(REVIEW ARTICLE)

# An econometric analysis of sectorial contribution to economic growth of Goa

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## Abstract

The study delves into the economic dynamics of Goa over a 26-year period, examining sector-wise contributions and their implications for the state's economic growth. Leveraging secondary data from credible sources like the RBI Handbook of Statistics and the Census Report, the research utilized various statistical tools including cointegration analyses, correlation studies, and causal inferences to explore relationships among Agriculture, Industry, Manufacturing, and Services vis-a-vis the state's Net State Domestic Product (NSDP). The findings reveal a significant shift in Goa's economic landscape, with a decline in the Agricultural sector's contribution, a steady ascent of the Service sector, and consistent roles played by Industry and Manufacturing. The statistical analyses depict the Manufacturing sector as statistically insignificant in influencing long-term economic growth. The research emphasizes the need for strategic interventions to rejuvenate the manufacturing sector for a more substantial contribution to Goa's economic growth. Additionally, the study highlights the vulnerability of Goa's economy to diverse factors and recommends balanced growth strategies across sectors to ensure sustained and diverse economic development in the state. Overall, this research contributes to a nuanced understanding of Goa's economic evolution and presents key insights into its economic trends and the interplay between different sectors and economic growth dynamics.

**Keywords:** Goa; NSDP; Economic growth; Agriculture; Industry; Manufacturing; Service

## 1. Introduction

In the intricate tapestry of Goa's economy, the agricultural, industrial, manufacturing, and service sectors play distinct yet interlinked roles, contributing significantly to the state's Gross Domestic Product (GDP) and overall economic stability. The impact of these sectors on Goa's GDP and their collective influence on the state's economic landscape is a testament to their individual prowess and combined contributions. Agriculture, while not the primary contributor to Goa's GDP, holds cultural and economic significance. The sector, marked by innovative initiatives during the pandemic, including schemes supporting cashew cultivation and experiments with various crops, contributes to the state's self-sufficiency in essential produce. The production of milk, eggs, and meat demonstrated growth, showcasing the resilience of the agricultural landscape. Although its direct contribution to the GDP might be relatively lower, agriculture remains an essential component of Goa's economic diversity, supporting local livelihoods and ensuring food security.

The industrial sector in Goa, encompassing a diverse range of activities, plays a substantial role in the state's economic growth. With multiple approved projects and expected employment for thousands of individuals, the industrial landscape illustrates the state's commitment to economic expansion and job creation. Industries in Goa, such as mining and manufacturing, have historically played a pivotal role in contributing to the state's GDP. However, challenges and shifts in regulations have impacted these sectors, influencing their economic contribution. The manufacturing sector, a subset of the broader industrial landscape, significantly impacts Goa's GDP. Its contributions, often intertwined with the industrial sector, include diverse activities such as the production of consumer goods, pharmaceuticals, and other manufactured products. Manufacturing units in the state, through expansion and new ventures, contribute significantly

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to Goa's GDP, employment generation, and economic growth. The service sector, encompassing tourism, transportation, and other essential services, is a major driver of Goa's economy. The state's GDP heavily relies on the revenue generated from tourism, which suffered a severe setback during the pandemic due to travel restrictions and safety concerns. The service sector's impact on the state's GDP is notable, reflecting the resilience of Goa's tourism-driven economy. Efforts to revive this sector are crucial to restoring the state's economic vibrancy and employment opportunities.

The combined impact of these sectors on Goa's GDP reflects the state's economic diversity and resilience. While tourism remains a substantial contributor, the agricultural, industrial, manufacturing, and service sectors each play a vital role in the state's economic stability and growth. As Goa navigates through the challenges post-pandemic, these sectors are essential pillars in rebuilding the state's economy, emphasizing their collective influence on Goa's GDP and its overall socio-economic development. The following study tries to statistical identify the sectorial contribution to economic growth of GDP.

## 2. Literature review

The analyses of Mitchell (1913) and further advanced by Burns and Mitchell (1946), offers a comprehensive exploration of economic fluctuations and their impact on the Gross Domestic Product (GDP) within the Baltic countries—Lithuania, Latvia, and Estonia. Delving into the non-periodic duration of economic cycles, ranging from one to twelve years, the study meticulously dissects the phases from peak to trough, recession, and recovery, providing a nuanced understanding of these cyclic patterns. Emphasizing the substantial influence of factors such as monetary and fiscal policies, oil price fluctuations, and technological shocks, the research underlines their differential impact on the economic activity of these countries, suggesting that while short-term changes in energy prices hold limited sway over economic activities due to their small value-added fraction, technological shocks play a pivotal role in the long-term development of the labor market. Overall, this comprehensive exploration serves as a pivotal resource for policymakers and economists seeking insights into the cyclical nature of GDP changes and their implications on economic development in the Baltic region.

Research across various countries, including Iran, Sri Lanka, Pakistan, and Italy, has extensively scrutinized the intricate connections between exports, imports, and economic growth. For instance, Atrkar Roshan Sedigheh's (2008) report on export expansion and economic growth in post-revolutionary Iran confirmed a notable relationship between these factors, echoing the importance of such interconnections in diverse economic contexts. In the Sri Lankan scenario, Velnampy. T and Achchuthan (2013) revealed a strong positive relationship between exports and imports, both significantly influencing economic growth. Murat Çetinkaya and Savas Erdogan's (2010) investigation using VAR Analysis pointed to established causality relationships between imports, exports, and GDP. Meanwhile, studies on export-led growth (ELG) hypothesis, particularly in Bangladesh, have delved into the dynamics of this model in relation to remittance, indicating its substantial impact on trade trends and overall economic development. Other analyses in South Asian countries and beyond, including studies by Love and Chandra (2005), Mukit & Islam (2018), Clarke and Ralhan (2005), Shirazi and Manap (2005), and many others, have showcased varying degrees of causal relationships between exports, imports, and GDP, providing rich insights into the complexities of economic dynamics in different contexts.

Moreover, research efforts extended to countries such as Indonesia, Kuwait, and Turkey, shedding light on diverse aspects of the inflation-GDP relationship. Studies by Rahmaddi & Ichihashi (2011), Saaed (2007), Jayathileke and Rathnayake (2013), Malik and Chowdhury (2001), and others revealed both positive and negative long-term relationships between inflation and economic development, uncovering the intricate nature of these economic variables. Empirical investigations by Faria and Carneiro (2003), Barro (1997), Malla (2002), and Bruno and Easterly (1999) in varied country contexts demonstrated nuanced findings regarding the impact of inflation on GDP. Furthermore, research on Italy by Barbara Pistoresi and Alberto Rinaldi (2011) offered a historical perspective on the relationship between exports, imports, and GDP from the Unification period to the modern-day era, unveiling varying directional causality between these variables over time, underscoring the complexities in trade dynamics and economic growth in different historical periods. These collective research endeavors highlight the multidimensional and intricate nature of trade, inflation, and economic development, underscoring the challenges in establishing consistent causality relationships within diverse economic landscapes.

*Objectives*

- To review sector wise contribution to economic growth.
- To analyze statistically the specific contribution of each sector—Agriculture, Industry, Manufacturing, and Services—to Goa's Net Domestic Product (NDP) over a selected time frame.

## 2.1. Hypothesis

Sectorial contributions significantly impact Goa's economic growth, with at least one sector playing a more dominant role than others in influencing the state's economic development.

## 3. Research methodology

The study involved sourcing secondary data from reputable sources like the RBI Handbook of Statistics and the Census Report covering the years 1994 to 2020, focusing on Goa's economic trends. Statistical tools such as ARDL for cointegration analysis, Pearson correlation for linear associations and long-run and short-run cointegration analyses were employed to study relationships between economic variables. Growth rates and percentage changes were calculated to understand Goa's economic landscape, enabling a comprehensive analysis of the region's economic trends and interconnections during the specified timeframe.

## 4. Results and discussion

The following section discusses about Goa's sector wise contribution towards economic growth by analysing it statistically and identifying the major sectorial contribution to economic growth.

## 4.1. Sector wise contribution

Goa's economy features diverse sectors that contribute to its growth. Agriculture, primarily cultivating rice, coconuts, cashew nuts, and fishing, remains a significant part of the state's economy. The industrial landscape includes small-scale manufacturing units producing processed fish, beverages, and pharmaceuticals. Additionally, the service sector in Goa encompasses tourism, retail, healthcare, education, and real estate, forming a vital part of the state's economic activities.
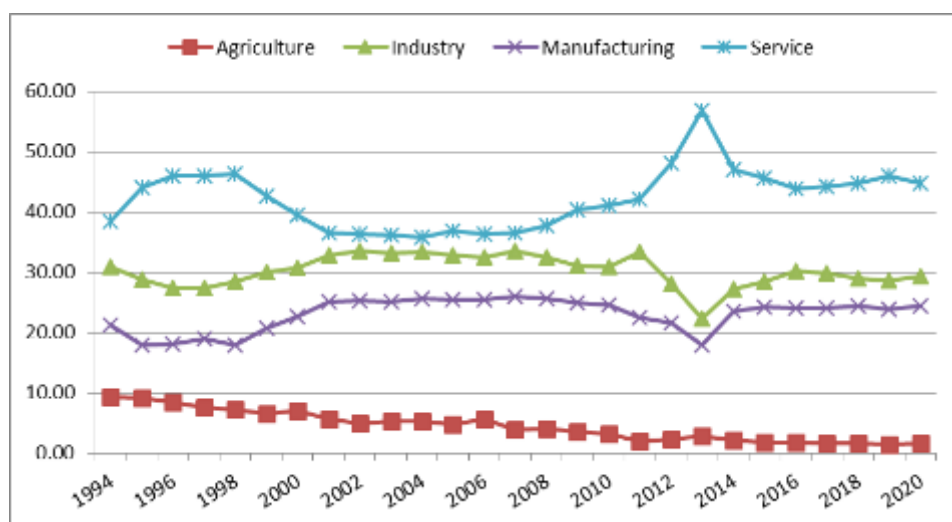


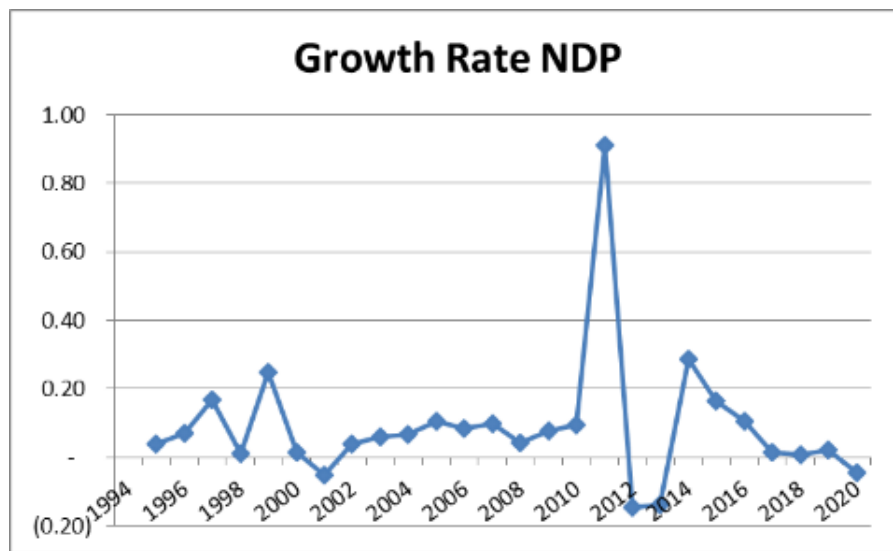Source: RBI statistical handbook (various years)

**Figure 1** Goa's sectorial contribution to economic growth from 1994-2020(in percentage)

The data presented in fig.-1 shows the percentage contributions of various sectors—Agriculture, Industry, Manufacturing, and Service—in Goa's Net State Domestic Product (NSDP) from 1994 to 2020. This information is crucial in understanding the economic evolution and the changing dynamics of Goa's economy over the years. Agriculture, while initially holding a substantial percentage share in the mid-'90s, experienced a consistent decline in its contribution to the NSDP. It started at approximately 9-9.3 per cent in the mid-'90s but steadily reduced to around 1.5 per cent by 2020. This decline might signify a gradual shift away from an agrarian-based economy towards other sectors.

The Industry sector, inclusive of manufacturing, showed a relatively stable presence, maintaining a percentage share ranging from the high 20s to the early 30s over the years. The combined contribution of Industry and Manufacturing remained consistent, depicting a consistent and significant presence in the state's economic output. In contrast, the Service sector showcased a steady increase, starting at around 38.5 per cent in the mid-'90s and reaching around 46 per cent by 2020. This steady rise points towards a growing emphasis on service-oriented industries in Goa's economy, especially as the tourism and hospitality sectors within the Service segment hold significant importance for the state.

The trends suggest a transition in Goa's economy from a more agriculturally driven structure to one increasingly dominated by the Service sector, while the Industry and Manufacturing sectors maintain a steady and significant presence. This shift might reflect Goa's adaptation to changing economic landscapes, embracing services and industries, particularly in response to global economic changes and local developmental needs. The sudden increase in Goa's service sector and the concurrent decrease in its industry and manufacturing sectors can be attributed to the region's growing emphasis on tourism and service-related industries, buoyed by global economic shifts favoring service-oriented economies, technological advancements, changing consumer demands, and evolving labor force dynamics. Government policies, coupled with changing market preferences, have likely encouraged a shift towards service-oriented sectors, while factors such as globalization, technological advancements, and potentially declining competitiveness in traditional manufacturing may have contributed to the decrease in the industry and manufacturing sectors. This transition underscores the need for strategic economic planning and diversification to ensure a balanced and sustainable economic growth in Goa.

However, the diminishing contribution of the Agriculture sector raises concerns about sustainability and diversification within the state's economic framework. It emphasizes the importance of balancing growth across sectors to ensure a robust and diverse economic foundation, securing long-term economic stability for the state. The fluctuations across sectors over the years highlight the evolving nature of Goa's economy and the need for strategic planning and policies to ensure balanced growth and sustainability across all sectors.



Source: RBI statistical handbook (various years)

**Figure 2** Goa's economic growth rate (NDP) from 1994-2020

In fig.-2 displays the Net State Domestic Product (NSDP) growth rates for Goa, spanning from 1995 to 2020, reveal a fluctuating economic landscape. Over these years, the state witnessed varying trends in its economic growth, marked by sporadic peaks and troughs. Periods of robust expansion, evident in years like 1999, 2005, 2011, and 2014, were contrasted by phases of economic contraction or minimal growth, notably observed in 2001, 2012, 2013, and 2020. These fluctuations indicate the vulnerability of Goa's economy to diverse internal and external factors, such as shifts in the tourism industry, global economic conditions, policy changes, pandemics and environmental concerns like mining bans. The data underscores the necessity for strategies and policies that promote more stable and sustained economic growth, reducing the susceptibility of the economy to external shocks and fostering consistency in Goa's economic trajectory.

## 4.2. Statistical analysis

This section uses various statistical tools to analyze relationships and model adequacy. Pearson correlation was utilized to measure the strength of linear associations, while long-run and short-run cointegration techniques helped assess the equilibrium relationships among non-stationary time series data, offering insights into long-term and short-term dynamics between variables. Furthermore, model adequacy tests, encompassing goodness-of-fit measures and diagnostic tests, ensured the accuracy and reliability of the models developed, verifying their suitability in representing and predicting the studied phenomena.

**Table 1** Unit Root Test

| Augmented Dickey Fuller Test (ADF) | | |
|---|---|---|
| | **At Level** | **At 1st Difference** |
| NSDP | -710318 | -5.191625 * |
| Agriculture | -2.504142 | -6.748765 * |
| Industry | -1.039381 | -6.368687 * |
| Manufacturing | -1.299125 | -6.149835 * |
| Service | -0.754439 | -4713007 * |

Note: ***, ** and * refers the non-acceptance of null hypothesis at 10 %, 5 % and 1 % of significance respectively; Source: Author's calculation

The table-1 presents Augmented Dickey Fuller (ADF) unit root test results for various economic indicators in Goa, analyzing both the original (level) and differenced data. At the initial level, all indicators—NSDP, Agriculture, Industry, Manufacturing, and Service—showed non-stationarity, as indicated by ADF test statistics surpassing critical values at a 1 per cent significance level, rejecting the null hypothesis. However, after taking the first difference, the data became stationary, evidenced by ADF test statistics falling below critical values at a 1 per cent significance level, signifying the variables' transformation to stationarity. This implies that the variables exhibited stationary behavior after a first-order differencing, validating their suitability for time series analysis.

**Table 2** Pearson Correlation

| Pearson Correlation Coefficient Results | | | | |
|---|---|---|---|---|
| | **NSDP_L** | **Agr_L** | **Ind_L** | **Maf_L** |
| Agr_L | 0.2721 | -- | -- | -- |
| Ind_L | 0.9379 | 0.1527 | -- | -- |
| Maf_L | 0.8408 | 0.1789 | 0.9489 | -- |
| Ser_L | 0.8905 | 0.3227 | 0.6904 | 0.5743 |

Correlation coefficients, using the observations 1995-2020 at 5 per cent critical value; Note: NSDP_L is log differenced Net State Domestic Product; Agr_L is log differenced for Agriculture; Ind_L is log differenced for Industry; Maf_L is log differenced for Manufacturing; Ser_L is log differenced for Service; Source: Author's calculation

The table-2 shows the Pearson Correlation Coefficient results, analyzing the relationships between various economic indicators in Goa from 1995 to 2020. The values represent the strength and direction of linear associations between log-differenced variables. The coefficients indicate the degree of correlation between different sectors. For instance, NSDP shows a strong positive correlation with Industry (0.9379), Manufacturing (0.8408), and Services (0.8905), while Agriculture exhibits relatively weaker positive correlations with other sectors. The correlations signify the interdependence and relationships among these economic factors during the specified period, providing insights into their concurrent movements and associations.

The table-3 illustrates the Long Run Causality analysis, showcasing the impact of different economic sectors on the long-term economic growth (NSDP_L) of Goa. The results reveal significant causality effects of certain sectors on NSDP. Industrial (Ind_L) and Service (Ser_L) sectors exhibit substantial positive influences on economic growth, with coefficients of 0.4773 and 0.4659, respectively. Agriculture (Agr_L) also shows a positive effect, although comparatively smaller with a coefficient of 0.0921. However, the Manufacturing (Maf_L) sector demonstrates a non-significant influence on NSDP_L, as its coefficient is both relatively small and statistically insignificant. This analysis suggests that the Industry and Service sectors play significant roles in driving long-term economic growth in Goa, while Agriculture shows a more moderate impact, whereas Manufacturing does not exhibit a statistically significant long-term causal effect on the state's economic growth during the period under study. Thus, the study does not find enough evidence to reject and accept the hypothesis that is "***Sectorial contributions significantly impact Goa's economic growth, with at least one sector playing a more dominant role than others in influencing the state's economic development***".

**Table 3** Long Run Causality

| Dependent variable: NSDP_L (Economic Growth) | | | | |
|---|---|---|---|---|
| **Explanatory** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| Agr_L | 0.092114 | 0.027037 | 3.406930 | 0.0043* |
| Ind_L | 0.477313 | 0.052899 | 9.023061 | 0.0000* |
| Maf_L | -0.087484 | 0.058317 | -1.500132 | 0.1558 |
| Ser_L | 0.465916 | 0.024961 | 18.666000 | 0.0000* |
| Constant | 0.006211 | 0.003531 | 1.758958 | 0.1004 |

Note: ***, ** and * refers the non-acceptance of null hypothesis at 10 %, 5 % and 1 % of significance respectively and Std. Error denotes Standard Error. NSDP_L is log differenced Net State Domestic Product; Agr_L is log differenced for agriculture; Ind_L is log differenced for industry; Maf_L is log differenced for manufacturing; Ser_L is log differenced for service; Source: Author's calculation

**Table 4** Short Run Causality

| Dependent variable: NSDP_L (Economic Growth) | | | | |
|---|---|---|---|---|
| Explanatory | Coefficient | Std. Error | t-Statistic | Prob. |
| Agr_L | 0.073542 | 0.016815 | 4.373512 | 0.0006* |
| Ind_L | 0.029963 | 0.011261 | 2.660783 | 0.0186** |
| Maf_L | -0.149968 | 0.037623 | -3.986082 | 0.0014* |
| Ser_L | 0.494029 | 0.021490 | 22.988309 | 0.0000* |
| ADJUSTMENT (EC) | -1.060340 | 0.047728 | -22.216232 | 0.0000* |

Note: ***, ** and * refers the non-acceptance of null hypothesis at 10 %, 5 % and 1 % of significance respectively and S.E denotes Standard Error. EC refers Error Correction. NSDP_L is log differenced Net State Domestic Product; Agr_L is log differenced for agriculture; Ind_L is log differenced for industry; Maf_L is log differenced for manufacturing; Ser_L is log differenced for service; Source: Author's calculation

The table-4 analyse the Short Run Causality, indicating the impact of various economic sectors on short-term economic growth (NSDP_L) in Goa. The results reveal the causal effects of different sectors on short-term economic growth. Service (Ser_L) displays a strong positive influence on short-term economic growth, indicated by a substantial coefficient of 0.4940. Agriculture (Agr_L) and Manufacturing (Maf_L) also exhibit positive impacts, albeit relatively smaller, with coefficients of 0.0735 and -0.1500, respectively. However, the Industrial sector (Ind_L) demonstrates a minor yet statistically significant impact on short-term economic growth, with a coefficient of 0.0299. The Error Correction term (EC) is significant with a coefficient of -1.0603, suggesting that the system corrects short-term deviations from the long-term equilibrium at a rate of about 106 per cent. This analysis implies that while Services show a substantial immediate impact, Agriculture, Manufacturing, and a lesser extent Industry contribute to short-term economic growth in Goa, with the system correcting deviations from long-term equilibrium at a notable rate.

**Table 5** Model Adequacy Test

| **Diagnostic Test** | **p-value** |
|---|---|
| Lagrange Multiplier Test (autocorrelation) | 0.39 |
| Normality Test | 0.54 |
| R-Squared | 0.77 |

Source: Estimated from Eviews and STATA

The table-5 examines the results of the Model Adequacy Test used to assess the validity and reliability of the model employed in the study for analyzing Goa's economic indicators. The Lagrange Multiplier Test, used to detect autocorrelation in the model, returned a p-value of 0.39, suggesting no significant autocorrelation issues. The Normality Test yielded a p-value of 0.54, indicating that the model's errors are normally distributed. The R-squared value of 0.77 signifies that the model explains approximately 77 per cent of the variation in the dependent variable, demonstrating a

relatively strong goodness-of-fit. These results from Eviews and STATA suggest that the model used in the analysis adequately fits the data, as it displays no significant autocorrelation or normality issues, while also explaining a substantial portion of the variation in the economic indicators under investigation.

## 5. Conclusion

The comprehensive analysis of Goa's economic landscape, spanning from 1994 to 2020, reveals significant shifts in sector-wise contributions and economic growth dynamics. The data illustrates a noteworthy transition from an agrarian-driven economy to one increasingly dominated by the service sector. While Agriculture showed a substantial decline in its contribution to the Gross State Domestic Product (GSDP), the Service sector steadily rose, reflecting a shifting economic emphasis. The Industry and Manufacturing sectors maintained consistent, although the statistical analysis reveals that Manufacturing's influence on Goa's long-term economic growth is statistically insignificant. This insignificance could be attributed to several factors, including a limited diversity of manufactured goods, restricted market penetration, and potential stagnation in innovation or technological advancement within the sector. Additionally, a lack of substantial investments or policies directed towards enhancing manufacturing's competitiveness and adaptability might have contributed to its limited impact on long-term economic growth. The Service sector's ascent indicating a growing reliance on service-oriented industries, notably in tourism and hospitality. This transition highlights the necessity for balanced economic planning and diversification to ensure sustained and diverse economic growth in Goa. The fluctuations observed in Goa's Net State Domestic Product (NSDP) growth rates underscore the economy's vulnerability to external factors, necessitating strategies for stable and sustained growth. The statistical analyses reveal the significance of sectors like Industry and Services in driving long-term economic growth, emphasizing the need for strategic planning for economic stability and growth. The model adequacy tests signify that the employed model accurately represents the economic indicators under investigation. This study stresses the importance of balanced growth across sectors and highlights the evolving nature of Goa's economy, urging strategic planning and policies for balanced growth and sustainability.

## Compliance with ethical standards

*Disclosure of conflict of interest*

No conflict of interest to be disclosed.

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