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Assessing Fiscal Sustainability: A Comprehensive Analysis of Brazil's Continuous Cash Benefit (BPC) Program

By Thais Salzer Procópio

Abstract- This paper analyzes the Brazilian social benefit known as Continuous Cash Benefit Programme (BPC), considering its rules, resource utilization, potential impacts, and adverse effects on society. The literature review was based on the Austrian Theory of Economic Intervention. We observed that the BPC needs to be reassessed regarding values, long-term sustainability, and control of adverse effects. Results showed that the value of the BPC per capita is higher than the value of other social benefits in Brazil. 37% of the budget for the analyzed social programs is allocated to the BPC, but it reaches only 18% of the total number of beneficiaries. The benefit amount is also higher than the nominal per capita household income of more than 40% of the Brazilian Federal Units. Since the BPC amount is tied to the minimum wage, which historically experiences real increases in value, and Brazilian data indicate a process of population aging, we expect that expenditures on the benefit will significantly rise in the coming decades.

Keywords: social protection, continuous cash benefit program, public expenditure, government intervention.

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Keywords: social protection, continuous cash benefit program, public expenditure, government intervention.

The opinions expressed in this article are the sole responsibility of the author and do not necessarily reflect the position of the organizations to which she is affiliated or assigned.

I. Introduction

Interventionism in Brazil is communicated to society through 'goodwill packages,' impacting various population groups to varying degrees. Each measure may appear well-intentioned, aiming for social well-being, and the groups benefiting from these interventions may seem deserving. But are the results of interventionist measures satisfactory for society as a whole?

Brazilian economic indicators reflect a high degree of government intervention in the country: General Government expenses reached a level close to 50% of GDP in 2022[1], the tax burden is close to 35% of GDP[2], and we have a public debt close to 90% of GDP by the IMF[3] methodology. Despite these data signaling a high degree of state intervention in the economy, the feeling is that the return brought to society is not commensurate with the promised and expected results, given such interference.

One of this government interventions is the Continuous Cash Benefit Program (BPC). BPC is a Brazilian social benefit, provided for in Law 8,742 of December 7, 1993, known as the Organic Law of Social Assistance (LOAS), which guarantees a monthly minimum wage to individuals with disabilities of any age and to elderly individuals aged 65 (sixty-five) or older who can prove they do not have the means to provide for their maintenance or have it delivered by their family.[4] This benefit is part of the group of interventionist measures aimed at social assistance provided by the Brazilian government. Despite its good intentions, as resources are scarce, and the benefit is paid with the population's funds, it should be evaluated in light of its overall effects on society, its cost-benefit analysis, and possible points for improvement in its formulation/ implementation.

In this context, the primary aim of this study is to undertake a thorough analysis of Brazil's Continuous Cash Benefit (BPC), scrutinizing its regulations, resource allocation, potential consequences, and societal drawbacks. The methodology adopted is bibliographic research discussed through the data analysis related to the benefit under review and other existing benefits in Brazil. The following factors will be analyzed: (a) the budget allocated to this benefit, both in total and by type of beneficiary, (b) a comparison of the relationship between the cost of the benefit and the total number of BPC beneficiaries with the Bolsa Familia program, (c) the evolution of expenses related to BPC and its link to the minimum wage, (d) an analysis of the potential increase in the cost of the benefit according to the age

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[1] https://sisweb.tesouro.gov.br/apex/f?p=2501:9:::9:P9_ID_PUBLICACAO:44070#:~:text=A%20despesa%20total%20do%20Governo,39%2C8%25%20do%20PIB.

[2] https://sisweb.tesouro.gov.br/apex/f?p=2501:9:::9:P9_ID_PUBLICACAO:43205#:~:text=Em%202021%2C%20a%20carga%20tribut%C3%A1ria,PIB%20em%20rela%C3%A7%C3%A3o%20a%202020.

[3] By the methodology of the National Treasury, the public debt is close to 80% of GDP.

[4] The direct rule established to qualify for the BPC is that the per capita income of the family group of the individual seeking the benefit should be equal to or less than 1/4 of the minimum wage. Nonetheless, a considerable number of beneficiaries do not meet these criteria but still manage to obtain the benefit through legal channels, demonstrating their inability to sustain themselves or receive support from their families.

pyramid of Brazil, (e) an analysis of the BPC value considering the distribution of poverty by age group in Brazil, and (f) adverse effects of BPC on the Brazilian social security system.

The Austrian Theory of Interventionism forms the main theoretical framework, providing insights for the discussion proposed here. The main works used for the academic discussion in this study are Mises (1977), Mises (1990), Hayek (1987) and Rothbard (2009).

In addition to this introduction, this work is organized as follows: Section 2 presents the theoretical foundation of the study. Subsequently, in section 3, an analysis of the general data of BPC, its characteristics, and its distribution among beneficiaries is conducted. Finally, the last section presents the study's conclusion.

II. Literature Review

According to prominent authors from the Austrian School of Economics, state intervention, even when well-intentioned with the goal of rectifying market failures or improving the social conditions of a population, can lead to adverse consequences for society. (Mises (1990), Mises (1977), Hayek (2001), Rothbard (2009)).

Mises (1977) defined intervention as “a limited order by a social authority forcing the owners of the means of production and entrepreneurs to employ their means in a different manner than they otherwise would”.

The author distinguishes two groups of state intervention adopted by government authorities with the aim of altering consumption in relation to what would occur in a market economy. They are interference through restrictions and interference through price controls.

The interference through restrictions can be exemplified by trade barriers imposed. The interference through price controls can be exemplified by policies of maximum and minimum prices, as seen in the setting of interest rates and minimum wage floors.

This definition of interventionism, according to Lavoie (1982), can be considered relatively narrow as it excludes crucial aspects such as public spending, taxation, operation of state industries, subsidized goods supply, and other forms of interventions. In this context, Rothbard (2009) expands the scope of Mises' analysis. The author defines state intervention as ‘the intrusion of aggressive physical force into society; it means the substitution of coercion for voluntary actions.”

The author identifies three comprehensive types of government intervention: autistic intervention, binary intervention and triangular intervention. Autistic intervention occurs when an agent, which can be the government, coerces an individual without receiving any goods or services in return.

Binary intervention occurs when the state compels someone to make an exchange or unilaterally offer goods or services (for exemple, taxes and government expenditure). Triangular intervention occurs when a third party (state) interferes in the exchange relationships of other agentes such as, for instance, through price or product control. Interventionism is often justified in classical theory by the existence of so-called 'market failures.' This situation theoretically occurs when the free market fails to achieve efficient resource allocation through the voluntary interaction of acting agents. In this case, according to theory, state intervention may be considered justifiable to achieve more efficient market allocations and enhance overall societal well-being.

However, even from this classical perspective, there is a necessity to analyze the cost-benefit relationship of government intervention. In addition to creating market distortions and affecting individual choices, the intervention entails costs for the population, as it is financed with public resources, typically sourced from taxes and borrowing. In this context, as stated by Gianturco (2017), it's important to note that state failures can, at times, be even more significant than potential market failures. Within the public choice theory, state failures result from unachieved or undesirable policy outcomes formulated by imperfect human decision-makers.

a) Interventionism aimed at social benefits

Most government intervention measures use resources from society and redirect these resources for purposes determined by those in government, as explained by Rothbard (2012). Aids and social benefits, such as the Continuous Cash Benefit (BPC), are called 'free' for society. However, according to Rothbard (2012), a genuinely free good should be abundant for everyone. If a good is not abundant for everyone, it shows that this resource is scarce, and offering it 'freely' costs society the loss of other goods.

According to the author, the resources required to supply the government's free service are taken from the remainder of production. However, payments are not made by users through voluntary purchases but rather through mandatory contributions from taxpayers. A fundamental division is made between payment and receipt of the service.

As we have observed, the BPC is a measure designed to ensure a minimum income for specific segments of society who lack the resources to support themselves or receive support from their families. Hayek (2001) discusses the importance of guaranteeing a minimum of subsistence means for everyone. In the author's perspective, economic security is often presented as an indispensable condition for genuine freedom.

According to the author, in a society that has attained a certain level of overall prosperity, there is no justification for not ensuring basic security for all

individuals without it being considered a privilege, while still upholding the overall freedom of the society. However, Hayek (2001) clarifies that the idea of economic security is vague, and the general approval of the security claim can become a danger to freedom.

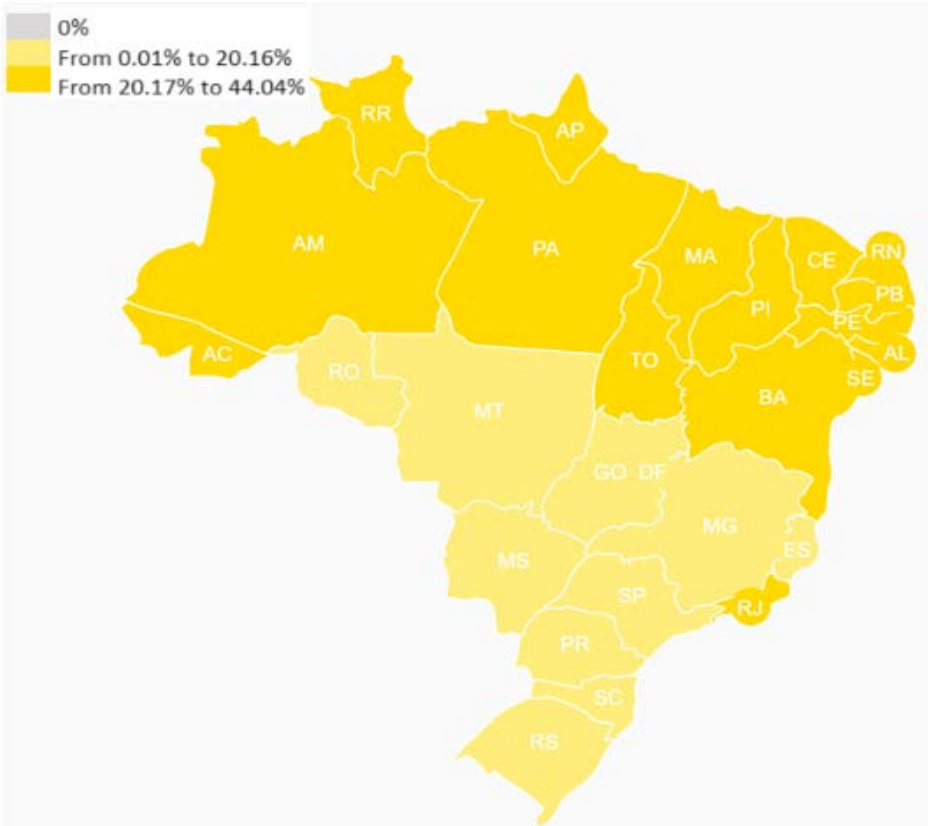
This demonstrates the author's concern regarding policies offering social benefits, as often their needs will be subjective, and they may be provided to some at the cost of others' freedom.

III. Analysis of BPC Data

a) General Analysis of Citizen Benefits in Brazil

Data from the first half of 2023[5] reveals that in Brazil, the primary social benefits extended to citizens ('Auxílio Brasil', 'Bolsa Família', 'BPC', 'Garantia-Safra', and 'Seguro Defeso') reached over 46 million recipients, which is roughly 25% of the population. The total disbursement for these benefits during the first half of 2023amounted to R$ 111.8 billion.

Considering Brazil's vast territorial expanse, it is crucial to analyze the regional distribution of these benefits. The figure 1 below illustrates the comparison of benefits by location in Brazil, displaying the percentage range of the population in each Federal Unit that receives some of the listed social benefits mentioned earlier. It becomes apparent that there is a significant variation in the demand for these benefits across the country, with a concentration in the Northern and Northeastern regions. Notably, these regions, which have a higher concentration of these benefits, generally coincide with areas characterized by lower average income in the country.[6] Furthermore, these regions have also witnessed higher rates of labor underutilization[7] and informal employment[8] in recent years.



Source: https://portaldatransparencia.gov.br/beneficios

Figure 1: Comparative benefits by location (1st semester of 2023)

The chart below, figure 2, illustrates the allocation of resources among the various social programs mentioned earlier. We can observe that 37% (R$ 41 billion) of the funds allocated to benefits are directed to the BPC, which is the focus of our study. When we consider the number of individuals who received the BPC in the first half of 2023, we reach 5,451,640 beneficiaries, representing 18% of the total number of beneficiaries covered by all the programs under analysis.

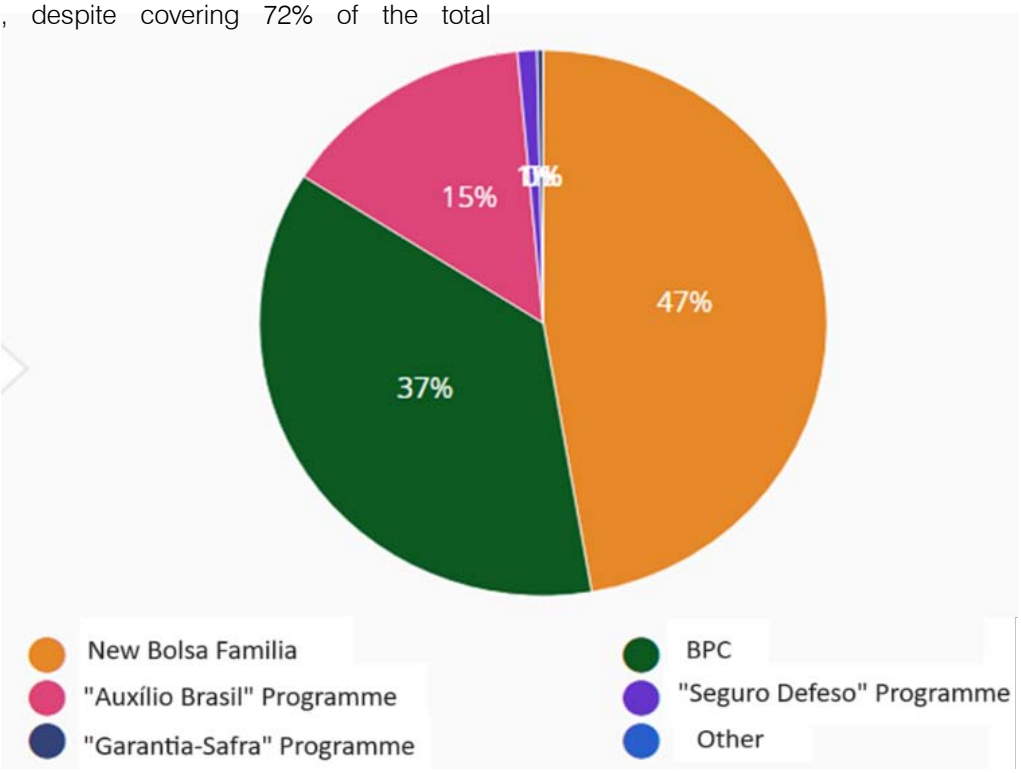
[5] Fonte: portaldatransparencia.gov.br

[6] According to the Wealth Map of Brazil: https://cps.fgv.br/riqueza

[7] According to data from IBGE: https://biblioteca.ibge.gov.br/visualizecao/livros/liv101979.pdf

[8] According "fundo Brasil": https://www.fundobrasil.org.br/wp-content/uploads/2023/01/mapeamento-trabalho-informal-corte1-1.pdf

This data indicates that the value allocated to each beneficiary of the BPC is higher than the per capita amount distributed to beneficiaries of other programs. For example, despite covering 72% of the total beneficiaries, Bolsa Família (income transfer program in Brazil) corresponds to only 47% of the total value allocated to benefits.



Source: https://portaldatransparencia.gov.br/beneficios

Figure 2: Benefit Value by Type of Benefit (First Semester of 2023)

b) Analysis of Beneficiaries of the Continuous Cash Benefit (BPC) Based on Data from the Year 2022

In this section, we will analyze the BPC data from the year 2022. As explored in the introduction, the BPC, a social benefit provided by Law 8,742 of December 7, 1993, known as the Organic Law of Social Assistance (LOAS), guarantees a monthly minimum wage to individuals with disabilities and elderly individuals aged 65 or older who can prove that they do not have the means to provide for their maintenance or have it delivered by their family.

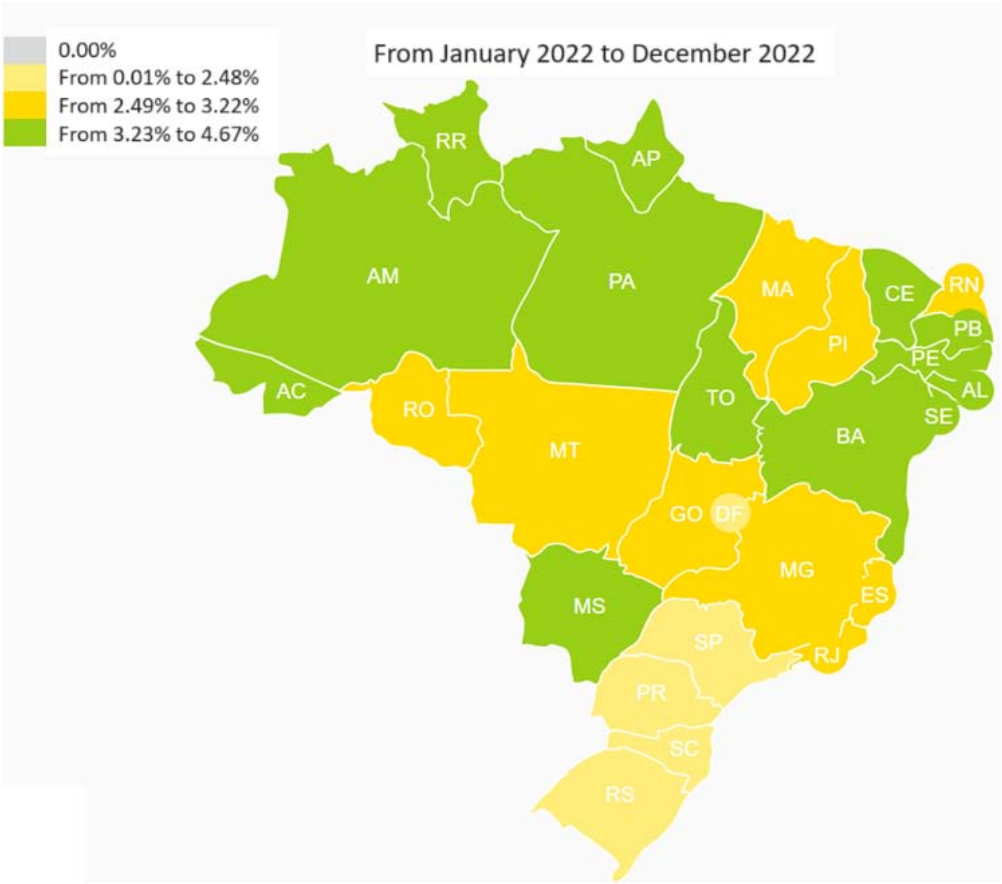
Following the mentioned law, those eligible to receive the benefit are individuals with disabilities or elderly individuals whose monthly per capita family income is equal to or less than 1/4 (one-quarter) of the minimum wage[9]. However, a significant portion of this benefit is granted through legal action to families with per capita income exceeding 1/4 of the minimum wage, provided that it can be demonstrated that the beneficiary lacks the means to maintain themselves with dignity.

The cost to public accounts for this benefit is significant. In 2022, the total expenditure on the BPC was R$ 70.9 billion[10]. Out of this total, R$ 38.5 billion (54%) were designated to People with Disabilities (PCD), while R$ 32.4 billion (46%) were allocated based on an age criterion. In December 2022, approximately 2.77 million PCD and 2.34 million elderly individuals received the monthly benet, totaling more than 5.1 million beneficiaries.

Regarding the Brazilian Federative Units with the highest proportion of their population benefiting from the BPC, it is observed that, in general, the concentration of this benefit is higher among people in the North and Northeast regions. This distribution shows similarities with the map of aggregated benefit distribution, as seen in Figure 3, and seems to be consistent with the socioeconomic situation of the country, as the target audience for this benefit consists of individuals with low per capita family income. These regions generally have the poorest socioeconomic indicators in the country.

[9] Destaca-se que existem iniciativas, inclusive proposição já aprovada no congresso, o Projeto de Lei do Senado nº 55, de 1996, (porém vetada pelo presidente, e suspensa pelo TCU após derrubada de veto), que buscam elevar o limite de renda familiar per capita para fins de concessão do BPC, de 1/4 de salário mínimo para 1/2 salário mínimo

[10] Fonte: https://www.mds.gov.br/relcrys/bpc/docs/downloads/2022/DezTodos.pdf



Source: https://portaldatransparencia.gov.br/beneficios

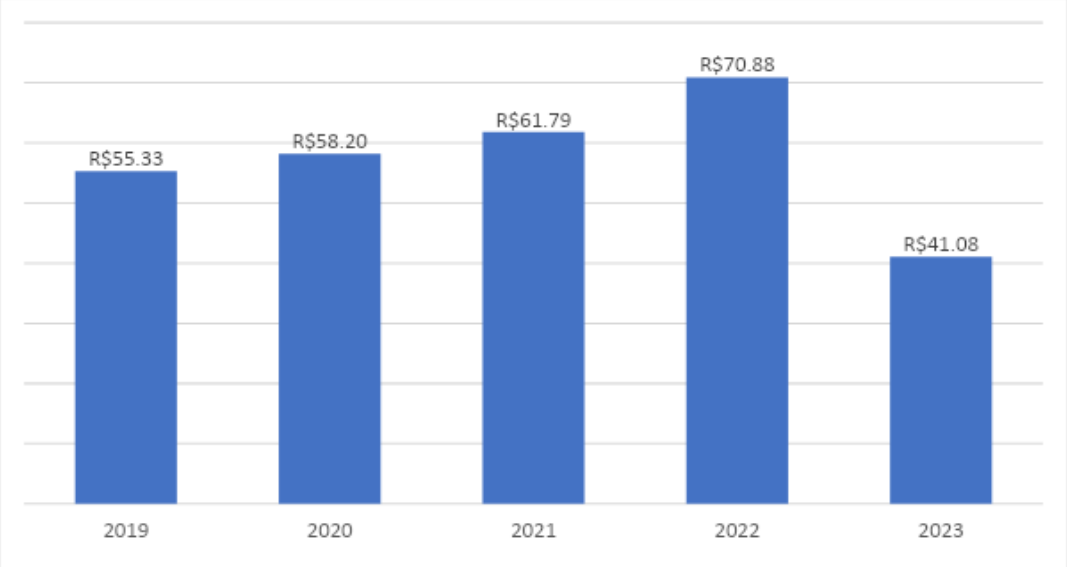
Figure 3: Comparative BPC by location (2022)

c) *Evolution of BPC Expenditures and its Linkage to the Minimum Wage*

Figure 4 illustrates the trend in BPC expenditures over the years using nominal data. Increases in nominal and real benefit values have been observed over the years. Since the BPC value is linked to the minimum wage, increases in the minimum wage value, while keeping the total number of beneficiaries constant, also increase total BPC expenditures.

This information becomes more relevant when considering the real increases in Brazil's minimum wage over the years. According to the OECD Economic Report: Brazil 2018[11], the real minimum wage in 2018 was 80% higher than the minimum wage in 2003. By way of comparison, the per capita GDP of the country only saw a 23% increase over the same timeframe.

[11] https://www.gov.br/casacivil/pt-br/conteudo-de-regulacao/brasil-ocde/eventos/2018/ocde-lanca-survey-economico-de-2018-sobre-o-brasil-1/ocde-lanca-survey-economico-de-2018-sobre-o-brasil/survey_2018.pdf



Source: https://portaldatransparencia.gov.br/beneficios

Figure 4: Expenditure on BPC (in R$ billion)

The legislation mandates that the value of the BPC paid to its beneficiaries should be equivalent to one minimum wage. In Brazil, the minimum wage for the year 2022 was set at R$ 1,212.

Article 7 of the Federal Constitution of Brazil establishes the right of both urban and rural workers to receive a minimum wage, as determined by law. This minimum wage is nationally standardized and should be sufficient to cover both the basic essential needs of individuals and those of their families. The minimum wage should also undergo periodic adjustments to preserve its purchasing power.

When we compare the minimum wage value in 2022 with the nominal monthly per capita household income in the Federal Units of Brazil for the same year, we observe that the BPC amount exceeds the per capita income in 12 Federal Units, representing over 44% of the country's Federal Units. Figure 5, presented below, illustrates the nominal monthly per capita household income values by Federal Unit in 2022.

Brazilian federative units	Monthly nominal per capita household income of the resident population (R$)	Brazilian federative units	Monthly nominal per capita household income of the resident population (R$)
Brasil	1.625	Pernambuco	1.010
Rondônia	1.365	Alagoas	935
Acre	1.038	Sergipe	1.187
Amazonas	965	Bahia	1.010
Roraima[1]	1.242	Minas Gerais	1.529
Pará	1.061	Espírito Santo	1.723
Amapá	1.177	Rio de Janeiro	1.971
Tocantins	1.379	São Paulo	2.148
Maranhão	814	Paraná	1.846
Piauí	1.110	Santa Catarina	2.018
Ceará	1.050	Rio Grande do Sul	2.087
Rio Grande do Norte	1.267	Mato Grosso do Sul	1.839
Paraíba	1.096	Mato Grosso	1.674
		Goiás	1.619

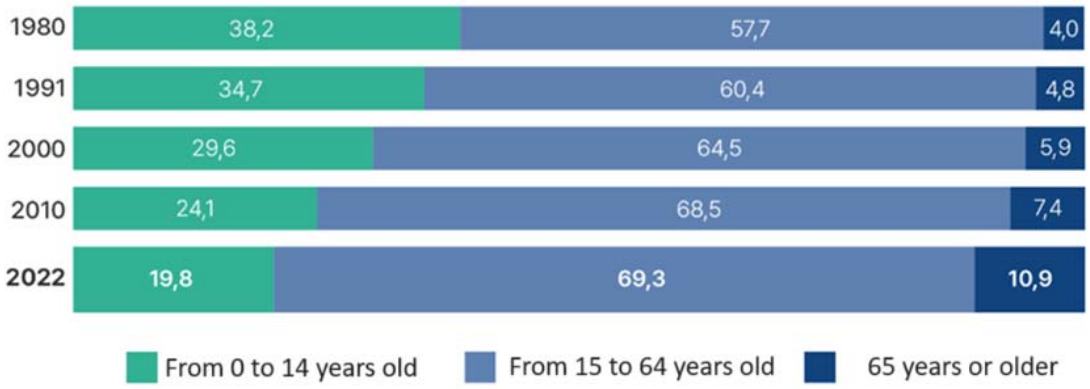
Fonte: IBGE, Diretoria de Pesquisas, Coordenação de Pesquisas por Amostra de Domicílios, Pesquisa Nacional por Amostra de Domicílios Contínua - PNAD Contínua - 2022.

Source: IBGE – PNAD

Figure 5: Nominal Monthly Per Capita Household Income by Federal Units in 2022

d) BPC and Brazil's Age Pyramid

We have observed that approximately 45% of the BPC is allocated to the elderly (individuals aged 65 or older who qualify for the benefit). Data on the proportion of the resident population in Brazil by age group indicate that the country is experiencing a demographic aging process, as illustrated in Figure 6.

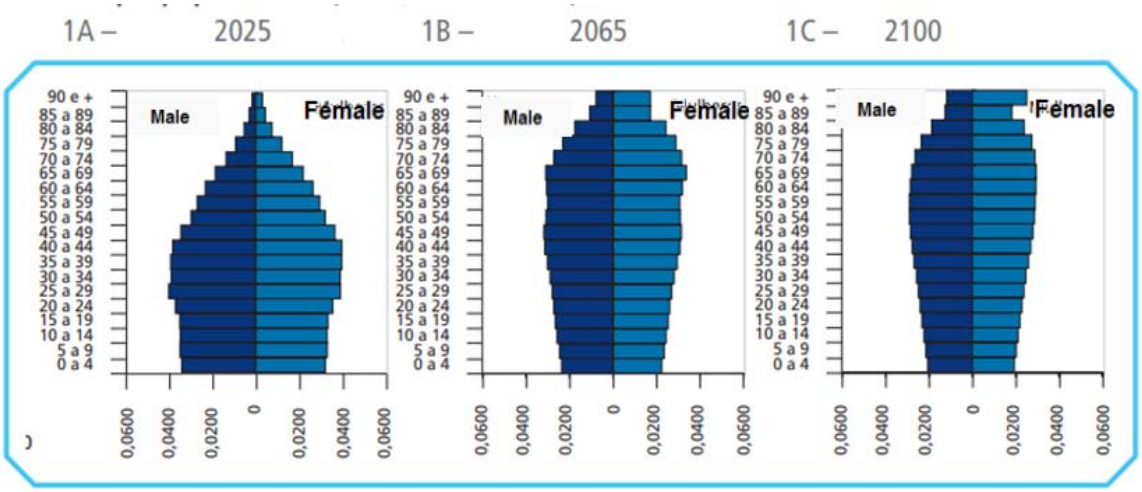


Source: Censo 2022

Figure 6: Proportion of the Resident Population in Brazil by Age Groups

Bonifácio and Guimarães (2021) have illustrated that there is still a significant expectation of change in the country's age distribution, with a decrease in the close share of the younger population (up to 15 years old) and an increase in the relative share of the elderly population (above 65 years old). Figure 7 offersa visual representation of this demographic shift. Projections indicate that the population aged 65 and over is expected to increase from 9.8% in 2020 to nearly 30% by the year 2100.

In analyzing the BPC, this information deserves attention because the pool of individuals eligible to receive the benefit is likely to grow significantly. This could make the benefit financially and budgetarily unsustainable for the country in the coming decades.



Source: Bonifácio and Guimarães (2021)

Figure 7: Projected Age Pyramid Expectations of the Brazilian Population by Gender, in the Scenario outlined by IBGE/Ipea for the years 2025, 2065, and 2100

e) The Value of BPC Considering the Poverty Distribution by Age Group in Brazil

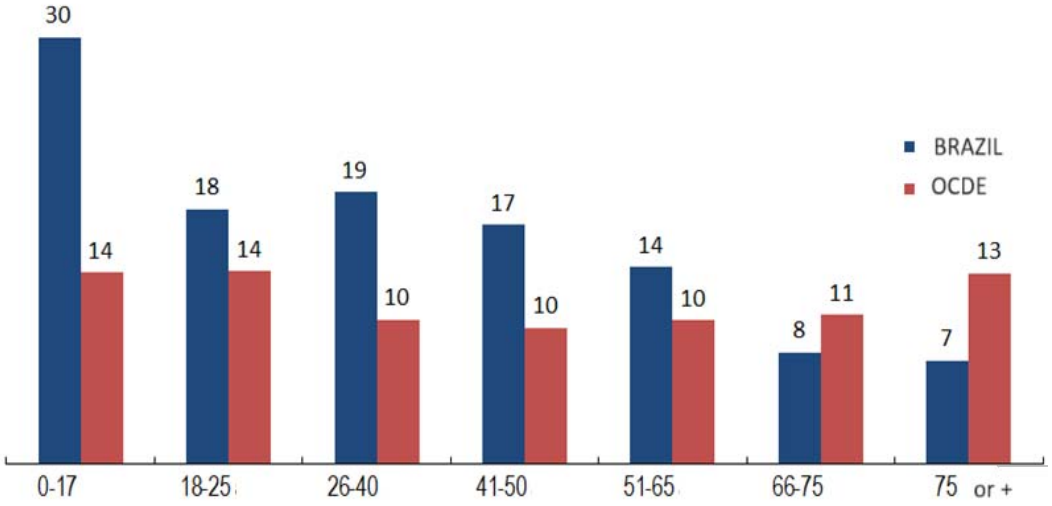
The Federal Constitution of Brazil establishes the value of the BPC linked to the minimum wage. According to the OECD Economic Report[12], the current minimum wage level is at least six times higher than the country's poverty line.

The distribution of poverty among age groups in Brazil, as depicted in Figure 3, highlights the lack of uniformity in poverty across the country. While 30% of

[12] https://www.gov.br/casacivil/pt-br/conteudo-de-regulacao/brasil-ocde/eventos/2018/ocde-lanca-survey-economico-de-2018-sobre-o-brasil-1/ocde-lanca-survey-economico-de-2018-sobre-o-brasil/survey_2018.pdf

the population between the ages of 0 and 17 are considered poor[13], among the elderly (aged over 65), this proportion is approximately 8%.

These data become even more noteworthy when comparing the proportions of poverty across age groups with other countries. Considering OECD countries, not only do they exhibit more excellent uniformity in the distribution of poverty by age group, but the proportion of young people below the poverty threshold is much lower than that of Brazil.



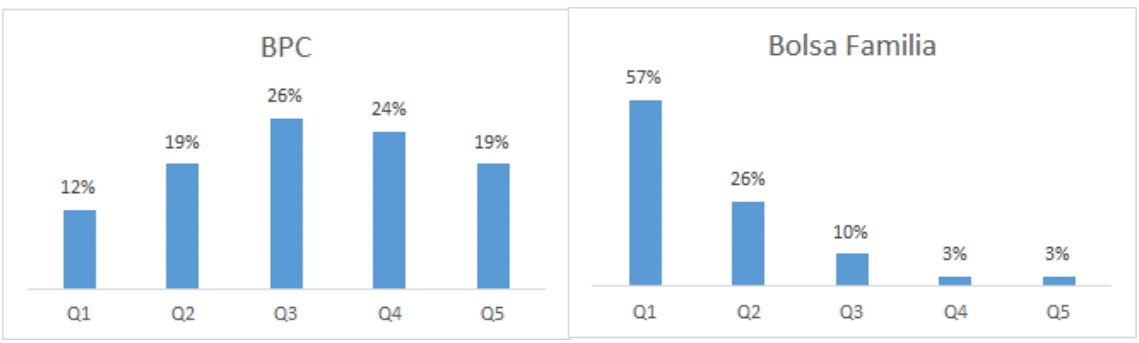
Source: OECD Income Distribution Database (IDD)

Figure 8: Poverty Distribution by Age Groups (In %)

In this context, although the BPC aims to target the poorest population, it is not a policy aimed at reducing inequality among age groups in Brazil, as a significant portion of its resources is directed towards individuals over 65.

It's important to consider that, given Brazil's economic situation, the BPC provides relatively high benefits per individual, equivalent to one minimum wage. This value is relatively high because, according to data from IBGE, in 2018, the average income of the poorest 40% of Brazil's population was R$376, significantly below the benefit provided by the BPC (which was set at R$954 in 2018).

When comparing, for example, the BPC to the Bolsa Família Program (PBF), the PBF can be considered a well-targeted benefit and is the program that contributes the most to reducing inequality in Brazil. Most of its resources (57%) are directed towards the poorest quintile of the population, and approximately 90% of the total subsidy is received by the poorest 50%. This is not the case for the BPC transfer, as indicated by World Bank data. Figure 9 below illustrates the distributional analysis of subsidies for Bolsa Família and BPC by quintile of the population. A significant portion of the BPC is directed towards the portion of the population in the wealthiest quintiles. It is largely due to many of legal actions involving the benefit.



Source: World Bank

Figure 9: Distribution of Bolsa Família and BPC Subsidies by Quintile

[13] The poverty threshold defined by the IDD is set at 50% of the available median income in each country.

f) Adverse Effects of BPC: Conflict with Elderly and Social Security

The BPC aimed at the older people presents a direct conflicts with Brazil's social security system. It can be considered both assistive (as one needs to prove insufficient resources to receive it) and possess characteristics of a pension benefit since, in the case of the BPC for the older people, it serves the purpose of replacing the income of those who can no longer work, starting at the age of 65.

The conflict arises because to receive the benefit no contributions to the system are required, and the amount paid is the same as contributory benefits for those who contribute to social security.

To illustrate this conflict, TAFNER and NERY (2018) provide an example that vividly portrays the situation.

> "Consider two Brazilians: one contributed for 34 years, the other never. Suppose that the first insured individual always received one minimum wage. Both can only receive benefits at the age of 65 because they are not eligible for retirement due to the contribution period (which requires 35 years of contributions). The first is suitable for age-related retirement (starting with 15 years of contributions), while the second is not. However, the minimum pension and the assistance benefit floor are the same: one minimum wage. Due to the effects of tying Social Security to the minimum wage (as explained in the chapter on urban age-related retirement), 34 years of contributions would result in the minimum pension, which is precisely the same amount as the BPC.
>
> Both Brazilians would be eligible to receive a benefit at the same age and of the same value: 65 years old, with one minimum wage. One of them contributed for 34 years, and the other never did. Does this make sense? There is concern that these rules may discourage formalization and contributions. Clearly, having formal employment is not simply a matter of choice, at least for a significant portion of insured individuals, but the disincentive is there. Interestingly, there is an additional disincentive: the legislation allows for accumulating 2 BPC benefits in the same household (for example, an elderly couple). It means that the first received BPC is not counted when assessing the poverty condition for the second BPC. The law does not extend the same treatment to retirement benefits, potentially making it impossible to receive a BPC, even if they are of the same value. In practice, jurisprudence has extended the treatment of income received as BPC to exclude income from being considered part of the poverty line, even for pensions and retirement benefits of 1 minimum wage."
>
> (Note: This is a translation of the provided text.)

It demonstrates that this government intervention generates the adverse incentive of reducing contributions to social security, as the benefit of one minimum wage is offered to those who meet the BPC criteria, even if they have not contributed anything to social security throughout their lives.

IV. Conclusion

This study aimed to assess the BPC, a Brazilian social benefit that is part of the group of interventionist measures aimed at social assistance in the country and had a total cost of R$ 70.9 billion to public accounts in 2022.

The methodology adopted was bibliographic research discussed through the analysis of benefit data, considering its rules, resource utilization, potential impacts, and adverse effects on society. The Austrian Theory of Interventionism was chosen as the primary theoretical framework because it highlights the potential negative consequences arising from government interventionist measures.

It was noted that the per-recipient value of the BPC benefit exceeds that of other social benefits in Brazil. 37% of the budget of the analyzed social programs is allocated to the BPC, reaching only 18% of the total beneficiaries covered by all programs under review. Comparatively, the Bolsa Família program, for example, accounts for 47% of the total value allocated to benefits but reaches 72% of the total beneficiaries.

The value of the BPC benefit is also higher than the nominal monthly per capita household income of 44% of the Federative Units in Brazil.

Furthermore, concerning the financial sustainability of the benefit, worrisome factors were identified. Since the BPC benefit is linked to the minimum wage, and Brazil has a history of significant real increases in its value, expenditures on this program tend to rise over the years. From 2002 to 2022, for example, the real increase in the minimum wage was nearly 80%. Population aging should also be considered. Since approximately 45% of the BPC is allocated to the elderly, and Brazil is experiencing a demographic aging trend, it is anticipated that expenditures on this benefit will significantly rise in the forthcoming decades. The population aged 65 and over is expected to grow from 9.8% in 2020 to nearly 30% by 2100.

Finally, it was found that the BPC generates some adverse incentives. One is related to not contributing to the country's social security by a portion of the population that expects to qualify for the BPC when they retire. Another adverse incentive is related to the possibility of the benefit being subject to judicial proceedings, which leads to the distributional analysis of BPC subsidies by income quintile of the population showing that a significant portion of the benefit is directed towards the portion of the population in the wealthiest quintiles.

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Dynamics of Foreign Direct Investment in Rajasthan

By Pawan Kumar

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GJHSS-E Classification: LCC: HC1-999

Strictly as per the compliance and regulations of:

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Abstract- Rajasthan, a land of promises has received ₹ 1549.10 crore FDI inflows in 2019-20 and ₹ 6259.48 crore in 2022-23 which is about a 304 per cent increase in FDI inflows in the last four years. FDI inflows have grown at a Compound Annual Growth Rate (CAGR) of 33.23 percent in Rajasthan in the post-liberalization period in India. While the states are competing to attract more FDI inflows organize investor's summit and initiate policy reforms to facilitate investment opportunities in their region. This study aims to analyse determinants of FDI inflow in Rajasthan state which is a land-locked state with an abundance of natural resources and skilled manpower. Foreign Direct Investment (FDI) a non-debt-creating capital inflow stimulates employment generation, and fills the gap between domestic saving and investment. It is found that there is a direct relation between FDI inflows and the Gross Domestic Product growth of the host state.

It is a global phenomenon that FDI inflows create inter and intra-regional imbalances. Statically, Rajasthan falls in laggard states in terms of receiving FDI inflows which receive about 1 percent of the total FDI inflows of the country. However, Rajasthan receives the maximum FDI inflow share among the BIMARU states of India. This study attempts to investigate determinants of FDI in the state, highlights the bright opportunities and potential of the state to attract quite more FDI in sectors like Automobile, tourism, Metallurgical, Logistics and Food processing industry. Secondary data is obtained from Department for promotion of industries and internal trade (DIPIIT), Reserve bank of India (RBI) publications and The Directorate of Economics and Statistics (DES), using linear regression analysis on time series data. Though it is elusive to find determinants of FDI inflow. However, this study reveals that there is a strong correlation between FDI, SGDP, Infrastructure, and availability of credit and Net value Added by the industrial sector of the region.

Keywords: foreign direct investment, state gross domestic product, infrastructure and net value added.

I. Introduction

Equity was one of the prime objectives of the planning period in India (1950-1991). However, due to the policy implementation efficiency of a few regions, land reforms and green revolution could succeed only in a few states of India, especially in Punjab, Andhra Pradesh and Tamilnadu. Eventually, these states strengthened their economy fairly well. On the other hand, due to various limitations, other states could not grow at the same pace. Subsequently, there exists a regional imbalance in the Indian economy. Nowadays there is fierce competition in attracting FDI among states in India. There is the concentration of FDI inflows only in four states which leads to regional imbalances in the economy. The gross state domestic product (GSDP) of Rajasthan state has grown at a compound annual growth rate (CAGR) of 12.83 per cent from 2004-05 to 2014-15. It is viable to generate renewable energy sources and wind power in Rajasthan. Renewable Energy Corporation Ltd. (RRECL) has focused on the promotion of renewable energy projects, primarily on solar energy potential, wind energy and organic material-based biomass energy in the state. The region offers opportunities in the areas of organic farming, food processing industry, bio-diesel seeds farming as well as in building cold storages and warehouse development. Textiles, Gem, stones and Jewelry, and Agro-processed food are in high demand in the international market. The state exports to more than 200 countries, with major direction towards USA, Germany, UK, UAE, Japan and China. Rajasthan has improved its ease of doing rank year on year and did a major policy reform through Rajasthan Investment Promotion Scheme (RIPS) 2019, where many incentives were offered to manufacturing sector, MSME sector and Service sector as well as district level screening committees were formed to render the services to tourism sector and startups in Rajasthan. The state has launched Export Promotion Policy 2021 with the prime objective to achieve the global competitiveness. Rajasthan Export Promotion Council (REPC) and "RAJNIVESH" one contact point for all clearance initiatives are implemented. Capital injection from outside will definitely help the state to manage with fiscal deficits and infrastructure building as well as strengthening the human capital of the region. Rajasthan with presence of Japanese Industrial Zone and 03 operational Special Economic Zones. The state is found as one of the best states in facilitating setting up of business, complying with environment procedure, registering and complying with tax procedure, carrying out inspections in mission mode, it has consistently improved its Ease of Business Doing rank, its stand on 8th rank in 2019. Assessment of state implementation of Business Reforms, Report 2015, published by Department of Industrial Policy Promotion (DIPP), Govt. of India and World Bank ranked Rajasthan as 6th aspiring state.

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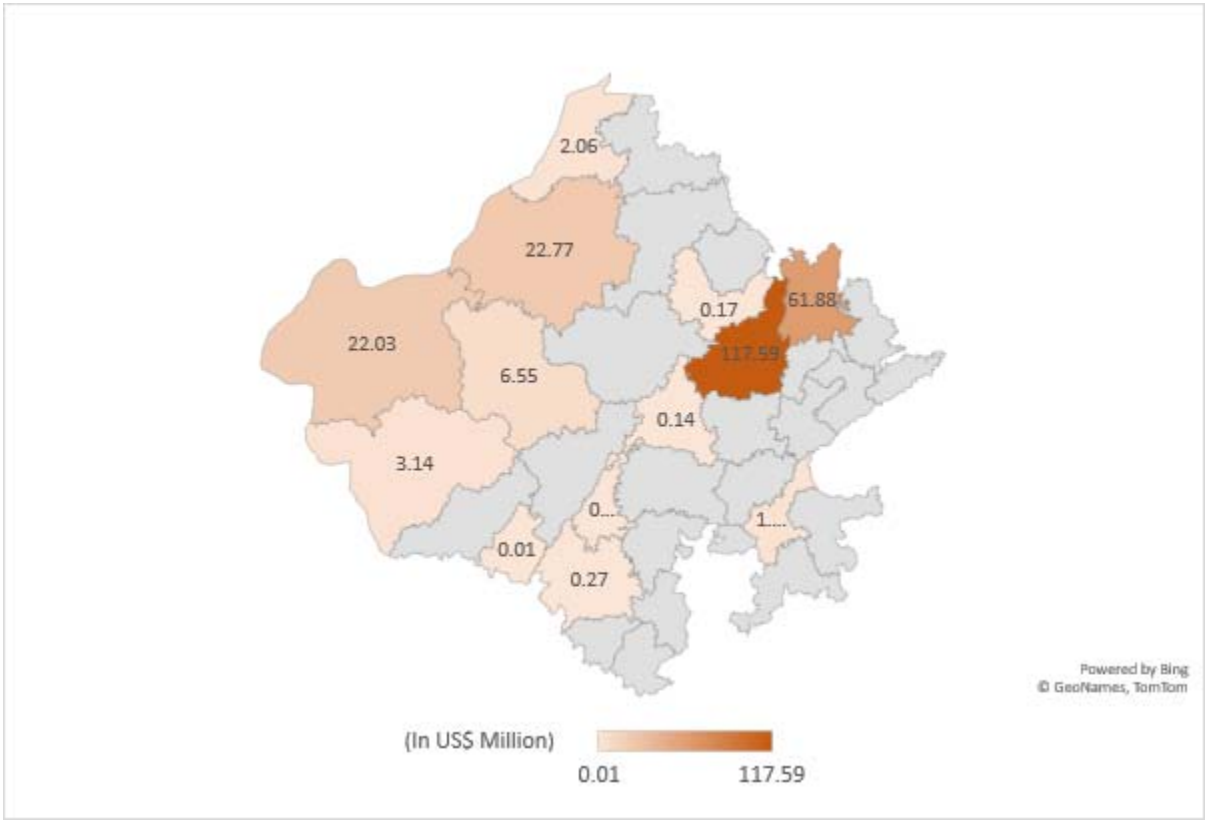
Table 1: Table showing Rajasthan's position in the production of various items

Rank	Production
1st	Rapeseed, pearl millet (Bajra), mustard, and wool production
Leading producer	Cement, 21 plants, an abundance of precious stones, cutting and polishing diamonds, gem industry
	Metallic and minerals; marble, sandstone, rock phosphate, limestone and lignite, gold, copper and silver
2nd largest	National Highways Network in the state
2nd	Oilseeds and spices, milk
3rd	soya bean and coarse cereals
4th largest	Power generation capacity
7th largest	State wise contribution to India's GDP

Rajasthan is the largest state of India with a strategic location, availability of Freight Corridor DMIC (Delhi-Mumbai Industrial Corridor) of which 39 percent part passes through the state, covering three big districts i.e Jaipur Ajmer and Jodhpur districts of Rajasthan. In Alwar District (Khushkhera Bhiwadi-Neemrana) industrial region, a model of a future city in about 165 sq kms is proposed namely Greenfield Integrated Township (GIT) and SNB Global City (Shahjahanpur-Neemrana-Behrore) in Neemrana and Bhiwadi Tapukada Industrial complex. Presence of unicorns in Jaipur, Car Dekho has become Rajasthan's first unicorn company raised $250 million.



Source: Author's presentation with the help of MS Excel 2019

Figure 1: District wise FDI inflow in Rajasthan

The Pink city of India and state capital Jaipur receives maximum FDI. Alwar district, the host district of Japanese industrial zone attracts second highest FDI inflows in the state. Bikaner, known for its snacks, sweets and wool production also marks its position in FDI inflows. Jaisalmer, with a lot of potential for mineral oriented industries, handlooms and renewable energy are other two districts also ranks 4th position in FDI attracting location in the state. Barmer, Southwest region of the state with the presence of Cairn energy MNC gets substantial amount of foreign investments.

Table 2: Sectors attracting major FDI's in Rajasthan for the period 2008-09 to 2022-23

Sectors	Amount In (Us $ Million)
Telephone Communication Services	756.42
Solar Energy Based Electric Power Generation	205.9843
Hospital Activities	148.6773
Internet Service and Content Update Provider Service	324.4831
Other Non-Specialized Wholesale Trade N.E.C.	321.0201
Other Credit Granting	464.8385
Academic Tutoring Services	245.2593
Manufacture of Bread	177.9433
Non-Life Insurance	230.3182

Source: Researcher's computation from Ministry of Commerce & Industry, Govt. of India.

Table 2 shows the main sectors where Rajasthan is receiving FDI inflows from period 2008-09 to 2022-23, Telephone communication under the telecommunication sector is achieving highest inflows, followed by other credit granting sector under Financial services sector is attracting second highest inflows, and internet service provider such as content updating under the Information and technology head is receiving third highest FDI inflows in the state. Insurance industry, Academic tutoring and Other non-specialized wholesale trade sector also shows movement and attracts foreign investments.

Table 3: A brief tabulation of Policies and Schemes by the Rajasthan Government and their main objectives to develop investment-friendly climate in the Rajasthan state:

Policy Initiative	Objectives
Rajasthan Solar Energy Policy, 2014	– To develop 25,000 MW capacity solar power hub for making the state power sufficient.
Rajasthan State Policy on Intellectual Property Rights, 2021	– Innovative practices, to promote Entrepreneurship, – Awareness on copyrights and intellectual property rights
Rajasthan Electric Vehicle Policy (Revp) 2022	– Holistic development of electric vehicle ecosystem in the state. – Promote manufacturing of e -vehicles and batteries in the state.
Rajasthan MSME Policy, 2022	– establish 20,000 new MSME units, cumulative investment of 10,000 crore,100,000 employment generation. – ZED certification to 9000 MSME units
Rajasthan Logistics, warehouse and logistics park policy, 2022	– To make a robust network of warehouses – To build a cost-effective logistics network. – To make Rajasthan as most conducive ecosystem for industrial development. – To create a real time data surveillance and analytics Centre.
Rajasthan Handicraft Policy, 2022	– to make internationally competitive handicrafts – to push handicrafts exports- – To develop handicraft sector a profit-making and growth-oriented sector – to create 50,000 jobs in the Handicrafts sector in the next 5 years.

Rajasthan Investment Promotion Scheme, 2014, 2019, 2022	– To achieve 15 percent annual growth rate in manufacturing and services. – Inclusive regional growth – Attractive investments in sunrise sector – To priorities climate and sustainability, incentivize green initiatives.
Rajasthan Film Tourism Promotion Policy, 2022	– To offer film shooting friendly destination. – Skill development – Employment generation
Mukya Mantri Laghu Udyog Protsahan Yojana (MLUPY), 2019	– Loan offer to manufacturing and service sector – Employment generation

Source: Compiled by researcher from investindia.gov.in/state/rajasthan.

Numerous dedicated web portals are operated by the state government agencies to forester the ease of doing and assistance to the investor:

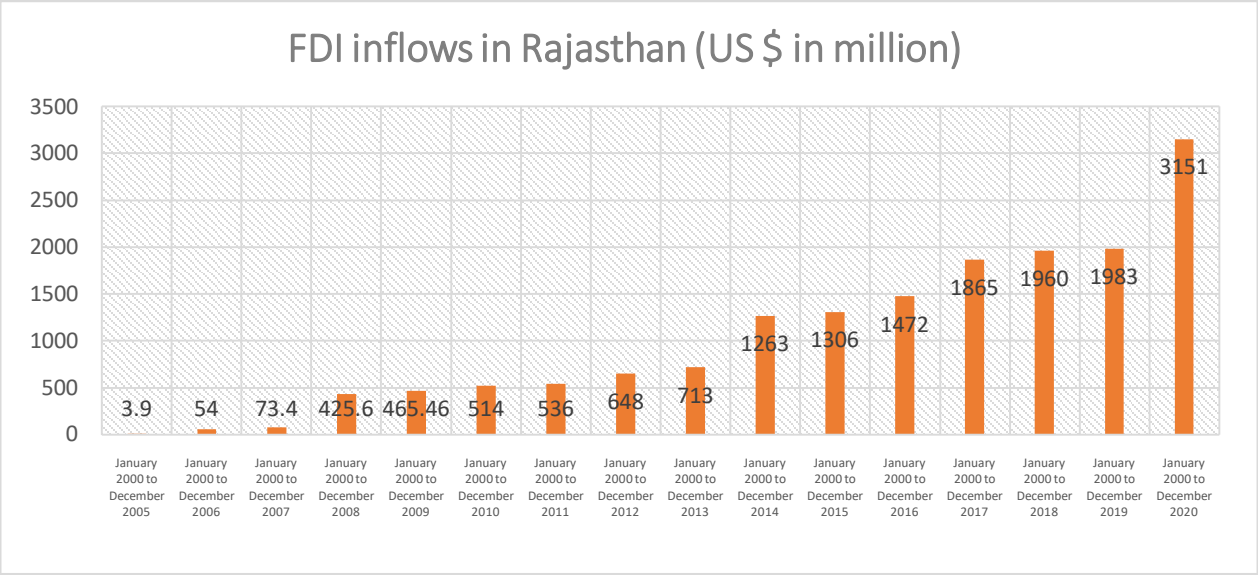
1. INVEST INDIA (https://www.investindia.gov.in/state/rajasthan)
2. INDUSTRIAL BUREAU OF INVESTMENT PROMOTION
3. (https://industries.rajasthan.gov.in/bip/#/home/dptHome)
4. RAJ NIVESH (https://rajnivesh.rajasthan.gov.in/)
5. INVEST RAJASTHAN (https://invest.rajasthan.gov.in/)
6. RAJASTHAN STATE INSUTRAL DEVELOPMENT AND INVESTMENT CORPORATION (https://industries.rajasthan.gov.in/riico/#/home/dptHome)

Time bound approval and clearance through single window clearance is a major radical step by the state to reach out to the investors and make the investment flow easy and convenient in the state.

Table 4: Potential sectors of Rajasthan which are backed up by favorable resources in the state:

Sectors	Basis of the potential of the sector
Agri Processing	– Largest production of mustard, medicinal and aromatic crops – pulses, garlic, Isabgol mustard, pearl seeds (bajra), guar gum, coriander – 2nd Largest Milk producing state
Auto and EV	– Presence of 100 plus automobile and accessory manufacturing units. – Manufacturing units and assembling plants of reputed MNCs like Hero Motors, Honda Cars, and Ashok Leyland
Electronics System Design & Manufacturing	– Availability raw material such as Silica and Copper – Bhiwadi region within National Capital Region (NCR) is proposed as ESDM hub. – Mahindra World City, equipped with state of art and modern technology in the Pink city of India.
IT & ITES	– IT SEZ -Mahindra World City in Jaipur – Fintech park to proactively support IT players in Finance Segment.
MEDICAL & HEALTH	– Pharmaceutical Manufacturing – MedTech – Medical Devices Park – Opportunities on PPP Mode – Medical Education and Research
MINES, MINERALS AND CERAMICS	– Only producer of Zinc and Lead – Highest repute in Marble, Calcite, and Selenite – Leading producer of Limestone, Copper Ore, Rock Phosphate, Gypsum and Silver – feldspar, gypsum, ball clay, fire clay, silica sand, china clay, limestone and dolomite – Largest on-shore producer of Crude Oil and second largest producer of Natural Gas in India.
RENEWABLE ENERGY	– highest installed solar generation capacity (over 8000 MW) – the region receives 300 plus days of bright sunny days, favorable for solar energy. – functional 2245 MW Solar Park in Bhadla, Jodhpur in 5783 hectares.

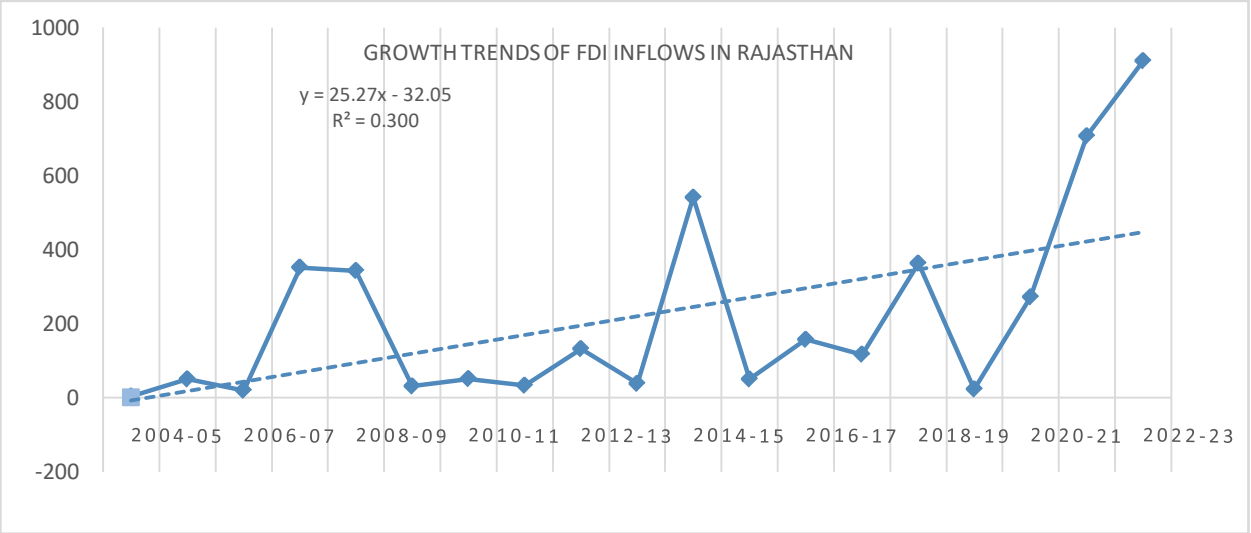
Source: Researcher's compilation from Invest Rajasthan web portal



Source: Researcher's computation from DPIIT, Ministry of commerce, Govt. of India

Figure 2: Cumulative FDI inflows in Rajasthan State in US $ Million

From a meager 3.9 million US Dollars in the year 2005 to 3151 million US Dollars in the year 2020 shows that there is a positive cumulative growth in FDI inflows in the state. Various efforts by the state government such as MSME sector reforms, policy ease, Rajasthan investment Promotion policy, New Industrial policy and investment submits all have contributed to make Rajasthan as an investor's friendly state in India. However, the total share of FDI inflows are minimal and it accounts for only one percent of the share. There is huge potential in the state and the government should take a mission mode action to attract more FDI's, so that region can march ahead on the path of economic development.



Source: Researcher's computation from DPIIT, Ministry of commerce, Govt. of India

Figure 3: Annual growth trends of FDI inflows in Rajasthan State

The amount of FDI inflows have grown significantly ear on year in Rajasthan, there was a significant rise in the inflows during 2013-14 due to investments in telecommunication sector, leather industry and plastic products manufacturing. A positive movement was observed during 2017-18, investment flows in hospitality industry, construction industry, credit granting banking momentum and monetary intermediation of commercial banks. In post corona pandemic, a positive trend in observed in investments in hospital industry and Rajasthan has been emerging as a medical tourism Centre, whole sale trades also account a major part in inflows and educational tutoring has also able to attract FDI inflows in the state.

II. Review of Literature

a) Inter-State Studies on FDI inflows

According to (Sebastian Morris, 2004), Gujarat is one of the leader states in attracting FDI share in India, but it has fall short in comparison to its peer states such as Tamilnadu and Maharashtra. The reason is Gujarat has focused only in chemical sector and small-scale manufacturing sector and not paid much emphasis on Information technology and biotechnology which are the expected booming sectors in future. Quality governance, poor electricity supply and high price situation are some more factors those have adversely affected the FDI inflows in Gujarat.

Archana, Nayak and Basu (2007) investigated in their econometric analysis on the impact of FDI in India that FDI have a positive impact on labour productivity and employment. Labour efficiency has improved due to bubble over effects of FDI through introduction of capital movement, Tech- upgradation and managerial skills. The FDI inflow and developed states have a positive relation and it is found that rich states have a high labour productivity rate while the backward states have a negative labour productivity. The impact of FDI on labour productivity depends on the capacity to absorb technology in the host country (Nelson and Phelps, 1966; Benhabib & Speigel, 1994). The findings have rose a serious question that after New economic policy 1991, the disparities between rich and poor states of India are widening as the absorption capacity of less develop states is poor, and thus unable to attract sufficient amount of FDI in comparison to the developed states of India.

Chatterjee, Mishra and Chatterjee (2013) identified the factors influences inter-state variations in the FDI inflows. The FDI inflows in states are significantly influenced by the profitability of the existing enterprises in these regions. There is neutral impact of social or physical infrastructure in attracting FDI in various states of India. FDI inflows fill the gap between desired and actual level of capital stock, and to push the economic growth through outside investment. It is suggested that states should reframe policies towards investment-oriented environment and skill their human capital as efficient.

J Acharyya (2015) found that FDI are the heterogeneously spread over different Indian states there are two major determinants for variation in FDI inflows in states i.e. favorable policy of the state and development level in the state. This paper examines the income level of the people in rich states and poor states, volume of trade and FDI inflows in these states. It also highlights other significant factors for FDI receipts i.e. social resource, historical resource and natural resources. Strongly recommends to equalize the growth in all the states of the country, through a push in Industry and agriculture sector of backward states.

According to *Sinha and Nayan* (2017) analysed that more than 85 percent of FDI is concentrated in five states (Maharashtra, Delhi, Tamilnadu, Gujarat and Karnataka) of India, Northeast states of India almost get negligible FDI inflows. The state governments should do policy promotion to attract FDI in all the Indian states in equitable manner.

Saha and Bhowmick (2020) found that a positive correlation in ease of doing and FD inflows, policy makers must acknowledge this linkage and align their policies towards developing better conditions for ease of doing environment. The concentration of FDI in few states has resulted in skewed economic growth across the regions, FDI inflows facilitates employment opportunities and better standard of life. Urbanization, rapid industrialization and agglomeration of firms have created pull factors for FDI inflow in specific regions.

Singh, and D S (2020) in her research paper titled as "Foreign Direct Investment (FDI) and Growth of States of India" explored that excellent industrial development, financial and physical infrastructure has led Maharashtra as highest FDI receiving state in India. Sectors like electronics, automobile and auto accessories, hardware and petrochemical are most successful to attract FDI inflow in the state. Influx of FDI has contributed in the increase of per capita income, growth in GDP and ranked the state as third richest state in India.

A P Bhave (2014) analysed in his doctoral dissertation that introduction of SEZ policy in 2006, robust connectivity with international Airports, Delhi Mumbai Industrial Corridor (DMIC) and ports enable access to import -export in the state, growth in service sector are advantage for the Maharashtra state.

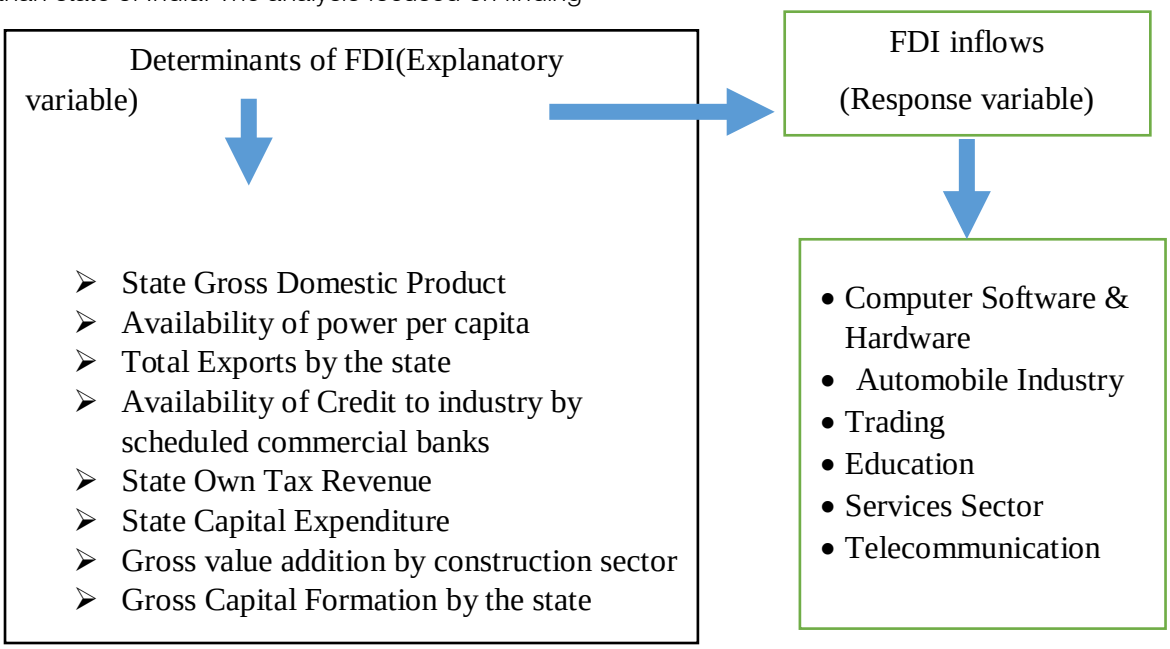
P Kumar (2023) "Trends and Patterns of Foreign Direct Investment Inflows in Karnataka" Karnataka has successfully recovered and attracted the highest FDI in the post-pandemic period top with about 37.5 percent inflows. Aerospace, defense manufacturing, Biotech, and Fintech are the dominant sectors receiving this inflow (KESDM). Historical data reveals that the state has successfully grabbed global investments as a consistent part of the state's economy and generated a significant number of job opportunities. The state of Karnataka is aware of the benefits of FDI inflow. Eventually, the region is progressing as a reputed investor's investor-friendly location for Foreign Direct Investment (FDI) inflows. FDI inflows in Karnataka have risen substantially over the period of 2012- 2022. The analysis of FDI inflows in Karnataka shows that the total FDI inflow share in the state was US $ 1023 million in 2012-13 which rose to almost four times in the year 2015-16 but declined in the next year i.e. 2016-17 years and remained only US $2132 million. Again, in the next

year, it increased to US$ 8575 million in the year 2017-18. The year 2019-20 suffered the terrible hit of the Covid-19 pandemic and economies were sluggish globally. However, India did a 'V' shape recovery and the inflows rebounded to US$ 7670 million in the year 2020-21. Karnataka received all-time high inflows in the year 2021-22 and topped the country with about 37.55 percent of FDI inflows share. The presence of large multinational companies has attracted other new investors also eventually Karnataka has become a hub of investment.

III. Data and Methodology

The secondary data used in the study are annual data in respect of FDI flow and selected variables for the time period 2004-05 to 2022-23 of Rajasthan state of India. The analysis focused on finding the determinants of FDI inflow in the state. The data is compiled from economic surveys of various years of Rajasthan state, DPIIT, Ministry of Commerce, Government of India and handbook of statistics on Indian states, RBI. The dependent variable FDI inflows in Rajasthan is regressed with possible independent variables, correlation analysis is done to identify the suitable variables. First of all, general characteristics of data are investigated by using descriptive statistics. Model-specific econometric test was also run to check the variability and validity of the model.

I performed regression analysis, first simple linear regression analysis to estimate the relationship between independent variables and dependent variables, followed by it, a multiple linear regression model is developed to see the impact of the most effective variables.



Source: Researcher's Model (2023)

Figure 3: Conceptual Framework for FDI Determinants

Table 5: List of Independent Variables Selected for the Study

	Type of factor	Variable	Acronyms of indicators	Expected Sign
A.	Market size	NSDP per capita	SGDP	+
B.	Infrastructure	Per capita availability of power	POWER	+
C.	Labour Productivity	Gross value added by the construction sector	GVAC	+
D.	Trade Openness	Total exports from the state	EXPORT	+
E.	Government policy	State Own Tax Revenue	OTAX	+
F.	Availability of credit	Credit to the industry by scheduled commercial banks	CREDIT	+
G.	Industrial sector	Net Value added by Industrial sector	NVAI	+
H.	Investment climate	Gross Capital Formation	GCF	+

Source: Researcher's computation.

a) Research Hypothesis

Testing the research hypotheses, in this study requires empirical analyses based on samples or observations.

H1: There is a significant relationship between the state GDP of Rajasthan and FDI inflows in Rajasthan.

H2: There is a significant relationship between the Availability of Credit to the Industry and FDI inflow in Rajasthan.

H3: There is a significant relationship between the Availability of Power and FDI inflows in Rajasthan.

H4: There is a significant relationship between the state's Own Tax Revenue of Rajasthan and FDI inflows in the state.

H5: There is a significant relationship between the State Gross Capital Formation of Rajasthan and FDI inflows in the state.

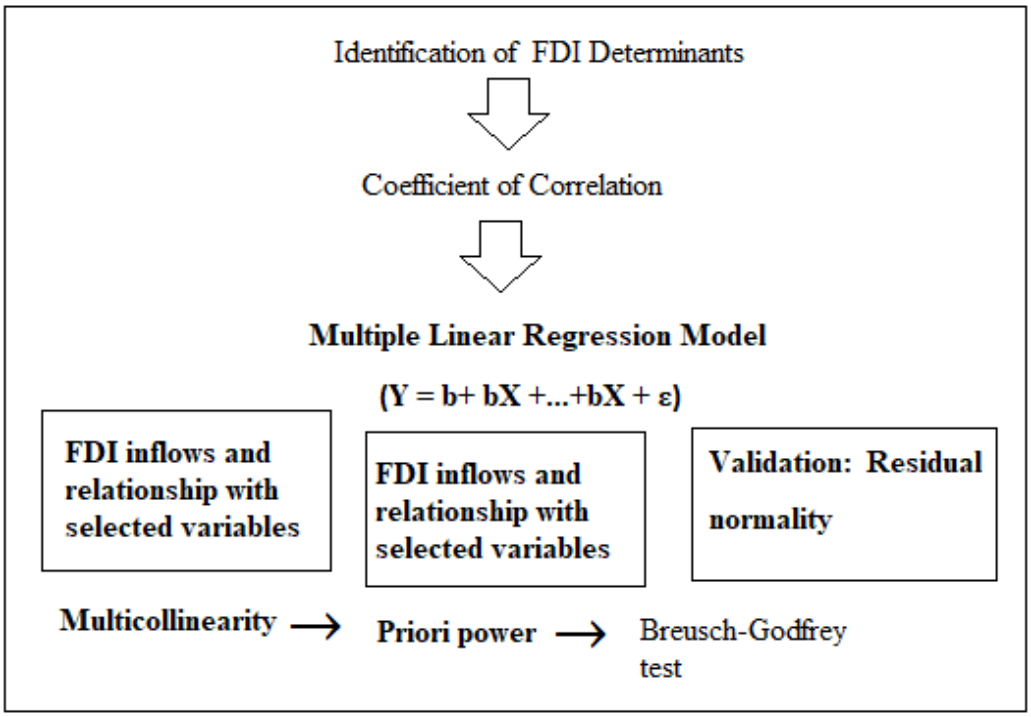
H6: There is a significant relationship between capital expenditure and FDI inflows in Rajasthan.

H7: There is a significant relationship between state Gross value addition by the construction sector of Rajasthan and FDI inflows in Rajasthan.

H8: There is a significant relationship between Total Exports of Rajasthan and FDI inflows in the state.

IV. Empirical Model and Analysis

a) Model Specification



Source: Prepared by Researcher.

Model I: Foreign Direct Investment Correlation Model

Karl Pearson's correlation coefficient (r) is the most common mathematical tool to measure a linear relationship between two different variables. This tool is used to find the strength of the relationship of two variables and their direction.

$$R = \frac{(n\ (\sum xy) - (\sum x)(\sum y))}{(\sqrt{[n\ \sum x2 - (\sum x)2][n\ \sum y2 - (\sum y)2)}}$$

Where

R = Pearson Coefficient

n = number of the pairs of the stock

∑xy = sum of products of the paired stocks

∑x2 = sum of the squared x scores

∑y2 = sum of the squared y scores

Table No 6: Karl Pearson's Coefficient of Correlation

Variables	Coefficient of Correlation (r)
State Gross Domestic Product (SGDP)	0.5545*
Credit to Industry (CREDIT)	0.6098*
Availability of power (POWER)	0.6589*
Gross Capital Formation (GCF)	0.4032^{NS}
Own Tax Revenue Collection (OTAX)	0.5541*
Domestic Capital Expenditure (CAPEX)	0.5058 *
Gross Value Added by Construction (GVAC)	0.5853*
Total Export by the State (EXPORT)	0.7921*

Significant at 0.05 level, **NS Non-Significant (p-value > 0.05)*
Source: Researcher's computation using MS Excel package 2019.

A moderately strong degree of correlation is found among the variables except for Gross Capital Formation (GCF) where the coefficient of correlation value is 0.4032 and p- value > 0.05 is also not significant.

However, a strong relation is found between total exports and FDI inflows, the coefficient of correlation value is 0.7921 with p-value <0.05. Availability of power (0.6589*), Credit to Industry (0.6098*) and Gross Value Added by Construction (0.5853*) are some other variables where a high degree of relationship is found. Other variables have also shown a moderate positive relationship with FDI inflows in the Rajasthan state.

Multiple linear regression formula

$$Y = b + bX + ... + bX + \varepsilon,$$

Model 1: The linear regression model

$$Y = b + bX + ... + bX + \varepsilon,$$

$$FDIt = \beta 0 + \beta 1SGDPt + \beta 2CREDITt + \beta 3POWERt + \beta 4GCFt + \beta 5OTAXt + \beta 6CAPEXt + \beta 7GVACt + \beta 8EXPORTt + \varepsilon t$$

b) Effects of various macro-economic indicators on FDI inflow in Rajasthan

Model II: Multiple Linear Regression Model

Multiple Linear Regression (MLR) is a statistical technique uses two or more than two explanatory variables to estimate the outcome of a dependent variable. The researcher uses variables transformations, calculates the Linear equation, R, p-value, outliers and the adjusted Fisher-Pearson coefficient of skewness. After checking the residuals' normality, multicollinearity, homoscedasticity and priori power, the program interprets the results. MLR is an extension of linear regression, FDI as a dependent variable is models as function of various determinants.

c) Result of Multiple Regression Analysis

	Coeff	SE	t-stat	Stand Coeff	p-value*
Intercept	-30.175981	12.053265	-2.503553	1.146825	0.027734
$SGDP_t$	—	—	—	—	—
$CREDIT_t$	3.457255	1.065965	3.243311	1.43348	0.0070432
$POWER_t$	-7.980006	4.352339	-1.833498	-1.322835	0.0916371
GCF_t	-2.502623	0.983523	-2.54455	-0.816444	0.0257222
$OTAXR_t$	3.144035	1.293855	2.429975	1.265031	0.031734
$CAPEX_t$	-2.947398	1.447305	-2.036473	-1.263023	0.0643899
$GVAC_t$	5.766918	2.686254	2.146825	1.449226	0.0529425
$EXPORT_t$	—	—	—	—	—

**Indicates 5% level of significance.*
Source: Researcher's computation using gretl package for econometric analysis.

1. FDI inflow and relationship with selected variables

R square (R) equals **0.742577**. It means that the predictors (X) explain 74.3 percent of the variance of FDI inflows. Adjusted R square equals **0.613866.** The coefficient of multiple correlation (R) equals 0.861729. It means that there is a very strong correlation between the predicted data (ŷ) and the observed data (y). Ln(Y) = -30.175981 + 3.457255 Ln (CREDIT) - 7.980006 Ln (POWER) - 2.502623 Ln (GCF) + 3.144035 Ln(OTAX) - 2.947398 Ln(CAPEX) + 5.766918 Ln(GVAC)

Results of the multiple linear regression indicated that there is a very strong collective significant effect between the SGDP, CREDIT, EXPORT, POWER, GDCF, OTAX, CAPEX, GVAC, and FDI Inflows in the Rajasthan State, **(F (6, 12) = 5.77, p = .005, R = 0.74, R = 0.61).**

The individual predictors were examined further and indicated that and CREDIT (t = -1.833, p = .002) POWER (t = 2.43, p = .032) and GCF (t = -2.036, p = .034) and OTAX (t = 2.147, p = .053) were significant predictors in the model, and SGDP (t = 3.243, p = .007) and EXPORT (t = -2.545, p = .026) were non-significant predictors in the model, as the two variables are dropped due to statistical error in the data.

The following independent variables are not significant as predictors for FDI inflows: Ln (EXPORT) and Ln (SGDP). Therefore, these variables are excluded from the model.

2. Goodness of fit Overall regression

Right-tailed, F= 5.769315, p-value = 0.0049 5716. Since p-value < α (0.05), we reject the null hypothesis. The linear regression model includes the error term = b+ bX +...+bX + ε, as it provides a better fit. The Y-intercept (b): two-tailed, T = -2.503553, p-value = 0.027734. Hence b is significantly different from zero.

3. Validation

Residual normality: The analysis assumes normality for residual errors. Shapiro Wilk test is run and the p-value equals 0.3089. Hence it is assumed that the data is normally distributed.

Heteroskedasticity was corrected (Appendix 1) *The White test* p-value equals 0.906103 (F=0.0992125). we can reject the null hypothesis, which means that the variance is homogeneous.

Multicollinearity: Intercorrelations among the predictors (X) were checked and no multicollinearity concerns as all the VIF values are smaller than 2.5.

Augmented Dickey-Fuller unit root test is used to check whether unit root is present in the data. If the p-value is less than 0.05 then it indicates a unit root. ADF unit root test is run and the result shows that the null hypothesis is rejected. The t-value is greater than the p-value and we have statistical evidence to reject the null hypothesis. (Appendix 2), all the selected variables are free from unit root and the data is stationary.

Breusch-Godfrey test for first-order auto-correlation OLS, using observations 2004-2020 (T = 19) Autocorrelation, Durbin Watson test and (Appendix 6)

Priori power: The entire model (8 predictors): The priori power is estimated before we advance further in the regression analysis. Although the power to test the entire model is strong: 0.61361, and we can reject null hypothesis.

V. Hypothesis Tested

On the basis of result of multiple linear regression analysis, it is found that four hypotheses are rejected and the remaining four are accepted. We can further explain that proxy variables of Government policy, infrastructural development,

Hypothesis	Result
H01: There is a significant relationship between the state GDP of Rajasthan and FDI inflows in Rajasthan.	REJECTED
H02: There is a significant relationship between the Availability of Credit to the Industry and FDI inflow in Rajasthan.	ACCEPTED
H03: There is a significant relationship between the Availability of Power and FDI inflows in Rajasthan.	ACCEPTED
H04: There is a significant relationship between the state's Own Tax Revenue of Rajasthan and FDI inflows in the state.	ACCEPTED
H05: There is a significant relationship between the State Gross Capital Formation of Rajasthan and FDI inflows in the state.	ACCEPTED
H06: There is a significant relationship between capital expenditure and FDI inflows in Rajasthan.	REJECTED
H07: There is a significant relationship between state Gross value addition by the construction sector of Rajasthan and FDI inflows in Rajasthan.	REJECTED
H08: There is a significant relationship between Total Exports of Rajasthan and FDI inflows in the state.	REJECTED

a) Result and Policy Implications

The multiple regression empirical results from model 1 show that FDI in Rajasthan state depends on factors like Availability of Credit to the industries in the state, Gross Capital Formation which is net increase in the physical assets in the state (building flyovers, roads,

raising industries, Highways, electric capacity, infrastructure development etc.), Own Tax Revenues collected by the state shows its efficiency of implementing the rules and regulations and then its robust model of tax collection, Gross Value Addition by the Construction sector. The statistical value of State Gross Domestic Product and Total exports are found to be insignificant in model 1, hence both the variables are dropped from the study. The coefficient of multiple correlation (R) equals 0.861729. It means that there is a very strong correlation between the above determinants and the FDI inflows in the state.

We reject H01, H03, H06 and H08 as the selected variables are statistically not significant. Whereas H02, H04, H05 and H07 are accepted. We can conclude that the four determinants have a strong positive impact on FDI inflow in Rajasthan.

1. Government policy (Availability of credit to the industries)
2. Government efficiency
3. Investment climate and
4. Labour productivity has a strong positive impact on the FDI inflows in Rajasthan state.

It serves as advice and empirical evidence for the policymakers in Rajasthan and other laggard states of India to support these four sectors with policy matters and attract more FDI in the respective states. apart from this, there are potential sectors of investment in Rajasthan such as renewable energy, the Food processing industry, the automobile industry, and the telecommunication industry. In a mission mode, an effective government can take advantage of its strategic location and connectivity, natural resource advantage and ease of doing business climate which can attract huge amounts of FDI inflows and can achieve overall prosperity with its spillover positive effects.

b) Limitations of the study and future research directions

The present study was limited to the trend and patterns analysis of FDI inflows in Rajasthan. This is probably the first study of macroeconomic determinants of FDI inflow in laggard states of India. The study could be more effective if a primary data component is also added and micro factors are included in the study. FDI outflows have not been touched at all, the analysis of outflow could also provide significant literature FDI FDI-related studies. With a limited objective of the study and constrain of resources and time, some key factors could also be included in the study. Hence there is scope for future study in this topic, some suggested topics are listed below:

1. FDI and food processing sector in Rajasthan. Or any specific sector or industry growth can be taken along with FDI inflows.
2. FDI and per capita growth in Rajasthan. Relationship between Net per capita income and FDI inflows.
3. Trade balance and foreign investments; a state-specific study.
4. Balance of payments and FDI inflows: a regional perspective.
5. Investment patterns of FDI in selected sectors of a state.

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Appendix 1: Heteroskedasticity-corrected, using observations 2004-2020 (T = 17)

Dependent variable: FDI

	Coefficient	Std. Error	t-ratio	p-value	
const	4382.10	1467.10	2.987	0.0174	**
SGDP	−0.804689	0.301242	−2.671	0.0283	**
CREDIT	0.0846466	0.0294466	2.875	0.0207	**
EXPORTS	0.0521218	0.0328846	1.585	0.1516	
POWER	−2.80678	2.42558	−1.157	0.2806	
GVAC	0.000526204	0.000202488	2.599	0.0317	**
GDCF	−0.00177953	0.000664923	−2.676	0.0281	**
OTAX	−0.0695812	0.0408829	−1.702	0.0272	*
CAPEX	−0.0991957	0.0376968	−2.631	0.0301	**

Statistics based on the weighted data:

Sum squared resid	10.50745		S.E. of regression	1.146050
R-squared	0.965710		Adjusted R-squared	0.931421
F(8, 8)	28.16329		P-value(F)	0.000045
Log-likelihood	−20.03236		Akaike criterion	58.06473
Schwarz criterion	65.56365		Hannan-Quinn	58.81013
rho	−0.500090		Durbin-Watson	2.698769

Statistics based on the original data:

Mean dependent var	950.3300		S.D. dependent var	967.5708
Sum squared resid	6717130		S.E. of regression	916.3194

Appendix 2: Correlation coefficients, using the observations 2004 - 2020

5% critical value (two-tailed) = 0.4821 for n = 19

FDI	CREDIT	EXPORTS	POWER	GVAC	
1.0000	0.6098	0.7921	0.6589	0.5340	FDI
	1.0000	0.7723	0.7220	0.5950	CREDIT
		1.0000	0.9313	0.9084	EXPORTS
			1.0000	0.9550	POWER
				1.0000	GVAC
	SGDP	GDCF	OTAX	CAPEX	
	0.5545	0.4032	0.5541	0.5058	FDI
	0.8723	0.7421	0.6729	0.6753	CREDIT
	0.9693	0.9063	0.9374	0.7391	EXPORTS
	0.9172	0.8422	0.9738	0.7837	POWER
	0.8535	0.7887	0.9618	0.8473	GVAS
	1.0000	0.9184	0.8960	0.7419	SGDP
		1.0000	0.8174	0.5873	GDCF
			1.0000	0.7677	OTAX
				1.0000	CAPEX

Appendix 3: Testing for a unit root in the selected variables Cointegrating regression

Augmented Dickey-Fuller regression

OLS, using observations 2004-2020 (T = 19)

Cointegrating regression - OLS, using observations 2004-2020 (T = 19)

Dependent variable: FDI

	coefficient	std. error	t-ratio	p -value
CREDIT	0.0547920	0.0358076	1.530	0.1603
EXPORTS	0.0220581	0.0831386	0.2653	0.7967
POWER	−0.727097	6.27394	−0.1159	0.9103
GVAC	0.000378278	0.000313546	1.206	0.2584
SGDP	−0.0200631	0.537998	−0.03729	0.9711
GDCF	−0.00209627	0.00125821	−1.666	0.1301
OTAX	−0.0558154	0.0629074	−0.8873	0.3980
CAPEX	−0.0788806	0.0580361	−1.359	0.2072

Appendix 4: OLS, using observations 2004-2020 (T = 19)

Dependent variable: FDI

	coefficient	std. error	t-ratio	p-value
CREDIT	0.0547920	0.0358076	1.530	0.01603
EXPORTS	0.0220581	0.0831386	0.2653	0.007967
POWER	−0.727097	6.27394	−0.1159	0.0103
GVAC	0.000378278	0.000313546	1.206	0.02584
GSDP	−0.0200631	0.537998	−0.03729	0.019711
GDCF	−0.00209627	0.00125821	−1.666	0.130101
OTAX	−0.0558154	0.0629074	−0.8873	0.003980
CAPEX	−0.0788806	0.0580361	−1.359	0.02072

Appendix 5: Breusch-Godfrey test for first-order autocorrelation OLS, using observations 2004-2022 (T = 19)

Dependent variable: FDI

	coefficient	std. error	t-ratio	p-value
const	4244.12	5136.88	0.8262	0.04359 *
CREDIT	0.0257692	0.0387668	0.6647	0.05275 *
EXPORTS	0.0400469	0.0805196	0.4974	0.06342
POWER	0.288279	5.29419	0.05445	0.09581
GVAS	8.33669e-05	0.000265482	0.3140	0.03627 *
FACTORY	−0.942584	1.07083	−0.8802	0.04079 *
GDCF	0.000686437	0.00113925	0.6025	0.05658 *
OTAX	−0.0170064	0.0528691	−0.3217	0.01571 *
CAPEX	−0.0320662	0.0504949	−0.6350	0.05456 *
uhat_1	−0.852218	0.384817	−2.215	0.0624 *

Appendix 6:

Durbin-Watson	2.3960815145580

Johansen test:

Number of equations = 9

Lag order = 1

Estimation period: 2004 - 2022 (T = 19)

Cointegration tests, ignoring exogenous variables

Rank	Eigenvalue	Trace test p-value	Lmax test p-value
0	1.0000	2363.0 [0.0000]	576.70 [0.0000]
1	1.0000	1786.3 [0.0000]	565.61 [0.0000]
2	1.0000	1220.7 [0.0000]	559.12 [0.0000]
3	1.0000	661.61 [0.0000]	550.95 [0.0000]
4	0.96053	110.66 [0.0000]	51.714 [0.0000]
5	0.87158	58.951 [0.0027]	32.839 [0.0073]
6	0.64727	26.111 [0.1289]	16.673 [0.1953]
7	0.41364	9.4385 [0.3324]	8.5412 [0.3339]
8	0.054542	0.89737 [0.3435]	0.89737 [0.3435]

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The Institutional Dimension of Sustainable Development in Brazil

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Abstract- This article aims to review the 'state of the art' of the institutional dimension of sustainable development, focusing on the portrayal of this dimension through indicators in Brazil. The research employs a theoretical-argumentative methodology for exploratory analysis of sustainable development in Brazil, from an institutional perspective. The procedures of bibliographic research and document analysis are used in the discussion. As a result, it is confirmed that the institutional dimension of sustainable development reveals a generic framework of institutional efforts and capacities. This dimension is poorly portrayed by sustainability indicators, due to its complexity and difficulty in collecting primary data. Accordingly, the strengthening of governance is suggested as a solution for the improvement of the institutional framework in the country.

Keywords: *sustainable development, institutional dimension, brazil, governance, indicators.*

GJHSS-E Classification: *LCC: HC59.7*

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The Institutional Dimension of Sustainable Development in Brazil

Verônica Nascimento Brito Antunes [α], Valéria Gonçalves da Vinha [σ] & Jacilene dos Santos Silva [ρ]

Abstract- This article aims to review the 'state of the art' of the institutional dimension of sustainable development, focusing on the portrayal of this dimension through indicators in Brazil. The research employs a theoretical-argumentative methodology for exploratory analysis of sustainable development in Brazil, from an institutional perspective. The procedures of bibliographic research and document analysis are used in the discussion. As a result, it is confirmed that the institutional dimension of sustainable development reveals a generic framework of institutional efforts and capacities. This dimension is poorly portrayed by sustainability indicators, due to its complexity and difficulty in collecting primary data. Accordingly, the strengthening of governance is suggested as a solution for the improvement of the institutional framework in the country.

Keywords: sustainable development, institutional dimension, brazil, governance, indicators.

I. Introduction

In the mid-twentieth century, faced with the global socio-environmental crisis and perception of the finitude of natural resources and their depletion, the notion of sustainability emerged in debates on development. The main causes of the global socio-environmental crisis can be understood from the following factors that put pressure on ecosystems and affect the climate: world population growth, inability to eliminate misery and poverty through economic growth and institutional inability to solve global problems (Sachs, 2008).

One of the first studies to highlight the danger of continuous and indiscriminate economic growth trajectories was produced by the Club of Rome in the report known worldwide as *The limits to growth* (Meadows, 1972). This report warned of a gradual increase in most problems related to the environment on a global scale. The absence of limits to the exploitation of natural resources is discussed, in clear opposition to the dominant conception of continuous growth of industrial society. Thus, the idea of *zero growth* became popular, given the impossibility of exploiting natural resources indefinitely for the continuous process of capitalist accumulation.

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At the Stockholm Conference (1974), Maurice Strong proposed the concept of 'Eco-development' that represented an alternative to polarization that placed on one side, the proposal of 'zero growth' and on the other side the developmentalist claims of third world countries, the 'right to growth' (Vieira, 2007). The main aspects of this proposal were articulated by Ignacy Sachs (1997). They took into account mainly the issues of education, participation of civil society, preservation of natural resources combined with the satisfaction of basic needs. The concept of eco-development was a great advance in the perception of the global environmental problem, as it highlighted the interdependence between economic development and the environment.

To reflect on the conciliation between environmental preservation and economic development and propose a global agenda, the World Commission for the Environment and Development (CMMAD), produced a report called "Our Future Common," also known as the *Brundtland report,* in 1987. This report sets out the classic and most widespread normative definition of the concept of sustainable development.

Despite all the efforts undertaken to understand and characterize the most diverse dimensions of sustainability, the tripod involving the environmental, social and economic dimensions has prevailed in studies on sustainable development. The institutional dimension of sustainable development started to be portrayed through indicators after the publication of the second edition of the popularly known 'Blue Book' in 2001, organized by the Commission for Sustainable Development (CDS) of the United Nations (UN)).

Following CDS/UN guidelines, with some adjustments to the national reality, the Brazilian Institute of Geography and Statistics in Brazil (IBGE) has published a series of Sustainable Development Indicators (IDS), since 2002, which are organized into four dimensions (economic , social, environmental and institutional) and divided into themes and subthemes. The institutional dimension indicators are subdivided into *Institutional Framework* and *Institutional Capacity*.

Environmental governance can be characterized as a thematic delimitation, extended to the sphere of sustainable development and environmental policies (Fonseca & Bursztyn, 2009). Reflecting on the framework of norms and institutions that characterize environmental governance in Brazil, Cavalcanti (2003)

admits the influence of advanced legislation on the environment. However, the application of the rules in the real world illustrates the conflicts between the economy and the environment and ecology observed in the country.

In this context, this article intends to examine the '*state of the art*' of the institutional dimension of sustainable development, focusing on the efforts to portray this dimension through indicators in Brazil. It aims to broaden the debate around strengthening governance, proposing it as a solution that improves the institutional framework in the country.

In methodological terms, the research fulfills exploratory and descriptive purposes through a theoretical-argumentative analysis of the institutional architecture of sustainable development. In terms of the technical procedures adopted for data collection and analysis, bibliographic and document research and content analysis were used. The following stages of research are presented: bibliographic survey of the dimensions of sustainable development, and documental research of guides and reports produced by the UN and IBGE. These sources help understand the institutional dimension of sustainability and elaborate on the implementation of its indicators and degree of reach.

II. The Conceptual and Theoretical Framework

In the words of Sachs (1997), *Ecodevelopment* means an endogenous development that depends on its own forces, with the objective of responding to the problem of harmonizing the social and economic objectives of development with an ecologically prudent management of resources and the environment.

This definition highlights a concern with economic aspects, without neglecting the social and environmental aspects. It also addresses a concern related to the quality of life and the commitment toward preserving the environment for future generations (Montibeller-Filho, 1993), revealing characteristic regulations that have been gradually improved.

International Union for Conservation Nature (IUCN) World Conference on Conservation and Development, was held in Canada in 1986. In this conference, the concept of Sustainable and Equitable Development was presented as a new model, based on the following principles: development, satisfaction of fundamental human needs, achievement of equity and social justice, pursuit for social self-determination and cultural diversity, and conservation of ecological integrity.

In 1987, the year after the IUCN Conference, with the mission of reflecting on the conciliation between environmental preservation and economic development and proposing a global agenda to change certain paradigms, the CMMAD produced the report called "Our Common Future," which defines the concept of sustainable development as follows: "*sustainable development is development that meets the needs of the present without compromising the possibilities of future generations to meet their own needs*" (CMMAD, 1991). In this way, the perception of the relationship between environmental problems and the development process is legitimized through the emergence of the concept of sustainable development (Guimarães, 1997).

The Brundtland report broadens and primes the academic debate on the meaning of sustainable development. According to Nascimento (2012), the vague formula unifies the strengths and weakness of the definition, as it does not explain the current human needs and those of future generations. However, it introduces the notion of intergenerationality in the concept of sustainability, associating it with the notion of social justice, reduction in social inequalities, and right of accessing the necessary goods for a dignified life, and ethical values, as a commitment to future generations.

Reinforcing the dynamism of sustainability, Bossel (1998) stresses that society and environment are continuously changing, along with technologies, culture, values and aspirations. Everything is constantly changing, which is why society must allow and sustain such changes.

It is pertinent to consider the notion of sustainability. It is an issue that decisively influences the conception and dissemination of the meaning of sustainability, and the worldview of those involved (Raccichini & Vinha, 2017), given that the sustainability approach is explored in various fields of knowledge. Thus, another source of influence for the formation of the concept of sustainability is the institutional visions and conceptions.

In this perspective, groups that influenced the construction and dissemination of the concept of sustainability can be identified, such as the *World Commission on Environment and Development* (WCED, 1987) – Our Common Future Report; *International Institute of Environment* and *Development* (IIED, 2001); *World Business Council for Sustainable Development* (WBCSD), (Mebratu, 1998). In general, the definition of sustainable development given by the Brundtland Commission and concept of "satisfaction of needs, comprise the central elements of institutional visions. However, there are differences in interpretation, resulting from the influences of the institutions' objectives. For now, we follow the notion of sustainability provided in the Report.

III. The Dimensions of Sustainability

In the Brundtland Report, the following three essential aspects of sustainable development are

highlighted: environmental protection, economic growth and social equity (CMMAD, 1991). However, it is necessary to consider that sustainability is multidimensional, has interdependent relationships between dimensions, and is composed of a complex system in which the human being is inserted.

Therefore, it should be noted that it encompasses more dimensions than the economic, social and environmental ones, which are frequently mentioned in studies on the subject.

By treating the concepts of "Ecodevelopment" and "Sustainable Development" as synonyms [1], Ignacy Sachs (1993) assumes that all development-oriented planning needs to simultaneously consider the following five dimensions of sustainability:

a) *social* (fighting poverty and building a civilization with greater equity in income distribution, to reduce the gap between the living standards of the rich and poor)

b) *economic (economic* efficiency must be evaluated in macro-social terms through the criterion of corporate profitability, aiming to promote structural changes that stimulate human development without compromising the environment)

c) *ecological* (related to the preservation of natural resources as a basis for biodiversity, this dimension proposes a more efficient production system with ecologically correct and economically viable solutions through the use of clean technologies and alternative renewable energy sources. It also defines the norms for adequate environmental protection)

d) *spatial or Geographic* (focused on a balanced rural-urban configuration, better territorial distribution of urban settlements and economic activities)

e) *cultural* (highlights respect for cultural specificities, identities and traditions of local communities, valuing the continuity of traditions and plurality of peoples).

Years later, Sachs themselves (2002) expand the approach to the scope of sustainable development by introducing the following three different dimensions which can be analyzed relatively:

f) environmental *(*includes respect for the self-purification capacity of natural ecosystems)

g) national policy (involves democracy, a reasonable level of social cohesion, human rights and the development of the State's capacity to implement the National project in partnership with all entrepreneurs)

h) international policy (based on the promotion of peace and international cooperation, international financial control, application of the Precautionary Principle in the management of environmental and natural resources, protection of biological and cultural diversity and scientific and technological cooperation).

Lage and Barbieri (2001) introduce the following two dimensions: the political dimension, which refers to the creation of conditions that allow civil citizens to effectively participate in the planning and social control of public policies; and the technological dimension, which refers to the promotion of local scientific and technological development.

Covering the psychological, social and cultural dimensions, Marrul Filho (2000) and Jacobi (2003) emphasized the practice of environmental education based on the need to understand the culture and achieve individual well-being, as constituent elements of sustainable development.

Despite all the efforts undertaken to understand and characterize the most diverse dimensions of sustainability, the tripod involving the environmental, social and economic dimensions has prevailed in studies on sustainable development.

Based on these three fundamental components, Elkington's (1998) *triple bottom line emerges* [2], in which society seeks a balance between the aspects that are "*socially desirable, economically viable and ecologically sustainable.*" The dynamic balance between the economic, social and environmental dimensions is most important in approaching corporate sustainability.

It is worth considering that the concept of sustainable development contemplates that multi-dimensionality includes more than the economic, social and environmental dimensions, which are often mentioned in studies on the subject. Based on this orientation, the importance of incorporating the institutional dimension is effectively perceptible, because Silva and Cheaz (2001, p.5) proposed *t*hat, there is no sustainable development without sustainable development organizations. Accordingly, the institutional dimension of sustainability includes:

> [...] the set of all formal and informal 'rules' that shape the nature of its identity, influence the intensity and quality of its dynamics and direct the commitments associated with its purpose. Among these 'rules of the game' are laws, policies,

[1] Ignacy Sachs in their discussion of the Conceptual Framework (1993, p. 19 and 24), agrees with the criticisms of the Brundtland Report's concept of Sustainable Development. They consider that the commonalities between it and Ecodevelopment are sufficient to be able to treat them as synonyms.

[2] The concept that defines the three guiding pillars of decisions and actions related to organizational management, brings the concept of corporate social responsibility closer to the concept of sustainability (Elkington, 2006). It emphasizes the need to integrate the economic and social dimensions to achieve environmental progress, expressing the fact that an organization can add or destroy value, simultaneously based on its performance, and the economic, social and environmental pillars (Elkington, 2006).

premises, approaches, plans, priorities, strategies, norms, institutional mechanisms, etc. (Silva & Cheaz, 2001, p.6).

Among other aspects, institutional sustainability corresponds to the existence of an institutional framework that deals with strategic planning, and specific actions for management and governance to guarantee environmental quality.

IV. Strengthening the Institutional Framework: Improving Governance as a Solution

The evident fragility of multilateral governance organizations in the face of cross-border externalities with global implications, highlights the paradox of the inexistence of coordinating tasks, especially when the world becoming increasingly interdependent (May, 2007).

This paradox is reproduced on other scales, where there are no proposals for integrating policies, and the articulation between sectors and cross-sectional actions is rare. For example, in Brazil, there is no" Strategy or National Plan for Sustainable Development." To assess progress and existing gaps, renew the commitment of countries, and discuss the new challenges in attaining sustainable development, the United Nations Conference on Sustainable Development (UNCSD), better known as Rio+20, emphasized the following two themes: *green economy in the context of sustainable development and poverty eradication, and the institutional framework for sustainable development*.

"Objective and themes of the United Nations Conference on Sustainable Development" was published in 2010 by the UN. It proposed to raise questions regarding how a focus on green economy and institutional framework can boost the countries' sustainable development agenda.

Regarding the institutional framework, the Report highlights the growth in the participation of informal and voluntary agreements, and networks and civil society arrangements, established by non-governmental actors under various circumstances. Accordingly, it expands the traditional framework that unifies the formal entities and the organizations involved in creating policies and carrying out activities. However, despite these advances, the mechanisms of articulation and integration are insufficient to guarantee coherence and coordination of policies, programs and actions aimed at sustainable development.

In this context, strengthening the institutional framework requires the commitment of all countries, sub-national levels of government, and civil society. They are required to implement policies and programs that integrate the economic, social and environmental dimensions, to strengthen mechanisms of empowerment, coordination and articulation between the actors. For this purpose, according to the UN, the following objectives must be contemplated (United Nations, 2010)

a) *Ensuring policy coherence and integration* (consists of integrating economic, environmental and social objectives in the formulation of legal frameworks, implementing policies and management instruments in an integrated manner, vertical integration between different levels of government and horizontal integration between sectoral institutions).

b) *Improved design analyses, assessments and scientific opinions* on natural hazards and human well-being (many assessments have been carried out at the international level, and their influences on policy formulation are diverse. Accordingly, it is necessary to improve the articulation between science and policy based on the improvement of databases, facilitating access to information for decision makers and citizens).

c) *Strengthen implementation, monitoring and accountability* (considering the apparent disconnect between regulatory and executive bodies in relation to the commitment assumed at a global level, it is necessary to strengthen the institutions and processes involved, and enhance accountability)

d) *Limit overlapping or duplication of activities* (establishment of coordination mechanisms to enable cooperation and information sharing between entities).

e) *Increase participation* (considers the high-priority objective of increasing the participation of groups, especially the poor and marginalized groups, in decision-making, and helps in the integration of dimensions in the formulation and execution of policies. It also promotes access to information for the poor, by giving voice to marginalized groups in decision-making, as a means of *'empowerment* ').

f) *Strengthen national and local capacities for sustainable development* (ultimately, the success or failure of sustainable development depends on its implementation at the national and local levels. The implementation, in turn, depends on the strength of institutional mechanisms that attempt to overcome strictly sectoral approaches using processes that integrate different sectors and levels of government. They should also encourage greater participation of stakeholders in the decision-making process and intensify efforts towards capacity building for new patterns of sustainable production and consumption).

Based on the objectives mentioned above, Mello (2013) sought to verify the relevant institutional aspects addressed in the Preparation Report for Rio +20, by conducting research on indicators of the institutional dimension of sustainable development.

Accordingly, they identified 13 articles relevant to the subject and carried out analyses by comparing the indicators used in the respective articles. Their objectives are mentioned in the report. In conclusion, research on indicators of the institutional dimension partially describe the objectives addressed in the UN report. Moreover, the article draws attention to the existence of a gap in the deeper discussion about the institutional dimension of sustainable development, especially with regard to governance.

It should be noted that Rio +20 cannot be counted as progress towards creating a global environmental governance mechanism or the strengthening of the United Nations Environment Program (UNEP), as proposed in its objectives (Viola & Franchini, 2012).

V. Indicators of the Institutional Dimension of Sustainable Development

One of the main results of ECO 92, the United Nations Conference on Environment and Development, was the recognition of the commitments of nations. It addresses the important role played by indicators in helping to create public policies that promote sustainable development.

In Global Agenda 21, the following considerations regarding sustainable development indicators were presented:

i) It is necessary to develop sustainable development indicators that serve as a solid basis for decision-making at all levels and contribute to the self-regulated sustainability of integrated systems.
ii) Countries at the national level, and governmental and non-governmental organizations at the international level should, develop the concept of sustainable development indicators to identify these indicators.
iii) Countries and international organizations should review and strengthen information systems and services in sectors related to sustainable development at local, provincial, national and international levels.

Indicators can be grouped into several categories considering the economic, social, institutional and environmental issues with the following characteristics: the indicator should relevant to the main objective to measure progress towards sustainable development; it should be understandable, clear and unambiguous; it should be achievable within the capacity of governments, with respect to their logistical, technical capacity and other limitations; it should be theoretically well-founded and adaptable to the future.

The initiative of the United Nations (UN) Commission for Sustainable Development (CDS) began in 1995, with the creation of the Work Plan for the Development of Sustainable Development Indicators. The plan gave rise to the first edition of a guide, called "*Indicators of sustainable development: guidelines and methodologies,"* popularly known as the "Blue Book." It established a set of 134 indicators to assess progress towards sustainable development, considering the social, economic and environmental dimensions. Its main function is to guide nations in the identification and implementation of indicators that favor the understanding of multiple interactions underlying sustainable development. Therefore, it is not rigid in determining the set of indicators that should be used and considers the diversities and country specificities (United Nations, 1996).

The institutional dimension of sustainable development started to be portrayed using indicators after the publication of the second edition of the Guide, in 2001. This official document resulted from meetings, discussions and tests that took place in the mid-1990s and aggregated 59 indicators of the four dimensions (United Nations, 2001).

Structurally, the CSD work program is guided by the selection of sustainable development indicators evolved from the *driving force–state-response* (DSR) model, indicating a variation of the pressure-state-response (PSR) model.

The concept of pressures (understood as negative impacts) has been replaced by the driving force (which can describe negative and positive impacts).

The CDS divided the chapters of Agenda 21 into five primary dimensions of sustainable, social, economic, environmental and institutional development. Within these categories, indicators were subclassified according to their driving force, state characteristics, and response. Therefore, the driving force represents the factors underlying the pressures, namely, human activities, processes and patterns that impact the environment (Carvalho & Barcellos, 2010).

The state indicators provide a reading on the condition, while response indicators represent social actions aimed at achieving sustainable development. This organizational structure was an important starting point for the identification and selection of indicators. It was used to present a preliminary list of sustainable development indicators in the publication.

The following important themes were suggested by the CDS for the institutional dimension: integration among decision makers; building capacity; science and technology; awareness about society and information; government and the role of civil society; international cooperation and conventions; civil defense capability; legislative and institutional programs; civil society participation. Based on the tests carried out across 22 countries, including Brazil, a structure with 15 themes and 38 sub-themes was defined and divided into four

dimensions. It provided a guideline for the formulation of indicators to the countries.

Although the DSR model has been useful in organizing the indicators and testing the process, the focus of the analytics framework has been redirected to emphasize key policies or themes, highlight the value of using the indicator and encourage the involvement of governments and civil society in the use and testing of indicators (United Nations, 2001).

Table 1 presents the themes and sub-themes suggested by the CDS/UN for the construction of indicators of the institutional dimension of sustainable development.

Table 1: Themes, sub-themes and sustainability indicators for the institutional dimension

Theme	Sub-theme	Indicator
Institutional Programs	Implementation of Sustainable Development Strategy	Sustainable national development strategy
	International cooperation	Implementation of ratified global agreements
Institutional Capacity	Access to information	Number of Internet users per 1,000 inhabitants
	Communication Infrastructure	Number of telephone lines per 1,000 inhabitants
	science and technology	Percentage of GDP invested in science and technology
	Civil defense	Economic and human losses in the face of catastrophes

Note: Prepared by the authors – Adapted from UNITED NATIONS, 2001.

In its third edition, published in 2007, the CDS/UN guide presented a basic set of 50 indicators including 46 accessories that helped establish relationships with Agenda 21, Plan Implementation Plan, and Millennium Development Goals (MDGs).

The core set of indicators satisfies the following three criteria: a) they address issues that are relevant to sustainable development in most countries, b) provide critical information not made available by other core indicators, and c) can be easily calculated by most countries (data are already available or can be collected in a reasonable time and at a low cost). However, the accessory indicators can provide complementary information that is not relevant or easily available for certain or most countries, respectively.

The set of indicators of the new publication is structured using themes and sub-themes, like the 2001 version. However, it does not present the same division of indicators in four dimensions (social, economic, environmental and institutional).

According to CDS, this change emphasizes the multidimensional nature of sustainable development and reflects the importance of integrating its dimensions. Consequently, new cross-cutting themes such as poverty and natural hazards, were introduced, as shown in Table 2.

Table 2: New arrangement of themes suggested by the CDS/UN

Themes of the Sustainable Development CDS Indicators			
Poverty	Governance	Health	Demography
Natural Hazards	Environment	Earth	Education
Biodiversity	Economic development	Consumption and production patterns	World Economic Partnership
Oceans, seas, coastal and freshwater areas			

Note: United Nations, 2007.

Observing the new themes proposed in the third edition of the CDS/UN Indicators, we found that the topic of Governance is closest to the themes of institutional dimension (institutional framework and capacity), discussed in the previous edition. The Governance theme only presents the following two indicators from the basic set: i) Percentage of the population that paid bribes and ii) Number of intentional homicides per 100,000 inhabitants. This theme does not discuss indicators from the accessories group.

How is the institutional dimension of sustainable development portrayed in Brazil¿

Following the guidelines of the CDS/UN, with certain adjustments to the national reality, the IBGE, has published a series of Sustainable Development Indicators (IDS), since 2002. These indicators are structured in four dimensions and divided into themes and sub-themes. Regarding the institutional dimension, the following two themes are presented: *Institutional Framework and Institutional Capacity.*

In the first series published by the IBGE, four indicators were presented for the institutional dimension. In 2004, the indicator *Existence of municipal councils* was included in the institutional framework theme, and the indicator *Internet access* indicator was included in the capacity theme. This structure was maintained in the 2008 edition.

In the 2010 series, there was a lack of updated data. Therefore, the indicator for the existence of municipal councils was modified, being limited to *municipal environmental councils,* and the indicator *public spending on environmental protection* was eliminated.

The fifth publication of the IDS/IBGE (2012) presented 16 themes, and 62 indicators, including nine indicators that represented the institutional dimension. There were advances in the sense of governance assessment, as suggested by the CDS/UN.

The sixth publication of the IDS/IBGE (2015) maintained the purpose of the previous editions. It allowed access to an information system for the supervision of sustainability in the Brazilian development pattern. Additionally, it introduced new indicators, and updated the already published indicators. The edition presented 63 indicators, most of which were published in the 2012 edition. Among these indicators, 12 comprised the institutional dimension. There was a change in *the Internet* Access indicator (to follow the UN's suggestions), because information regarding the number of Internet users per 1000 inhabitants, became available. The new indicators of this dimension intend to aggregate the framework of the governance structure for sustainable development (IDS/IBGE, 2015).

The *Cultural Heritage* indicator represents cultural and environmental diversity (natural, material and immaterial) recognized in the country and worldwide. Currently, in Brazil, 11 cultural and eight natural properties are recognized as world heritage by the United Nations Educational, Scientific and Cultural Organization (UNESCO). The Environmental legislation indicator reveals the number of cities that have adopted legislation to deal with the environmental issue. The *Municipal Environment Fund* identifies the number of cities that have the financial resources necessary for the development of environmental policy actions.

In the latest publication, IDS/IBGE (2017), the number of indicators that portray the four dimensions of sustainability increased to 64, 11 of which belong to the institutional dimension, with an intention to eliminate the "Local Agenda 21" indicator.

Next, Table 3 presents the evolution of the indicators of institutional dimension, over the years 2002, 2012 and 2015, according to the editions published by IBGE.

Table 3: Indicators of the institutional dimension constructed by the IBGE

Theme	Indicators		
	2002	2012	2015 -2017
Institutional Framework		Ratification of global agreements	Ratification of global agreements
		Municipal Environmental Councils	**Environmental legislation**
	Ratification of global agreements	River Basin Committees	Municipal Environmental Councils
		Civil society organizations	River Basin Committees
			Civil society organizations
Capacity institutional	Research and Development (R&D) Expenses	Research and Development (R&D) Expenses	Research and Development (R&D) Expenses
	Access to telephony services	Access to telephony services	**Municipal Environmental Fund**

		Internet access	Access to telephony services
		Local Agenda 21	Internet access
		Inter-institutional articulations of the Municipalities	Local Agenda 21
			Cultural heritage
			Inter-institutional articulations of the Municipalities

Note: Prepared by the authors - Adapted from IDS/IBGE 2002, 2012 and 2015.

In Table 3, the main advances attempted to verify the presence of governance mechanisms for sustainable development based on the participation of civil society. The processes of articulation and cooperation between social and political actors (interinstitutional articulations of the municipalities) and their effects on institutional arrangements were included. These arrangements are participatory mechanisms for perceiving the demands of the population and monitoring government actions

Because of the complexity of the subject, we do not have extensive statistical production, which hampers data availability and creates pertinent gaps, including better management and governance diagnoses aimed at sustainable development.

VI. Final Considerations

The intensification and multidimensionality of conflicts that involve economic, social and ecological aspects, were verified not only in Brazil, but throughout the world. They remind us that we need to consider other aspects associated with the governance of natural resources.

Among other aspects, institutional sustainability corresponds to the existence of an institutional framework that deals with strategic planning and specific actions for management and governance, to guarantee environmental quality.

The panorama presented on the institutional dimension of sustainable development reveals a generic picture of institutional efforts and capacities. These factors remain underexplored by the indicators, because of their complexity and insufficiency of data and information in Brazil.

Future research should be developed to better assess this dimension, including the proposition of new indicators. However, the UN itself suggests that the institutional dimension needs to be improved by strengthening the governance of sustainable development.

In this aspect, to break with the political, institutional and administrative isolation that has characterized the performance of organizations and actors operating in the country, a cooperative structure of incentives that creates institutional conditions for coordination, becomes necessary.

Digging deeper into the role of governance as a coordination instrument and considering that interactions are multidimensional, it is necessary to contemplate a notion of governance that deals with the transposition of the role of regulating/coordinating State and political-administrative limits of actions.

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The Impact of Technological Innovation and Institutional Quality on the Environment in Nigeria

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Abstract- The study investigated the impact of technological innovation, institutional quality on the environment in Nigeria. The study spanned from 1990 to 2022. The key variables in the study were technological innovation as proxy by technological index, institutional quality as proxy by six governance indicators, and carbon emission as proxy for environment. While the control variables include energy consumption and Gross domestic product. The study first conducted a pre-estimation test using Descriptive statistics and Correlation matrix, and Augmented Dickey Fuller test for stationarity while Ordinary least was used as major estimation techniques since it does not violates classical linear regression assumption. The findings from the preliminary estimation shows that all data series are stationarity at levels. The result form the best linear unbiased estimates indicate that environmentally related technological innovation destructively affects $C0_2$ emissions while energy consumption and economic growth positively impact $C0_2$ emissions.

Keywords: *technological innovation, institutional quality, environment, gross domestic product.*

GJHSS-E Classification: *LCC: GE1-350*

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Abstract- The study investigated the impact of technological innovation, institutional quality on the environment in Nigeria. The study spanned from 1990 to 2022. The key variables in the study were technological innovation as proxy by technological index, institutional quality as proxy by six governance indicators, and carbon emission as proxy for environment. While the control variables include energy consumption and Gross domestic product. The study first conducted a pre-estimation test using Descriptive statistics and Correlation matrix, and Augmented Dickey Fuller test for stationarity while Ordinary least was used as major estimation techniques since it does not violates classical linear regression assumption. The findings from the preliminary estimation shows that all data series are stationarity at levels. The result form the best linear unbiased estimates indicate that environmentally related technological innovation destructively affects $C0_2$ emissions while energy consumption and economic growth positively impact $C0_2$ emissions. Based on these findings, the government should raise investment in environmental technological innovation so as to improve the quality of institutional environment to achieve sustainable development targets.

Keywords: technological innovation, institutional quality, environment, gross domestic product.

I. Introduction

Past decades have witnessed a dramatic surge in the consumption of fossil fuels and other energy sources most especially in developing economies and this becomes imperative in order to achieve economic prosperity (he-man and Islam, 2023; Obodisa et al, 20224, Zhang et al, 2022). The surge in energy consumption has also increases the pace for greenhouse gas emissions (GHG) as a result of catastrophic variations in weather patterns, including tornadoes, volcanic eruptions and earth quakes. The aftermath of these myriads of problems have significantly affected human welfare, wildlife and ecosystems (Obodbisa et al, 2022b).

In addition to other greenhouse emission; $C0_2$ is considered as a major pollution in operation in both developing and developed nations. Therefore, reducing the pace of $C0_2$emission has been a subject to the discourse among world leaders. The $C0_2$ emission was actually tippled since 19A60 due to the continues consumption of solid, liquid and gaseous furls (Ashamed and Saheng, 2021). The regard, innovating in environmental related technology required the development of institutional as an importance factor that can mitigate the adverse effects of $C0_2$ emission on human health and the environment (Khan, 2022, Zhangatal 2022).

Underneath the environmental related technological innovation is the identification of new products and improvements in existing products, process that can reduce energy consumption. Recently, technological innovation has played a vital role in rescuing global all climate charge, Obobisietal, 2002a). Quantum of studies have been conducted on the fundamental role of technological innovation as a driver of industrial transformation, as well as pudding and increasing the quality and efficiency in them modern era (Wang and Li, 2002). It has also been argued that environmental related technology is a powerful teaching that has a more significant positive group etc. on the environmental (Dong et al; 2022). Technology offers benefits to the environmental by using green energy and reducing the use of fossil fuels. These technologies may hope the country in improving the efficiency of their production Oriento. This will help prevent climate change impact and encourage green economic growth, and significantly lower C02 emissions (Dorgatal, 2022). Aside the developments of environmental related technology innovations, institutional framework would also as sit in environmental protein measures by lowering C02 emissions and enhance environmental Quality's (Obobica et al, 2022b).It has also been debated extensively that institutional quality is a sin equal non in government policy implementation and pollution control. Strong institutional frameworks combat corruption, support establishing the rule of law, reducing military participation in poultices and increase, public financial management (Hassan et al, 20220a). The importance of our institutions in determining environmental quality is significant and inestimable intense institutional rules and a strict rule of laid can force businesses to reduce Co2 emissions. Better intuitional quality is essential to decrease pollution and ensure environmental sustainability (Asongu, and Odhuambo, 2019).

In the light of this background, the study intends to examine the impact to technological innovations and

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institutional quality on Co2 emissions a proxy for climate change.

II. Selected Existing Literature

Historical validation has provided limited empirical evidence on the role of technological innovation and institutional quality on climate change in selected countries in West Africa. Prominent among these studies are (Youetal; 2022) Quetta. 2020, Ben Amara and Chen, 2002) among others. They argued that environmental related technology innovation has developed a significant instrument for organization to accomplish market reputation, sustainable development and compliance with international environmental laws and standards. Studies by Fernandez et al. 2018: Retro Vic and Tobago eta. 2020; Sabir, 2022 used research and development to measure the level of technological innovation, energy efficiency is also considered as essential indicator for measuring technological innovation. These studies conducted that energy efficiency plays a relatively significant role in product C02 emissions.

In a similar study conducted by Alvarez – Herranz et al, 2017, cheng et al 2019l, Has brain and Alam, 2019, Frdogan et al. 2020). They proposed foreign direct investment as a measure of technological innovation. They concluded that technological innovation positively impact sustainability growth and lowers environmental pollution. Studies conducted by Adebayoetal (2023) on the effect of technological innovation on the environmental in BRCC counties using panel data estimation. They drew an inference that technological advancement reduces C02 emissions for selected countries in BRICS.

Radian & Tuspekora (2002) examine the impact of technological innovation, renewable energy, and economic growth on environmental sustainability in Kazakhstan. The results show that technical innovation and renewable energy sources positively impact the attainment of environmental sustainability by riding $C0_2$emissions, while economic growth and fossil fuel consumption increase $C0_2$ emissions. In another study conducted by Usman and Hammar, 2021) in APEC countries using panel data analysis. They demonstrate that technological advancement harm the environment overtime. This result was also confirmed by Acemogu *et al,* (2012), that while technological innovation encourages economic growth, it can also raise carbon emissions. It is then suggested that government must employ cutting edge technology to encourage infant industry, stressing that technological innovation increases the industrial production levels and destroys the environment. In contrast, Denestor *et al.* 2021) investigated the association between innovation, carbon emissions and trade openings in African countries and found an inverted U – shaped relationship between innovation and carbon emission.

However, the linkage between institutional quality and environment has been found to be under explored in the literature (Jiang *et al,* 2022). A more recent study conducted by Egbetokun *et al.* 2020) proposed that a country's environmental legislation also requires competent institutions to encourage the use of renewable energy and achieve sustainable development. Studies by (Wang *et al.* 2023) investigated the impact of institutional quality, environmental governance and technological innovation on consumption of fossil fuels in the selected European union countries. Their result show that environmental governance and institutional quality reduces the consumption fossil fuels. This result was corroborated by the work of (holder and Seethe, 2021) who concluded that poor institutional quality has a negative impact on C02 emissions in emerging countries. A similar conclusion was also emphasizes by (Wawrzniak and Dri, 2020) that better government effectiveness reduces C02 emissions in emerging and developed countries. Obobiasa *et al* (2022b) also documented that green technical innovation and institutional quality reduce C02 emissions and supports sustainable developments. Similar study conducted by (Salman *et al.,* 2019) investigated the relationship among institutional quality, economic growth and C02 emissions, in Indonesia, South Korea and Thailand. They observed that extensive role of institutional quality goes a long way in decreasing emissions, and increasing economic growth, Kahn and Rae also corroborated the findings of (Salman *et al* ., 2019) by revealing that institutional reduce C02 emissions. Having reviewed that literature so far, it is therefore imperative to unravel the extent to which technological innovation and institutional quality can reduce C02 emissions.

III. Theoretical Framework and Methodology

The underlying theoretical model underlining the relationship between environment, technological innovations and institutional takes its root from Environmental Kuznets curve as proposed by Simon-Kuznets. (EKC) conjecture seeks to establish an inverted U-shaped nexus between income per capita and environmental degradation. It emphasizes that at early stages of economic growth and development, environmental degradation increase at an increasing rate. Nonetheless, after some threshold of economic developments, the movements tend to reverse at higher levels of economic progress.

Kuznets curve when used to analyses environments income and pollution it is called (EKC).

This means that for a society to attain higher level of development, natural resources must be employed because it will have some residual effects on the environment there by achieving prolonged and sustained development with better institutional quality in the process.

As economy develops, pollution grows at a faster rate since priority and attention are devoted to rising and increasing material production output. This leads to insensitivity of the people which makes them more interested in financial gains other than the environment in which they live in. The rapid growth therefore leads to higher use and utilization of natural resources and subsequently higher levels of pollutants which degrades and reduces environmental quality.

a) Data

Since the study intends to unravel the extent to which innovation related technology and institutional quality impact on the environment. It is therefore imperative to identifying some key variables needed for estimation namely dependent and independent variables. The study use carbon emission C02 as proxy for environmental (Umar *et al.,* 2020) while technological innovation and institutional quality are used as independent variables. The study went further to incorporate some control variables such as economic growth, energy consumption and trade openness. The data were sourced from World Bank Development indicator, 2021, institution quality was used as governance indicator.

b) Model Specification

Following the work of (Shabir *et al.,* 2021) and (Wang *et al,.* 2023) the model as specifies as follows.

$$C0_2 - fF\ (TI, IQ, TOP, ECO, GDP).$$

Where TI represents Technological innovations, Technological index was used to represent technology innovation, IQ – represents institutional Quality which according to Wang *et al*. (2023) include six governance indicators namely control of corruption (CC), government effectiveness (GE), Political stability (PS), and regulatory quality (RQ). Rule of law (RL) and voice and Accountability (VA). The data were obtained from world development indicators and in the range of –2.5 to 2.5.

TOP – represents trade openness which could be obtained by the addition of export plus import as a ratio of GDP.EO represents energy consumption – Aggregate energy consumption as a ratio of GDP.GDP – represents Gross domestic product as a proxy for economic growth.

IV. Result Presentation, Analysis and Interpretation

This section entails the presentation of results from the data analysis also well as the interpretation of the obtained results on the effects of technological innovation, institutional quality on environment.

The remaining aspects comprise the descriptive statistics unit root result, correlation and ordinary least square regression result.

Table 4.1: Description Statistics.

Variable	C02	TI	IQ	ECO	GDP
Mean	0.057243	0.030695	0.026638	0.001248	0.045129
Median	0.058150	0.039250	0.026450	0.009000	0.038800
Maximum	0.230500	0.153300	0.031100	0.43220	0.097900
Minimum	l-0.055800	-0.131300	0.024400	-0.435700	0.035,000
Std. Dev.	0.60750	0.053224	0.001419	0.145360	0.017653
Skewness	0.628366	-0.842927	1.160923	l-0.434319	2.116536
Kurtosis	3.430486	4.740159	4.700781	6.70l86971	5.l894809
Jarqu-Bera	3.088214	10.27295	14.49634	25.39069	46.02294
Probability	0.213502	0.00587842	0.000711	0.000003	0.000000
Observation	42	42	42	42	42

Source: Author's Computation (2023) Using E-views (10)

The statistical measure of central tendency, dispersion, skewness, kurtosis and normality test describe the characteristics of the above data. The jarque–Bera (JB) statistics rejected the null hypothesis of normal distribution for all the variables namely Carbon dioxide emission, technological innovation institutional qualities, energy consumption and Gross domestic product are statistically significant at 5% as their JB probability is lesser than 5%, this indicate that cross. sectional variables are normal. According to the probability of the used variable (CO_2, TI, IQ, ECO, GDP) except for $C0_2$ with the probability value of0.1213502 which is greater than 5% level.

Table 4.1 reveal that the average growth rate within the period was 0.030695 with the maximum of 0.153300 reported in 2012, while the minimum is 0.039250 observed in 2017. Similarly the P-value of all estimates and result which represented the probability of observing a simple value as extreme as the value actually observed given that the null hypothesis is true served as a guide for accepting or rejecting null hypothesis at various stage in the analysis, by comparing it to significance level.

Table 4.2: Correlation Matrix of the Variables.

Variable	$C0_2$	TZ	I	ECO	GDP
$C0_2$	1.0000	0.3700	0.0415	+0.2046	-0.1313
TI	0.3700	1.0000	0.257	-0.0606	-0.4l848
IQ	0.0415	0.2537	1.0000	l-0.0571	-0.5188
ECO	-0.2046	- 0.06066	-0.0606	-0.0571	1.0000
GDP	-0.1318	-90.4848	-0.5188	0.0360	1.000

Source: Author's Computation, 2023 Using E-view 10.

Table 4.2 Shows the correlation matrix of variables for detection of possible strong correlation between technology innovation, institutional quality on the environment. From the result, it shows there's a strong and positive relationship between technological innovation and institutional quality on the environment.

It can be inferred that positive association exist between technological innovation and institution quality with technological innovation value of 0.3700 and 0.045 for institutional quality which means that $C0_2$ emission is positively associated with technological innovation and institutional quality in Nigeria. Also, the result shows that there is a positive relationship between $C0_2$ emission and energy consumption and negative relationship with Gross domestic product. This result validates the energy led $C0_2$assumption. This shows that a 1% rise in energy usage will probably enhance carbon emissions by 0.2046 and a decrease of 0.4313 percent in the Gross domestic product in the long run. This outcome is consistent with the previous studies of (Lawson, 2002, Islam *et al,* 2021 and Musha *et al,* 2021).

a) Stationarity Test

The study examined the unit root test on the selected variables using the Augmented Dickey Fuller (ADF) and the result of the unit root is presented below:

Table 4.3

Variable	Test Order	Critical Value	P Value	Order of Integrate
$C0_2$	Level	-4.145238	0.0033	I(O)
TI	Level	-6-529573	0.0000	I(O)
IQ	Level	-2.630404	0.0122	I(O)
ECO	Level	l-5.128463	0.0001	I(O)
GDP	Level	l-3.750442	0.0320	I(O)

Table 4.3 displays the stationary of the variables used in the study. It can be inferred from the table that all the variables are integrated at levels. This means that there is no long run relationship among the variables, a short run relationship may exist and there is no need for co-integration estimation.

Table 4.4: Ordinary Least Square Result

Dependent Variable: $C0_2$.

Methods: least square.

Variables	Coefficient	Std Error	t-statute	Pro
TI	0.0311679	0.151565	2.056406	0.0468
IQ	-0.073356	0.054395	l-1.348270	0.1857
ECO	-0.1070l57	5.641250	L0.108977	0.9850
GDP	-0.083095	0.ll876187	-0l.0948370	-9,250
C	0.019752	0.198422	0.09905470	.9212

R-Squared	0.178194	Mean dependent view	0.031190
Adjusted R-Square	0.089350	S.D deponent View	0.053475
S.C. Regression	0.051030	Akaike Info Criterion	-3.001477
Slum Square resultt	0.096349	Schwarz criterion	-2.794611
Log (Likelihood	68.0101	Hannah – Qulin Crater	-2.92565
F – Statistic	2.005700	Durbin – Watson stat	1.219277
Prob (F-statiscs)	0.113856		

Source: authors Computation (2023) using E-view 10

Table 4.4 Show the ordinary least square result coefficients, standard error, t-statistics and probability value for all the selected variables. The result of the coefficient show the influence of specified independent variable of technological innovation, institutional quality and gross domestic product on environment in Nigeria. The study observed that a unit change in variable such as technological innovation charge in variable such as technological innovation (0.04468, P < 0.05), Renewable energy consumption (0.9850, P >0.05), and institutional quality (1Q), (0.1857, P > 0.5) and Gross domestic product (0.9212, P > 0.05) will result into an increase in the growth rate in carbon emission in the long run. This implies that all the indicators of Technological innovation and gross domestic product contributed positively toward the carbon dioxide emission but does not statically significant at 5% level of significance.

Similarly, the coefficient of determination (R- Square) value of 0.3608.38 Indicate that 36.08% of the variation in technological innovation and Gross domestic product attributed to changes in variables such as carbon emission while standard error of the regression value of 0.46029supports the overall fitness.

V. Conclusion

This study investigated the effect of technological innovation, institutional quality, gross domestic product on carbon emission in Nigeria with the application of ordinary least square (OLS) and various diagnostic test techniques. The results of unit root test suggest that all the variables in the model are stationary at level and that of correlation indicate that there exist positive relationship between technological innovation, institutional quality on the environment which implies the existence of short – run relationship between carbon emission, technological innovation and gross domestic product.

The result also revealed that technological innovation and gross domestic product are positively related with carbon emission, which means technological innovation and gross domestic product does not hinder carbon emission based on the P – value as expressed in the analysis above.

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FSSRC/ASSRC Memberships

Introduction

FSSRC/ASSRC is the most prestigious membership of Global Journals accredited by Open Association of Research Society, U.S.A (OARS). The credentials of Fellow and Associate designations signify that the researcher has gained the knowledge of the fundamental and high-level concepts, and is a subject matter expert, proficient in an expertise course covering the professional code of conduct, and follows recognized standards of practice. The credentials are designated only to the researchers, scientists, and professionals that have been selected by a rigorous process by our Editorial Board and Management Board.

Associates of FSSRC/ASSRC are scientists and researchers from around the world are working on projects/researches that have huge potentials. Members support Global Journals' mission to advance technology for humanity and the profession.

FSSRC

Fellow of Social Science Research Council

FELLOW OF SOCIAL SCIENCE RESEARCH COUNCIL is the most prestigious membership of Global Journals. It is an award and membership granted to individuals that the Open Association of Research Society judges to have made a 'substantial contribution to the improvement of computer science, technology, and electronics engineering.

The primary objective is to recognize the leaders in research and scientific fields of the current era with a global perspective and to create a channel between them and other researchers for better exposure and knowledge sharing. Members are most eminent scientists, engineers, and technologists from all across the world. Fellows are elected for life through a peer review process on the basis of excellence in the respective domain. There is no limit on the number of new nominations made in any year. Each year, the Open Association of Research Society elect up to 12 new Fellow Members.

Benefit

To the institution

Get letter of appreciation

Global Journals sends a letter of appreciation of author to the Dean or CEO of the University or Company of which author is a part, signed by editor in chief or chief author.

Exclusive Network

Get access to a closed network

A FSSRC member gets access to a closed network of Tier 1 researchers and scientists with direct communication channel through our website. Fellows can reach out to other members or researchers directly. They should also be open to reaching out by other.

Career | Credibility | Exclusive | Reputation

Certificate

Certificate, LOR and Laser-Momento

Fellows receive a printed copy of a certificate signed by our Chief Author that may be used for academic purposes and a personal recommendation letter to the dean of member's university.

Career | Credibility | Exclusive | Reputation

Designation

Get honored title of membership

Fellows can use the honored title of membership. The “FSSRC” is an honored title which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., FSSRC or William Walldroff, M.S., FSSRC.

Career | Credibility | Exclusive | Reputation

Recognition on the Platform

Better visibility and citation

All the Fellow members of FSSRC get a badge of "Leading Member of Global Journals" on the Research Community that distinguishes them from others. Additionally, the profile is also partially maintained by our team for better visibility and citation. All fellows get a dedicated page on the website with their biography.

Career | Credibility | Reputation

Future Work

Get discounts on the future publications

Fellows receive discounts on future publications with Global Journals up to 60%. Through our recommendation programs, members also receive discounts on publications made with OARS affiliated organizations.

Career | Financial

GJ Account

Unlimited forward of Emails

Fellows get secure and fast GJ work emails with unlimited forward of emails that they may use them as their primary email. For example,
john [AT] globaljournals [DOT] org.

Career | Credibility | Reputation

Premium Tools

Access to all the premium tools

To take future researches to the zenith, fellows receive access to all the premium tools that Global Journals have to offer along with the partnership with some of the best marketing leading tools out there.

Financial

Conferences & Events

Organize seminar/conference

Fellows are authorized to organize symposium/seminar/conference on behalf of Global Journal Incorporation (USA). They can also participate in the same organized by another institution as representative of Global Journal. In both the cases, it is mandatory for him to discuss with us and obtain our consent. Additionally, they get free research conferences (and others) alerts.

Career | Credibility | Financial

Early Invitations

Early invitations to all the symposiums, seminars, conferences

All fellows receive the early invitations to all the symposiums, seminars, conferences and webinars hosted by Global Journals in their subject.

Exclusive

Publishing Articles & Books

Earn 60% of sales proceeds

To take future researches to the zenith, fellows receive access to all the premium tools that Global Journals have to offer along with the partnership with some of the best marketing leading tools out there.

Exclusive | Financial

Reviewers

Get a remuneration of 15% of author fees

Fellow members are eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get a remuneration of 15% of author fees, taken from the author of a respective paper.

Financial

Access to Editorial Board

Become a member of the Editorial Board

Fellows may join as a member of the Editorial Board of Global Journals Incorporation (USA) after successful completion of three years as Fellow and as Peer Reviewer. Additionally, Fellows get a chance to nominate other members for Editorial Board.

Career | Credibility | Exclusive | Reputation

And Much More

Get access to scientific museums and observatories across the globe

All members get access to 5 selected scientific museums and observatories across the globe. All researches published with Global Journals will be kept under deep archival facilities across regions for future protections and disaster recovery. They get 10 GB free secure cloud access for storing research files.

ASSRC

ASSOCIATE OF SOCIAL SCIENCE RESEARCH COUNCIL

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The primary objective is to recognize the leaders in research and scientific fields of the current era with a global perspective and to create a channel between them and other researchers for better exposure and knowledge sharing. Members are most eminent scientists, engineers, and technologists from all across the world. Associate membership can later be promoted to Fellow Membership. Associates are elected for life through a peer review process on the basis of excellence in the respective domain. There is no limit on the number of new nominations made in any year. Each year, the Open Association of Research Society elect up to 12 new Associate Members.

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Organize seminar/conference

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Exclusive

Publishing Articles & Books

Earn 60% of sales proceeds

Associates can publish articles (limited) without any fees. Also, they can earn up to 30-40% of sales proceeds from the sale of reference/review books/literature/publishing of research paper.

Exclusive | Financial

Reviewers

Get a remuneration of 15% of author fees

Associate members are eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get a remuneration of 15% of author fees, taken from the author of a respective paper.

Financial

And Much More

Get access to scientific museums and observatories across the globe

All members get access to 2 selected scientific museums and observatories across the globe. All researches published with Global Journals will be kept under deep archival facilities across regions for future protections and disaster recovery. They get 5 GB free secure cloud access for storing research files.

Associate	Fellow	Research Group	Basic
$4800 **lifetime designation**	$6800 **lifetime designation**	$12500.00 **organizational**	APC **per article**
Certificate, LoR and Momento **2** discounted publishing/year **Gradation** of Research **10** research contacts/day **1 GB** Cloud Storage **GJ** Community Access	**Certificate,** LoR and Momento **Unlimited** discounted publishing/year **Gradation** of Research **Unlimited** research contacts/day **5 GB** Cloud Storage **Online Presense** Assistance **GJ** Community Access	**Certificates,** LoRs and Momentos **Unlimited** free publishing/year **Gradation** of Research **Unlimited** research contacts/day **Unlimited** Cloud Storage **Online Presense** Assistance **GJ** Community Access	**GJ** Community Access

Preferred Author Guidelines

We accept the manuscript submissions in any standard (generic) format.

We typeset manuscripts using advanced typesetting tools like Adobe In Design, CorelDraw, TeXnicCenter, and TeXStudio. We usually recommend authors submit their research using any standard format they are comfortable with, and let Global Journals do the rest.

Alternatively, you can download our basic template from https://globaljournals.org/Template.zip

Authors should submit their complete paper/article, including text illustrations, graphics, conclusions, artwork, and tables. Authors who are not able to submit manuscript using the form above can email the manuscript department at submit@globaljournals.org or get in touch with chiefeditor@globaljournals.org if they wish to send the abstract before submission.

Before and during Submission

Authors must ensure the information provided during the submission of a paper is authentic. Please go through the following checklist before submitting:

1. Authors must go through the complete author guideline and understand and *agree to Global Journals' ethics and code of conduct,* along with author responsibilities.
2. Authors must accept the privacy policy, terms, and conditions of Global Journals.
3. Ensure corresponding author's email address and postal address are accurate and reachable.
4. Manuscript to be submitted must include keywords, an abstract, a paper title, co-author(s') names and details (email address, name, phone number, and institution), figures and illustrations in vector format including appropriate captions, tables, including titles and footnotes, a conclusion, results, acknowledgments and references.
5. Authors should submit paper in a ZIP archive if any supplementary files are required along with the paper.
6. Proper permissions must be acquired for the use of any copyrighted material.
7. Manuscript submitted *must not have been submitted or published elsewhere* and all authors must be aware of the submission.

Declaration of Conflicts of Interest

It is required for authors to declare all financial, institutional, and personal relationships with other individuals and organizations that could influence (bias) their research.

Policy on Plagiarism

Plagiarism is not acceptable in Global Journals submissions at all.

Plagiarized content will not be considered for publication. We reserve the right to inform authors' institutions about plagiarism detected either before or after publication. If plagiarism is identified, we will follow COPE guidelines:

Authors are solely responsible for all the plagiarism that is found. The author must not fabricate, falsify or plagiarize existing research data. The following, if copied, will be considered plagiarism:

- Words (language)
- Ideas
- Findings
- Writings
- Diagrams
- Graphs
- Illustrations
- Lectures

- Printed material
- Graphic representations
- Computer programs
- Electronic material
- Any other original work

Authorship Policies

Global Journals follows the definition of authorship set up by the Open Association of Research Society, USA. According to its guidelines, authorship criteria must be based on:

1. Substantial contributions to the conception and acquisition of data, analysis, and interpretation of findings.
2. Drafting the paper and revising it critically regarding important academic content.
3. Final approval of the version of the paper to be published.

Changes in Authorship

The corresponding author should mention the name and complete details of all co-authors during submission and in manuscript. We support addition, rearrangement, manipulation, and deletions in authors list till the early view publication of the journal. We expect that corresponding author will notify all co-authors of submission. We follow COPE guidelines for changes in authorship.

Copyright

During submission of the manuscript, the author is confirming an exclusive license agreement with Global Journals which gives Global Journals the authority to reproduce, reuse, and republish authors' research. We also believe in flexible copyright terms where copyright may remain with authors/employers/institutions as well. Contact your editor after acceptance to choose your copyright policy. You may follow this form for copyright transfers.

Appealing Decisions

Unless specified in the notification, the Editorial Board's decision on publication of the paper is final and cannot be appealed before making the major change in the manuscript.

Acknowledgments

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

Declaration of funding sources

Global Journals is in partnership with various universities, laboratories, and other institutions worldwide in the research domain. Authors are requested to disclose their source of funding during every stage of their research, such as making analysis, performing laboratory operations, computing data, and using institutional resources, from writing an article to its submission. This will also help authors to get reimbursements by requesting an open access publication letter from Global Journals and submitting to the respective funding source.

Preparing your Manuscript

Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.

Manuscript Style Instruction (Optional)

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11'", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

Structure and Format of Manuscript

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

a) A title which should be relevant to the theme of the paper.
b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
d) An introduction, giving fundamental background objectives.
e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
f) Results which should be presented concisely by well-designed tables and figures.
g) Suitable statistical data should also be given.
h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.

Format Structure

It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

All manuscripts submitted to Global Journals should include:

Title

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

Author details

The full postal address of any related author(s) must be specified.

Abstract

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Keywords

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, “What words would a source have to include to be truly valuable in a research paper?” Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods

Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

Formulas and equations

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

Tables, Figures, and Figure Legends

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.

Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

Preparation of Eletronic Figures for Publication

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

Tips for writing a good quality Social Science Research Paper

Techniques for writing a good quality homan social science research paper:

1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of homan social science then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.

6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10. Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.
Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

19. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

20. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

21. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

22. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

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Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.

Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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