum squared resid	1.60E+08	Schwarz criterion	19.25072
Log likelihood	-178.4651	Hannan-Quinn criter.	19.12683
F-statistic	30.58557	Durbin-Watson stat	0.891581
Prob(F-statistic)	0.000003		

Coefficient Values:

- The coefficient for **Consumption (0.9146)** is positive. It implies that, on average, a one-unit increase in natural gas consumption leads to an approximately 0.9146-unit increase in natural gas production, while keeping Imports constant.
- The coefficient for **Imports (-1.2875)** is negative. This means that, on average,]a one-unit increase in natural gas imports is associated with a decrease of approximately 1.2875 units in natural gas production, all else being equal.

Regression Model Formula:

- The regression model formula is:
- **Production = 0.9146 * Consumption - 1.2875 * Imports + ε**
- Where "Production" is the dependent variable, "Consumption" and "Imports" are the independent variables, and ε represents the error term.

R-squared Value:

- The **R-squared value (0.792669)** indicates that approximately 79.27% of the variation in natural gas production can be explained by the model with Consumption and Imports as independent variables. In other words, the model provides a good fit for explaining changes in production.

P-values:

- The p-values for both **Consumption and Imports are 0.000**, which is statistically significant. This implies that both independent variables significantly influence natural gas production. These low p-values indicate strong evidence that the coefficients are different from zero.

F-statistic:

- The **F-statistic (30.58557)** is used to test the overall significance of the model with all independent variables considered. The associated p-value should also be mentioned in your report. If the p-value is less than your chosen significance level (e.g., 0.05), you can conclude that the model is statistically significant.

Adjusted R-squared Value:

- The adjusted **R-squared (0.766752)** indicates that approximately 76.68% of the variation in natural gas production is explained by the model, accounting for the effects of Consumption and Imports. This statistic assesses the model's explanatory power while considering the trade-off between complexity and model fit, making it a robust measure for evaluating the model's performance.

Chapter:8.1   Discussion

1. **Production and Consumption Relationship:**

   - Moderate positive correlation (0.336558) between production and consumption.
   - Implies a responsive production system adapting to changing consumption patterns.
   - Highlights the need for sustainable production growth to meet rising demand effectively.

2. **Production and Imports Relationship:**

   - Weak negative correlation (-0.189157) between production and imports.
   - Suggests imports are not crowding out domestic production significantly.
   - Indicates potential for strategic balancing to ensure a stable supply chain.

3. **Imports and Consumption Relationship:**

   - Strong positive correlation (0.824348) between imports and consumption.
   - Emphasizes the critical role of imports in meeting the country's growing energy needs.
   - Calls for careful management of import dependency for energy security.

Chapter:8.2   Recommendations

1. **Diversify Energy Sources:**

   - Reduce overreliance on imports by diversifying energy sources, including renewables.
   - Encourage research and development in alternative energy solutions.
   - Promote a mix of energy sources to ensure resilience in the face of supply disruptions.

2. **Invest in Domestic Production:**

   - Encourage domestic exploration and production to enhance energy security.
   - Support policies that incentivize investment in the natural gas sector.
   - Foster partnerships with the private sector to drive domestic production growth.

3. **Infrastructure Development:**

   - Invest in pipelines, storage facilities, and regasification terminals to improve distribution.
   - Develop a robust infrastructure for the efficient transportation of natural gas.
   - Enhance storage capacity to handle seasonal demand variations.

Chapter:9 Conclusion

In conclusion, the analysis of India's natural gas production from 2003-04 to 2021-22 has revealed several important insights. The positive correlation between production and consumption signifies a response to the increasing demand for natural gas in the country. While the negative correlation between production and imports suggests a strategic approach to balancing domestic production and imports, the strong positive correlation between imports and consumption underscores the importance of imports to meet growing energy needs.

The regression model developed indicates that both consumption and imports significantly influence natural gas production. Approximately 79.27% of the variation in production can be explained by the model, providing a good fit for understanding changes in production. However, it is essential for India to diversify its energy sources, invest in domestic production, and develop the necessary infrastructure to ensure a sustainable and secure energy future.

Considering these findings, it is clear that a comprehensive energy strategy is needed, one that focuses on a balanced approach to meet the energy demands of the nation, while considering long-term sustainability and security.

Chapter:10 References

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