

Impact of MGNREGA participation on Household Income in India

ECON F342 : Applied Econometrics



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ABSTRACT

This study assesses the impact of the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) on household income in India. It uses the India Human Development Survey-II (IHDS-II) dataset and a weighted least squares regression approach to address heteroskedasticity. The analysis controls for a range of demographic, socio-economic, and consumption variables. We expect that participation in MGNREGA will be positively associated with household income by providing guaranteed wage employment and supporting asset creation. Additionally, factors such as urban residence, higher educational attainment, and increased consumption expenditure are expected to further contribute to higher income levels. These findings have important implications for future policy designs related to demographic job creation and income analysis. However, the study is limited by its cross-sectional design.

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Introduction

The Mahatma Gandhi National Rural Employment Guarantee Act 2005 (MGNREGA) was passed with the objective of improving livelihood security of households in rural areas across the country. It provides for at least one hundred days of assured wage employment to at least one member of every rural household whose adult members volunteer to do unskilled manual work. If the government fails to provide this employment, it is bound by the act to provide certain unemployment allowances to the people. In this manner, the government aims to safeguard the right to work. It considers employment to be a legal entitlement. The act also aims to create durable assets to augment land and water resources in order to improve rural connectivity and strengthen the resource base of the rural poor.

The impact of MGNREGA on rural households shows that the act had wide socio-economic prospects. It multiplied rural household savings leading to better micro-finance management. The act guaranteed one-third of the jobs to women, thus having a significant impact on their social participation. It increased tribal participation as well. There has been a visible push in rural infrastructure development, subsequently enhancing biodiversity and sustainable development. Overall, MGNREGA has proved to be a lifeline for poor households.

This project aims to delve into the impact of MGNREGA on household income in the country. Several research papers related to the impact of the act on various regions as well as demographics have been reviewed. The significance of this on consumption and food expenditure has also been studied. Finally, a regression model has been detailed, aiming to provide quantifiable results and give the readers a comprehensive picture of MGNREGA and its implication on income levels of households.

Literature Review

Paper 1: *Impact of MGNREGA on the livelihood Security of rural Poor in India: A Study Using National Sample Survey Data*

Author: Saswati Das

Introduction

The study, *Impact of MGNREGA on the livelihood security of rural poor in India*, authored by Saswati Das, investigates the effectiveness of the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) in enhancing livelihood security among India's rural poor. Utilizing data from India's National Sample Survey (NSS), this research evaluates how the program has influenced household consumption and expenditure patterns, focusing on both food and non-food items.

Methodology

The research employs a difference-in-differences approach to compare changes in monthly per capita expenditure (MPCE) between treatment households (those benefiting from MGNREGA) and control households (non-beneficiaries). Propensity score matching was used to ensure comparability between these groups. Data from the 61st (2004-2005) and 66th (2009-2010) NSS rounds were analyzed, with adjustments for inflation to maintain consistency.

Key Findings

1. **Spending Trends:** The study observed an increase in MPCE across all households during the study period. However, this growth was primarily attributed to overall economic trends rather than MGNREGA's direct impact.
2. **Program Effectiveness:** The true effect of MGNREGA on treatment households was found to be underwhelming. Beneficiary households experienced lower increases in MPCE compared to control households.
3. **Food vs. Non-Food Expenditure:** Both food and non-food expenditures grew more significantly for non-beneficiary households, indicating that MGNREGA's impact on improving access to basic needs was limited.
4. **Wage Disparities:** Wages earned through MGNREGA were lower than those available in alternative employment, further limiting its ability to enhance household income.

Challenges Identified

- Targeting Issues: Only about 43% of job cardholders belonged to manual unskilled laborer households, indicating inefficiencies in targeting the intended beneficiaries.
- Limited Employment Days: Households received an average of only 42 days of work annually under MGNREGA, far below the promised 100 days.
- Inflationary Pressures: The study highlights that inflation significantly influenced expenditure patterns, complicating assessments of MGNREGA's real impact.

Conclusion

While MGNREGA has succeeded in providing some level of employment and income support, its overall impact on improving livelihood security remains modest. The program's inability to meet its self-targeting goals and provide adequate days of employment limits its effectiveness. Policymakers must address these shortcomings by improving targeting mechanisms, increasing awareness among potential beneficiaries, and ensuring better implementation at local levels.

Paper 2: *Impact of MGNREGA on Rural Agricultural Wages in SAT India*

Author: N Nagaraj, Cynthia Bantilan, Lalmani Pandey, and Namrata Singha Roy

Introduction

This paper examines the impact of the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) on rural agricultural wages in semi-arid tropical (SAT) regions of India. Using data from ICRISAT's Village Level Studies in six villages across Telangana and Maharashtra, the study analyzes how MGNREGA has affected labor scarcity, agricultural and non-agricultural wages, cost of production, cropping patterns, and farm mechanization. The research compares key indicators before (2003-2005) and after (2009-2011) MGNREGA implementation to assess its effects on the rural labor market and agricultural sector.

Methodology

The methodology primarily relies on descriptive statistical analysis, including the calculation of compound growth rates and comparison of key indicators before and after MGNREGA. The researchers examined trends in real wages, labor use, mechanization, cropping patterns, and income over time. Data was collected through personal interviews with households in each village, using standard questionnaires on employment and cultivation. The sample households were selected using stratified random sampling to represent different landholding categories. To account for inflation, nominal values were converted to real terms using the wholesale consumer price index for agricultural laborers, with 2009-10 as the base year.

Key Findings

- Real wages for both farm and non-farm work increased significantly after MGNREGA implementation.
- Male farm worker wages grew sharply after MGNREGA compared to negative growth before.
- Gender wage gaps persisted and even increased in non-farm work.
- Labor use declined for crops like paddy, soybean and pigeon pea after MGNREGA.
- Farm mechanization increased to compensate for labor shortages.
- Area under labor-intensive crops like paddy and cotton decreased.
- Labor costs as a proportion of total production costs increased substantially.
- Non-farm income growth outpaced farm income growth in some villages.

Challenges Identified

- Labor scarcity: There was a growing shortage of agricultural labor, especially during peak seasons, due to the diversion of rural farm workers to MGNREGA projects.
- Rising wages and production costs: The implementation of MGNREGA led to a significant increase in agricultural wages, which in turn raised the cost of production for farmers. The share of labor costs as a proportion of total production costs increased substantially, impacting net returns.
- Persistent gender wage gap: Despite overall wage increases, the gender wage gap in rural labor markets persisted and even widened in some cases, especially for non-farm work.
- Declining labor use and changing cropping patterns: There was a steady decline in labor absorption for labor-intensive crops like paddy, soybean, and pigeon pea after MGNREGA implementation. This led to changes in cropping patterns, with a decline in area under labor-intensive crops in some regions.
- Youth migration from agriculture: There was a notable decline in the participation of male youth (20-34 years) in farm work, indicating a shift towards non-farm activities. This trend contributes to the aging of the agricultural workforce and poses challenges for the sector's future.

Conclusion

Using data from six villages in Telangana and Maharashtra, this study investigates how MGNREGA has affected rural agricultural incomes and labour markets in India's semi-arid tropical regions. Following the adoption of MGNREGA, the study finds notable developments, such as rising real wages, ongoing gender wage inequalities, a shift towards farm mechanisation, and a decline in labour usage in labour-intensive crops. In order to address changing rural labour market dynamics and guarantee agricultural sustainability, the research emphasises the necessity of focused governmental interventions. These problems include labour scarcity, rising production costs, and shifting cropping patterns.

Paper 3: *Food Expenditure and Household Welfare in India : MGNREGA Program Outcomes*

Author: Nidhi Menon

Introduction

The paper examines MGNREGA and its impact on household welfare in India. MGNREGA aims to enhance livelihood security by providing at least one hundred days of guaranteed employment every financial year to every household where adult members are willing to do unskilled manual work. Since individuals derive welfare more from the actual consumption of goods and services than from their income, consumption is a good method to understand the standard of living. This study investigates how welfare has changed in Uttar Pradesh, India, as a consequence of the MGNREGA policy between 2006 and 2009. Specifically, it explores how (i) food expenditure and (ii) nutritional intake have changed in households of districts with and without the policy over this time period and (iii) if households meet the nutritional adequacy requirements in districts with and without the policy. The paper hypothesizes that food expenditure and nutritional intake increased at a higher rate in households of districts with the policy rather than without it in this time period, and households in districts with the policy met a higher number of nutritional adequacy requirements than households in districts without it in this time period.

Methodology

To understand the effect of MGNREGA on welfare, the study used monthly food expenditure and nutritional value data for over 400,000 households in Uttar Pradesh, India between 2006 and 2009. The households were divided into three groups based on when the policy was implemented in their district (Phase I, Phase II, Phase III). Phase I households served as the Treatment Group, while Phase III households served as the Control Group. The study then analyzed the per capita food expenditure and nutritional adequacy ratio (NAR) and aggregated them based on districts, and then Phases. A difference-in-difference (DID) estimation was conducted to understand the effect of MGNREGA on welfare. The NAR was calculated by dividing the per capita nutrient intake by the Recommended Daily Allowance to determine if households met their nutritional requirements.

Key Findings

- **Food Expenditure:** In 2006, households in all three phases spent approximately the same amount on food. By 2009, Phase I households increased their expenditure by 30 percent, Phase II by 34 percent, and Phase III by 39 percent. The difference-in-difference estimation revealed that households in the Control Group were, on average, spending 35% more on food consumption than households in the Treatment Group.

- **Nutritional Adequacy Ratio:** Between 2006 and 2009, a decrease in nutritional value intake was observed for all nutrients in all three Phases. Households, on average, had an adequate amount of protein, fat, and thiamine in their diet regardless of their Phase or time period. Conversely, households, on average, did not have an adequate amount of energy, calcium, iron, beta-carotene, and riboflavin in their diet. Additionally, households in all three Phases, on average, had an adequate amount of ascorbic acid in 2006 but an inadequate amount of it in 2009.
- **MGNREGA's Impact on NAR:** The difference-in-difference estimate showed that MGNREGA had a positive effect on fat, energy, iron, beta-carotene, and riboflavin intake. However, MGNREGA had a negative effect on protein, calcium, thiamin, and ascorbic acid. MGNREGA played no role in the change in niacin because the DID value was 0. T-tests on all the values calculated were found to be significant with a p-value of 0.001 at the 99 percent confidence level.

Challenges Identified

- High food price volatility in India between 2006 and 2009.
- Fluctuations in agricultural versus non-agricultural wages, with higher agricultural wages potentially explaining increased food expenditure in the Control Group districts in 2009.
- The prevalence of micronutrient deficiency in developing countries.
- The initial selection of districts for Phase I implementation may not have targeted the most backward regions, potentially influencing the results.

Conclusion

From 2006 to 2009, food expenditure increased in households in Phase I, II, and III districts, but nutritional intake decreased in all these households. The Treatment Group did show some difference from the Control Group that could be accounted for by MGNREGA. These results suggest that more research is needed on the relationship between MGNREGA on food prices and nutritional intake. It is important to understand how the program has affected food expenditure and nutritional intake behavior. This is the first step in counties moving past just feeding their population to ensure food security, justice, and ultimately ensuring an increase in their population's welfare.

Paper 4: *Impact of the MGNREGA on Reducing Rural Poverty and Improving the Socio-economic status of Rural Poor: A Study in Burdwan District of West Bengal*

Author: Prattoy Sarkar, Jagdish Kumar and Supriya

Introduction

This study examines the impact of the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) on reducing rural poverty and improving the socio-economic status of rural poor in the Burdwan district of West Bengal. MGNREGA, enacted by the Government of India, is the largest employment program ever implemented in a country, aiming to provide 100 days of wage employment to every rural household willing to engage in unskilled manual work. The research focuses on assessing the effectiveness of MGNREGA in improving the lives of rural poor, primarily comprising small and marginal farmers and agricultural laborers.

Methodology

The study employed a three-stage random sampling technique to select 102 respondents (82 beneficiaries and 20 non-beneficiaries) from four Gram Panchayats in one randomly selected block of Burdwan district. Primary data was collected using structured questionnaires and personal interviews, while secondary data was gathered from government offices and publications. The research analyzed the socio-economic profiles of beneficiaries and non-beneficiaries, examining variables such as caste, family size, education levels, occupation, landholding patterns, and asset ownership. The impact of MGNREGA was assessed by comparing various socio-economic indicators over three years (2007-08 to 2009-10). A socio-economic index was constructed using 12 variables to evaluate changes in beneficiaries' economic status over time. Statistical analysis included simple tools like averages and percentages, as well as z-tests and chi-square tests to determine significant differences.

Challenges Identified

- Delay in wage payment (reported by 63% of beneficiaries)
- Non-availability of regular work (34%)
- Political disturbances associated with MGNREGA works (26%)
- Lack of special provisions for elderly persons (21%)
- Hectic process of bank/post office payments (15%)
- Corruption at various levels (9%)
- Nepotism (5%)
- Absence of work site facilities (6%)
- Some works not of good quality or necessity
- No provision for skilled or semi-skilled works (6%)

Key Findings

- Comparatively backward ethnic groups (SCs, OBCs) participated more in MGNREGA works, while general caste people constituted a larger share of non-beneficiaries.
- The program affected the traditional concept of joint households, with a higher proportion of job cards held by smaller households.
- Beneficiaries had lower education levels compared to non-beneficiaries.
- Agricultural labor was the main occupation for beneficiaries, while non-beneficiaries earned more from farming.
- Non-beneficiaries were more resource-rich in terms of land ownership, livestock, and farm machinery.
- Significant improvements were observed in beneficiaries' annual per capita income, monthly food expenditure, child education expenditure, savings, and debt reduction.
- Beneficiaries showed considerable improvement in dwelling house conditions, access to safe drinking water, and sanitation facilities.
- The socio-economic index revealed a decrease in the proportion of beneficiary households in poor socio-economic conditions from 43.9% in 2007-08 to 18.3% in 2009-10.

Conclusion

The study concludes that MGNREGA has been effective in targeting the most vulnerable sections of rural society and has led to significant improvements in their socio-economic conditions. The program has positively impacted beneficiaries' income, food expenditure, education spending, savings, and overall living conditions. However, challenges such as delayed wage payments, irregular work availability, and political interference need to be addressed to enhance the program's effectiveness. The research suggests incorporating special provisions for elderly persons, improving the payment process, and considering the inclusion of skilled and semi-skilled work options to further strengthen the impact of MGNREGA on rural poverty reduction and socio-economic development.

Paper 5: *Food Expenditure and Household Welfare in India : MGNREGA Program Outcomes*

Author: Prattoy Sarkar, Jagdish Kumar and Supriya

Introduction

India's workforce is largely informal, with workers lacking security and often migrating due to agricultural uncertainties. To address these issues, the Indian government launched the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) in 2006. MGNREGA aims to provide employment in rural areas, reduce migration, increase purchasing power, and create rural assets. This study evaluates the impact of MGNREGA on income, employment, food security, and welfare in 10 villages within the Semi-Arid Tropics (SAT) region across three Indian states.

Data and Methodology

In 2012-13, a household survey was conducted across Madhya Pradesh, Gujarat, and Maharashtra to assess the impact of MGNREGA. The study focused on 10 villages, with two each in Panchmahals and Junagadh (Gujarat), eastern Madhya Pradesh, southwestern Maharashtra (Solapur district), and Vidarbha (Akola district). The survey initially covered 1,678 households of small farmers and landless laborers, but the study concentrated on 891 households with job cards. These households were randomly selected, representing approximately 20% of the households in these social groups within each village.

Key Findings

- MGNREGA implementation varied across the three states.
- Average working days under MGNREGA were below 40 days per year in all studied villages.
- Wages were below prevailing agricultural labor rates but provided financial stability during non-agricultural seasons.
- Average employment days decreased over the years or remained stagnant, along with a declining number of beneficiaries, due to inadequate work availability, not alternative opportunities.
- Beneficiaries primarily used MGNREGA earnings for domestic expenses and children's education, not asset acquisition.
- Participants appreciated the community-wide benefits of rural assets created.
- Daily wages varied widely.
- Implementation focused on community assets like check dams and roads, except in eastern Madhya Pradesh, where farm ponds were emphasized.
- MGNREGA had no impact on agriculture or agriculture practices in the studied villages.

Challenges Identified

- Lack of awareness regarding MGNREGA governance.
- Respondents are not aware of the process of deciding the work activities.
- Dissatisfaction with delayed wage payments.
- Lack of supervision and transparency in work implementation.
- Low wage rates compared to agricultural labor.
- Inadequate availability of workdays.
- Some wage leakage persisted despite direct bank transfers.
- Limited direct material benefits to households in most villages.
- MGNREGA has not addressed food security concerns because the money earned from the activity is inadequate to ensure food security for the households.

Conclusion

The study of 10 villages showed that MGNREGA's outcomes were different across the three states. In Gujarat, the number of workdays provided under the program decreased over the years, while in Madhya Pradesh and Maharashtra, work opportunities increased. However, no household worked for the full 100 days in 2012-13. Delayed payments in all the villages discouraged people from asking for more work, except in Kanzara, where people worked on a daily wage basis. The participation of women in the program was very low compared to the national average because women found the work difficult. The way MGNREGA was implemented was an issue, with people not knowing how work activities were decided. Therefore, the program needs to be adjusted, focusing on areas that need the most help with rural unemployment and distress. Local government institutions should be more accountable to restore people's trust in MGNREGA as a useful social safety net.

Data & Methodology

I. About Dataset

The dataset we used is the India Human Development Survey-II (IHDS-II), it is a nationally representative, multi-topic panel survey that provides an in-depth look at human development across India. Covering 42,152 households from over 1,400 rural villages and more than 1,000 urban neighbourhoods, this dataset offers a rare longitudinal perspective by re-interviewing 83% of the households from the earlier IHDS-I (2004–05) and including a fresh sample to maintain representativeness.

II. Model Description

Our model uses INCOME as the dependent variable (pertaining to our research question), with the following independent variables: Sex (GENDER), Age (R05), Primary activity status (R07), Urban Dummy variable (URBAN2011), Highest level of education in the household (HHEDUC), Number of people in the household (NPERSONS), Number of household assets (ASSETS), Total consumption expenditure (COTOTAL), and participation in the MGNREGA program (WKNREGA2), which serves as the primary variable of interest in our research. Given the presence of heteroskedasticity in our model, we employ the Weighted Least Squares (WLS) method, using WT (Weights for 2012) as our weight variable.

$$\sqrt{\text{INCOME}} = \beta_0 + \beta_1 \text{GENDER} + \beta_2 \text{R05} + \beta_3 \text{R07} + \beta_4 \text{URBAN2011} + \beta_5 \sqrt{\text{HHEDUC}} + \beta_6 \log(\text{NPERSONS}) \\ + \beta_7 \exp(\text{ASSETS}) + \beta_8 \sqrt{\text{COTOTAL}} + \beta_9 \text{WKNREGA2} + \epsilon$$

III. Justification for the variables chosen

• GENDER

Gender is a well-documented determinant of income differences. In many contexts, including India, labour market opportunities, wage rates, and occupational choices vary by gender. Including GENDER in our model helps capture these disparities and isolate their effect on household income. As a dummy variable, GENDER is coded as 0 for Males and 1 for Females.

• R05 (Age)

Age serves as a proxy for work experience and the life-cycle effects on earnings. In income studies, earnings typically rise with age (up to a point) as individuals accumulate experience and skills. Accounting for age ensures that variations in income due to different stages of a working life are controlled.

- **RO7 (Primary Activity/Occupation)**

RO7 represents the respondent's primary economic activity status. This variable distinguishes between categories such as wage employment, self-employment, agricultural work, or non-market activities (e.g., housework or student status). Including RO7 allows the model to capture how the type of economic engagement influences income levels. This categorical variable has a total of 16 categories.

- **URBAN2011 (Urban Dummy Variable)**

Including URBAN2011 in the model is essential as urban households generally have higher incomes due to better job opportunities, infrastructure, and access to services. Urban areas also face a higher cost of living, making location a key determinant of income differences. Additionally, employment structures differ, with urban areas offering more formal and salaried jobs compared to rural, agriculture-based economies.

- **HHEDUC (Highest Level of Education in the Household)**

This variable captures the educational attainment of the most educated member in the household. Education plays a critical role in shaping economic opportunities, as higher levels of education are generally associated with better employment prospects, higher wages, and improved financial decision-making, all of which contribute to household income.

- **NPERSONS (Household Size)**

The total number of people living in a household directly influences income dynamics. Larger households may have more income earners, leading to higher total income. However, they also have higher resource demands, which may dilute per capita income, making it important to control for household size in the analysis.

- **ASSETS (Number of Household Assets)**

The stock of household assets reflects wealth accumulation and economic stability. Households with greater asset holdings are likely to have higher income levels, either due to rental income, business investments, or the ability to leverage assets for financial security. Including assets in the model helps account for differences in wealth that influence income beyond earnings alone.

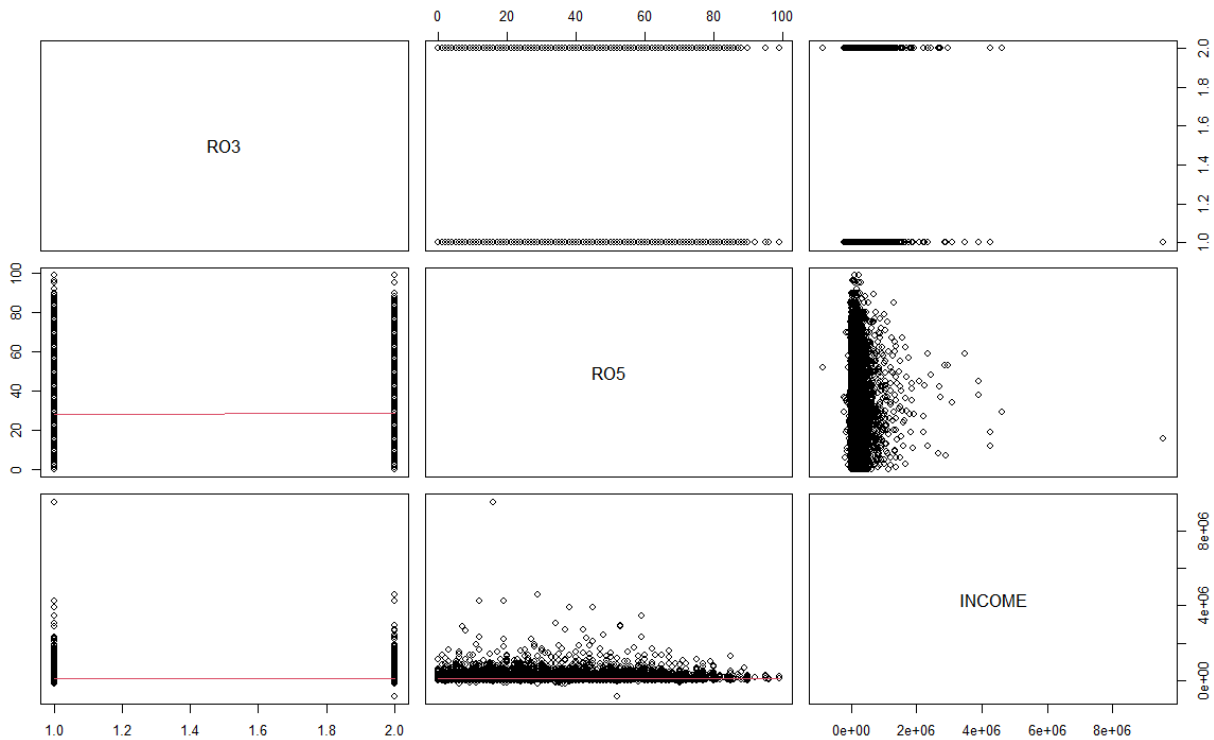
- **COTOTAL (Total Household Consumption Expenditure)**

Consumption expenditure serves as a proxy for household economic well-being. Higher consumption often indicates greater financial stability and disposable income, making it a key factor in understanding household income. It also helps capture variations in living standards across households.

- **WKNREGA2 (Participation in NREGA)**

This variable indicates whether a household benefits from employment under the National Rural Employment Guarantee Scheme (NREGA). Participation in such government programs can supplement household earnings, especially in rural areas where formal employment opportunities may be limited. Including this variable helps assess the role of public employment schemes in influencing income levels. As a dummy variable, WKNREGA2 is coded as 0 for Rural region and 1 for Urban region.

IV. Using Graph Matrix to justify the relationship between the Variables

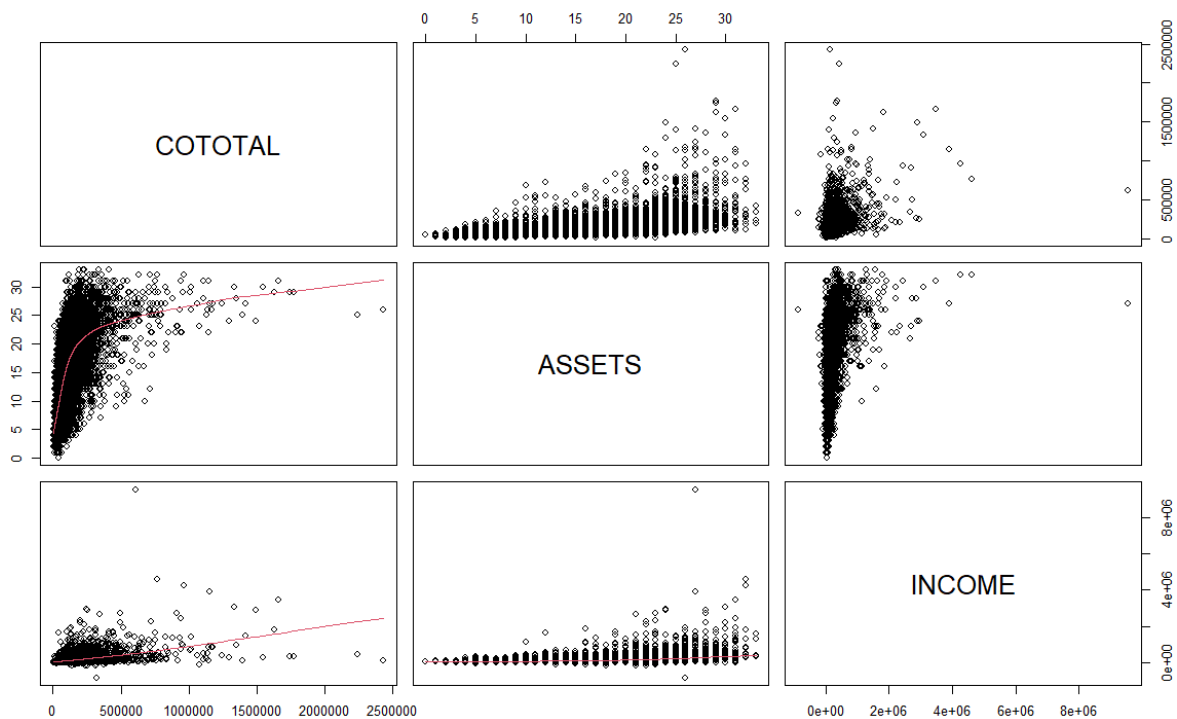


- **Gender (R03)**

- Since Gender is a categorical variable, it is appropriately included as a dummy variable (0/1) in the model without transformation.

- **Age (R05)**

- The scatterplot of Age (R05) against Income shows a non-linear, downward-sloping relationship, indicating that higher age is generally associated with lower income after a certain point.
- However, the spread suggests heteroskedasticity, and there is no strong evidence of a specific transformation (e.g., log or polynomial) being necessary.
- Keeping Age in its original form allows the model to capture both linear and non-linear effects.

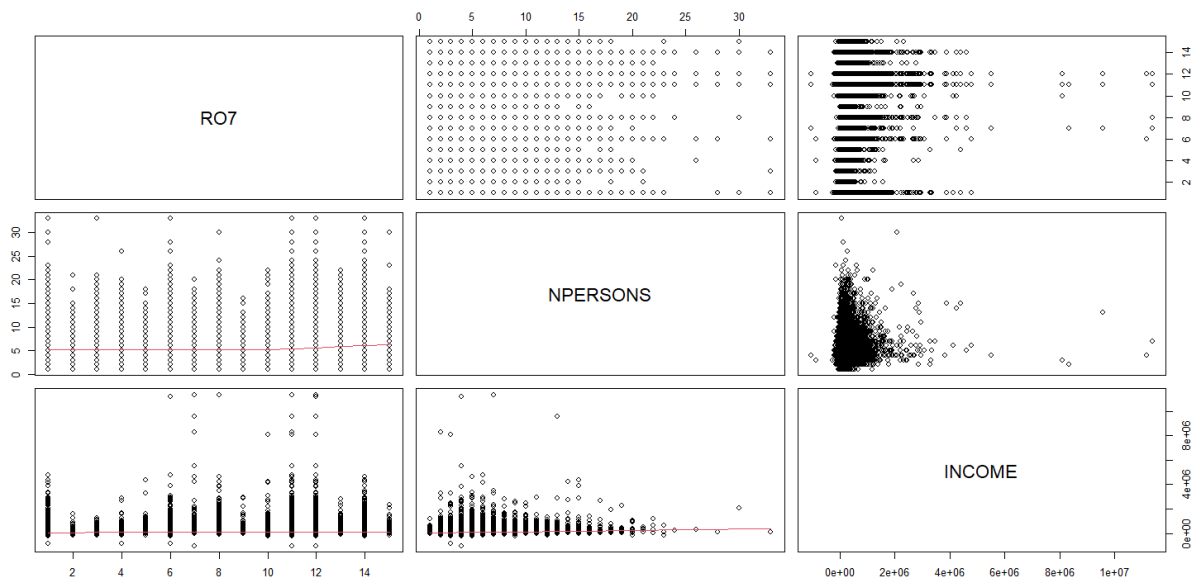


- **COTOTAL (Total Consumption Expenditure)**

- The scatterplot of COTOTAL vs. INCOME shows a non-linear increasing relationship with diminishing returns, meaning that higher consumption expenditure is associated with higher income but at a decreasing rate.
- The concave pattern suggests a square root transformation is appropriate to linearize the relationship and reduce heteroskedasticity.

- **ASSETS (Number of Household Assets)**

- The scatterplot of ASSETS vs. INCOME shows that at lower levels of assets, income increases slowly, but at higher levels, income growth accelerates.
- This convex pattern suggests an exponential transformation, which captures the compounding effect of assets on income.

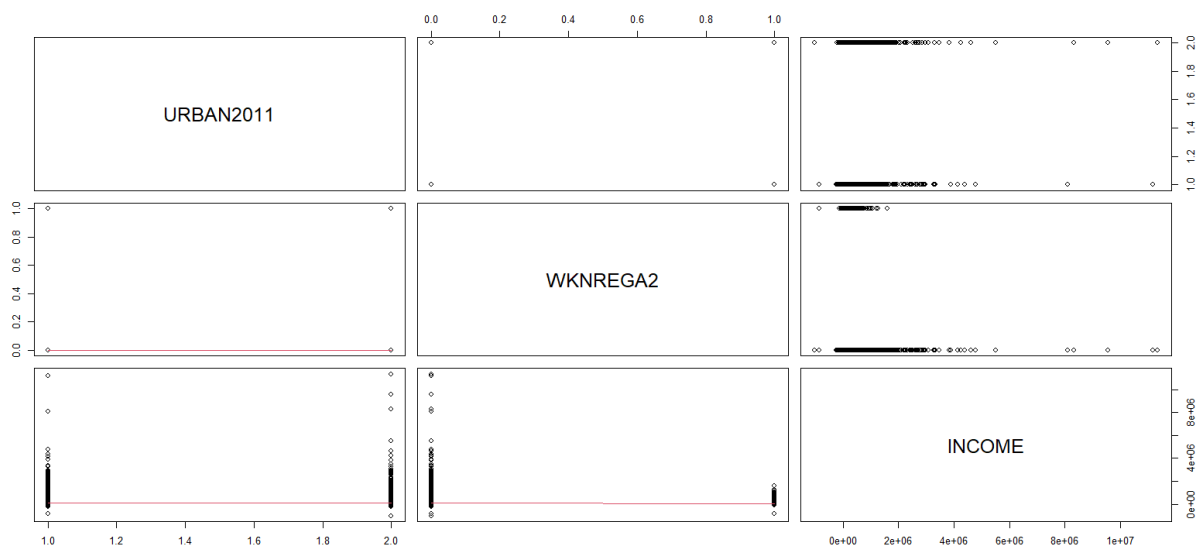


- **NPERSONS (Number of Household Members)**

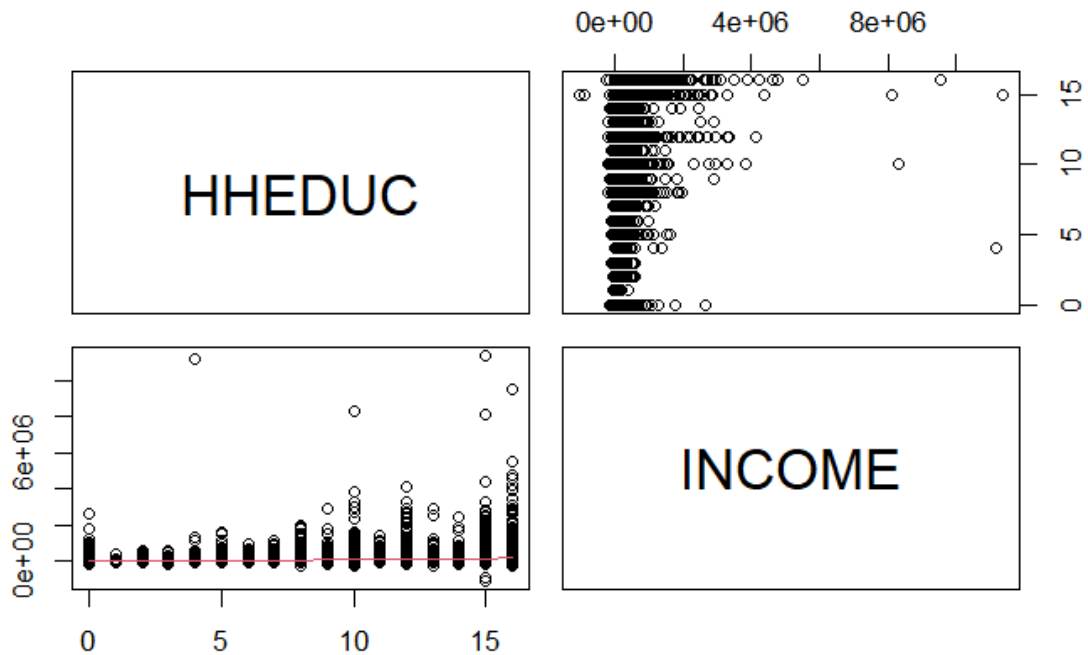
- The scatterplot of NPERSONS vs. INCOME shows a non-linear decreasing relationship, indicating that as the number of household members increases, income decreases but at a diminishing rate.
- The log transformation is appropriate because it captures the diminishing marginal impact of additional household members on income while stabilizing variance and improving model interpretability.

- **RO7 (Primary Activity/Occupation)**

- Since RO7 is a categorical variable and transformations are not applicable to categorical variables in a regression model, we will retain it in its original form without any modifications.



- **URBAN2011 (Urban Dummy Variable)**
 - Since URBAN2011 is a categorical variable, it is appropriately included as a dummy variable (0/1) in the model without transformation.
- **WKNREGA2 (Participation in NREGA)**
 - Since WKNREGA2 is a categorical variable, it is appropriately included as a dummy variable (0/1) in the model without transformation.



- **HHEDUC (Highest Level of Education in the Household)**
 - Since HHEDUC exhibits a somewhat nonlinear relationship with INCOME at a broader level, we will apply a square root transformation to better capture this non-linearity.

Results & Discussion

I. Summary Statistics

Variable	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	Categories
INCOME	-1,037,040	45,000	83,500	144,009	162,812	11,360,000	-
WT	154.1	2,952.30	4,585.30	5,926.30	7,214.30	156,647.50	-
RO3 (Gender)	-	-	-	-	-	-	Male: 101,974, Female: 102,414
RO5 (Age)	0	13	26	29.82	45	99	-
RO7 (Occupation)	-	-	-	-	-	-	Student: 55,644, Housework: 48,197, Too young/Unfit: 24,135, Non-agricultural wage labor: 17,220, Cultivation: 16,430, Salaried: 14,092, Others: 28,670
NPERSONS	1	4	5	5.964	7	33	-
HHEDUC	0	5	9	8.704	12	16	-
WKFARM	-	-	-	-	-	-	None: 156,913, Missing hours: 1,258, <240 hrs: 16,781, Part-time: 27,650, Full-time year-round: 1,786
URBAN2011	-	-	-	-	-	-	Rural: 135,013, Urban: 69,375
COTOTAL	180	63,962	97,604	132,030	156,726	4,080,760	-
ASSETS	0	11	16	15.76	21	33	-
WKNREGA	-	-	-	-	-	-	None: 195,309, Missing hours: 10, <240 hrs: 4,875, Part-time: 4,191, Full-time year-round: 3
WKNREGA2	0	0	0	0.04442	0	1	-
GENDER	0	0	1	0.5011	1	1	-

II. Regression Results

Weighted Residuals:				
Min	1Q	Median	3Q	Max
-34.395	-1.301	-0.332	0.726	106.548
Coefficients:				
	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-3.391e+01	2.304e+00	-14.715	< 2e-16 ***
GENDER	1.216e+00	8.755e-01	1.388	0.165040
RO5	2.797e-01	2.258e-02	12.390	< 2e-16 ***
RO7(02) Allied ag 2	-2.407e+01	6.446e+00	-3.735	0.000188 ***
RO7(03) Ag wage labour 3	5.816e+00	2.053e+00	2.833	0.004616 **
RO7(04) Nonag wage labour 4	8.818e+00	1.774e+00	4.971	6.68e-07 ***
RO7(05) Artisan/indpt work 5	-3.854e+00	4.670e+00	-0.825	0.409234
RO7(06) Small business 6	1.559e+01	2.211e+00	7.052	1.77e-12 ***
RO7(07) Organized Business 7	7.962e+01	5.317e+00	14.975	< 2e-16 ***
RO7(08) Salaried 8	6.715e+01	1.883e+00	35.667	< 2e-16 ***
RO7(09) Profession 9	3.822e+01	6.832e+00	5.595	2.21e-08 ***
RO7(10) Retired 10	7.221e+01	3.418e+00	21.128	< 2e-16 ***
RO7(11) Housework 11	9.748e+00	1.620e+00	6.017	1.78e-09 ***
RO7(12) Student 12	4.455e+00	1.630e+00	2.734	0.006263 **
RO7(13) Unemployed 13	1.037e+01	3.183e+00	3.260	0.001116 **
RO7(14) Too young/Unfit 14	-2.104e-01	1.722e+00	-0.122	0.902771
RO7(15) Others 15	-2.381e+00	4.600e+00	-0.518	0.604760
URBAN2011(1) urban 1	3.100e+01	8.547e-01	36.272	< 2e-16 ***
I(HHEDUC^0.5)	2.311e+01	3.276e-01	70.540	< 2e-16 ***
I(log(NPERSONS))	3.942e+01	8.762e-01	44.982	< 2e-16 ***
exp(ASSETS)	3.362e-12	7.464e-14	45.046	< 2e-16 ***
I(COTOTAL^0.5)	6.442e-01	3.064e-03	210.205	< 2e-16 ***
WKNREGA2	-1.655e+01	1.814e+00	-9.127	< 2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				
Residual standard error: 2.785 on 202015 degrees of freedom (2153 observations deleted due to missingness)				
Multiple R-squared: 0.3605, Adjusted R-squared: 0.3605				
F-statistic: 5177 on 22 and 202015 DF, p-value: < 2.2e-16				

III. Interpreting the OLS estimates

Common Interpretation - Since the dependent variable is modeled as a nonlinear function, the marginal effects of each independent variable include a multiplicative factor of $2\sqrt{INCOME}$. Consequently, the impact of these variables is considerably more pronounced for individuals with higher income levels.

$$\frac{\partial INCOME}{\partial X} = 2\beta \sqrt{INCOME}$$

Here INCOME is the initial income of the household before any interference. In the interpretations below $2\sqrt{INCOME}$ will be referred to as *Household Income Factor* - HIF for simplicity. β is the slope coefficient for the respective dependent variables, as is interpreted below thus not included in HIF.

1. Intercept (-33.91)

When all predictors are zero (i.e. GENDER = 0, RO5 = 0, all RO7 categories are at the reference level, URBAN2011=0, and the transformed continuous variables are zero), the model predicts a \sqrt{INCOME} of -33.91.

2. GENDER (1.216)

Holding all else constant, between households with the same income level (\sqrt{INCOME} is same for both), a female member contributes 1.216 times the HIF units increase in income compared to male counterpart. However this result is insignificant at a 90% confidence interval (p - value = 0.165). So we can't differentiate between male and female contributions to the household income.

3. RO5 (Age) (0.2797)

Holding all else constant, between households with the same income level (\sqrt{INCOME} is same for both), a one unit increase in age contributes 0.2797 times the HIF units increase in the household income.

4. Occupation Categories (RO7) – Base: Cultivation

This is a categorical variable with *Cultivation (RO7 01)* as base. Holding all else constant -

- **RO7(02) Allied agriculture 2 (-24.07)**

Being in Allied Agriculture is associated with a decrease of 24.07 in \sqrt{INCOME} relative to cultivation. This suggests substantially lower income (in transformed terms).

- **RO7(03) Ag wage labour 3 (5.816)**

Compared to cultivation, working as agricultural wage labour increases \sqrt{INCOME} by 5.82 units.

- **RO7(04) Nonag wage labour 4 (8.818)**

Each unit of non-agricultural wage labour results in an 8.818 units more increase in \sqrt{INCOME} than cultivation.

- **RO7(05) Artisan/indpt work 5 (-3.854)**

The negative coefficient (though not statistically significant, $p = 0.409$) indicates a 3.854 units lower \sqrt{INCOME} relative to cultivation, but we can't be sure this difference is prevalent in the population.

- **RO7(06) Small business 6 (15.59)**

Operating a small business is associated with a 15.59 per unit increase in \sqrt{INCOME} compared to cultivation.

- **RO7(07) Organized Business 7 (79.62)**

Individuals in organized business have a \sqrt{INCOME} that is 79.62 units higher than those in cultivation.

- **RO7(08) Salaried 8 (67.15)**

Salaried employment increases \sqrt{INCOME} by 67.15 compared to cultivation.

- **RO7(09) Profession 9 (38.22)**

Professionals earn 38.22 units more in \sqrt{INCOME} than those in cultivation.

- **RO7(10) Retired 10 (72.21)**

Being retired is associated with a 72.21 unit increase in \sqrt{INCOME} relative to the cultivation base; this might capture pension or retirement benefits.

- **RO7(11) Housework 11 (9.748)**

Engagement in housework (if it represents a source of income or household economic activity) increases \sqrt{INCOME} by 9.75 units relative to cultivation.

- **RO7(12) Student 12 (4.455)**

Students have a 4.46 unit higher \sqrt{INCOME} than the cultivation group.

- **RO7(13) Unemployed 13 (10.37)**

The unemployed show an increase of 10.37 units in \sqrt{INCOME} relative to cultivation. This could reflect transfers or other factors not captured by simple earnings.

- **RO7(14) Too young/Unfit 14 (-0.2104)**

There is virtually no difference (and it is not statistically significant) compared to cultivation.

- **RO7(15) Others (-2.381)**

Similarly, this group does not differ significantly from cultivation in terms of \sqrt{INCOME} .

5. URBAN2011 (31.00)

Holding all else constant, between households with the same income level (\sqrt{INCOME} is same for both), a person living in an urban area contributed 31 times the HIF to their household income as compared to a person living in a rural area.

6. HHEDUC^(1/2) (23.11)

$$\frac{\partial(INCOME)}{\partial(HHEDUC)} = \beta \times \sqrt{\frac{INCOME}{HHEDUC}}$$

Holding all else constant, a 1 year increase in highest household education results in a 23.11 times

$$\sqrt{\frac{INCOME}{HHEDUC}}$$

unit increase in household income.

This suggests that education has a strong positive effect on income, though the marginal benefit on income in original units diminishes as education increases (because the transformation compresses larger values).

7. log(NPERSONS) (39.42)

Holding all else constant, a 1 percent increase in the number of people in a household results in a 39.52 times HIF percent increase in the household income.

$$\frac{\partial(INCOME)}{\frac{\partial(NPERSONS)}{NPERSONS}} = \beta \times \text{HIF}$$

Since the variable is log-transformed, the income benefit increases at a decreasing rate as the household size grows.

8. $\exp(\text{ASSETS})$ (3.362e-12)

$$\frac{\partial(\text{INCOME})}{\partial(\text{ASSETS})} = \beta \times e^{\text{ASSETS}} \times \text{HIF}$$

Holding all else constant, 1 unit increase in number of assets in the household leads to a $3.36e^{-12}$ into

$$e^{\text{ASSETS}} \times \text{HIF}$$

units increase in the household income level.

Because the predictor is in an exponential form, even a tiny change in the exponentiated value corresponds to a large relative change in the original asset value.

9. $(\text{COTOTAL})^{(1/2)}$ (0.6442)

$$\frac{\partial(\text{INCOME})}{\partial(\text{COTOTAL})} = \beta \times \sqrt{\frac{\text{INCOME}}{\text{COTOTAL}}}$$

Holding all else constant, between households with the same income level ($\sqrt{\text{INCOME}}$ is same for both) and same consumption expenditure level, a unit increase in consumption expenditure leads to a 0.644 times

$$\sqrt{\frac{\text{INCOME}}{\text{COTOTAL}}}$$

unit increase in the household income level. Higher consumption is positively associated with income, with diminishing returns due to the square root transformation.

10. WKNREGA2 (-16.55)

Holding all else constant, between households with the same income level ($\sqrt{\text{INCOME}}$ is same for both), participation in MGNREGA program contributes 16.55 times the HIF units less to the household income as compared to not participating in it.

IV. Discussion of Findings

Point 10 shows that the policy was not much effective in increasing the household income on an average. However this does not indicate anything related to the friction involved in the employment process, which is very low in MGNREGA provides opportunities compared to elsewhere.

All the dependent variables have a varying effect on the effect on the household income depending on the initial level of household income. This is because the best-fit model associated with the data satisfying all OLS and related assumptions has a non-linear dependent variable.

The findings confirm that MGNREGA serves as a safety net for economically disadvantaged households but does not directly lead to higher income levels. The positive effects of urbanization, education, and asset accumulation highlight the importance of long-term economic policies that promote skill development and financial inclusion.

V. Diagnostics:

In this section we will check the validity of OLS assumptions, and some possible biases that may have occurred such as omitted variable bias and model misspecification bias.

OLS Assumptions

1. Model is linear in parameter by definition.

$$\sqrt{\text{INCOME}} = \beta_0 + \beta_1 \text{GENDER} + \beta_2 \text{RO5} + \beta_3 \text{RO7} + \beta_4 \text{URBAN2011} + \beta_5 \sqrt{\text{HHEDUC}} + \beta_6 \log(\text{NPERSONS}) + \beta_7 \exp(\text{ASSETS}) + \beta_8 \sqrt{\text{COTOTAL}} + \beta_9 \text{WKNREGA2} + \epsilon$$

2. Random sampling of observations - IHDS dataset ensures no bias in this regard.
3. Sample variation should be non-zero. In the image below RO7 and URBAN2011 are categorical variables thus R is unable to find the variance.

> zero_variance_vars								
GENDER	RO5	RO7	URBAN2011	HHEDUC	NPERSONS	ASSETS	COTOTAL	WKNREGA2
FALSE	FALSE	NA	NA	FALSE	FALSE	FALSE	FALSE	FALSE

4. Conditional Mean Independence Assumption (assuming that the expected value of the population error term given any independent variable from the model is zero). There is no direct test for CMIA, but the absence of omitted variable bias, exogeneity and correct specification of model (all shown later) can assure that CMIA is satisfied.

5. No perfect multicollinearity. The VIF table is shown below.

```
> vif(reg_model)
```

	GVIF	Df	GVIF^(1/(2*Df))
GENDER	1.532421	1	1.237910
RO5	1.693641	1	1.301400
RO7	3.063370	14	1.040793
URBAN2011	1.163001	1	1.078425
I(HHEDUC^0.5)	1.220632	1	1.104822
I(log(NPERSONS))	1.219892	1	1.104487
exp(ASSETS)	1.039970	1	1.019789
I(COTOTAL^0.5)	1.360877	1	1.166566
WKNREGA2	1.082896	1	1.040623

NOTE: The GVIF (Generalized Variance Inflation Factor) values appear here instead of the traditional VIF values because our model includes categorical variables (RO7, etc) with multiple levels. Most of the GVIF values are below 5, indicating low multicollinearity.

The highest GVIF is for RO7 (3.06), but since RO7 is a categorical variable, it has 14 degrees of freedom (Df) resulting in relatively high GVIF. It is better to interpret the second column.

6. No heteroskedasticity:

```
> bptest(reg_model)
```

studentized Breusch-Pagan test

data: reg_model

BP = 7.8259, df = 22, p-value = 0.9976

Null Hypothesis (H_0): Errors have constant variance (homoskedasticity).

Alternative Hypothesis (H_1): Errors have non-constant variance (heteroskedasticity).

Since the p-value is 0.9976 ($\gg 0.05$), we fail to reject the null hypothesis. This means there is no evidence of heteroskedasticity, and the assumption of homoscedasticity holds.

7. Error terms are normally distributed given any independent variable in the model.

```
> library(moments)
> residuals <- residuals(reg_model)
> skewness(residuals)
[1] 2.187987
> kurtosis(residuals)
[1] 24.28572
```

Ideally for this assumption to be satisfied, skewness should be close to 0 and kurtosis should be low. Considering a large sample size of 200,000 observations, the values above are justifiable.

Ramsey's RESET Test for functional misspecification:

```
> # Ramsey's RESET test for misspecification
> library(lmtest)
> resettest(reg_model, power = 2)

      RESET test

data:  reg_model
RESET = 0.44881, df1 = 1, df2 = 202014, p-value = 0.5029
```

Null Hypothesis (H_0): The model is correctly specified (no omitted variables or functional form misspecification).

Alternative Hypothesis (H_1): The model is misspecified (possible omitted variables or incorrect functional form).

Since the p-value is 0.5029 (> 0.05), we fail to reject the null hypothesis. This means there is no evidence of model misspecification or omitted variable bias.

Conclusion

This study investigated the impact of MGNREGA participation on household income in India using the nationally representative India Human Development Survey-II (IHDS-II). Employing a Weighted Least Squares (WLS) approach to address heteroskedasticity, our model incorporated a comprehensive set of variables including demographic characteristics, education, household size, asset holdings, consumption expenditure, and participation in MGNREGA to disentangle the determinants of household income. The regression results reveal that while factors such as urban residence, higher education, and increased consumption expenditure are robustly associated with higher income, participation in the MGNREGA program (as measured by WKNREGA2) is linked with a statistically significant negative effect on household income.

This negative association suggests that households availing themselves of MGNREGA may inherently be those with lower income levels, potentially due to self-selection into the program based on economic vulnerability. Moreover, the relatively low wages provided under MGNREGA, when compared to alternative income-generating opportunities, could be contributing to this observed effect. These findings align with the broader literature that critiques the immediate income-enhancing effects of the program despite its critical role as a safety net.

However, it is important to consider that the benefits of MGNREGA extend beyond direct income augmentation. The program has been instrumental in creating durable assets, improving rural infrastructure, and enhancing the overall livelihood security of marginalized households. These non-monetary benefits, while not directly captured in the income figures, contribute to long-term rural development and economic resilience. Consequently, the negative coefficient on MGNREGA participation in our income model should not be interpreted as evidence of program failure but rather as an indication that the program is effectively targeting households with pre-existing economic disadvantages.

Our analysis highlights several policy implications. First, increasing the wage rates and ensuring timely payments could help improve the income trajectories of beneficiary households. Second, measures to reduce administrative inefficiencies and enhance transparency in work allocation might further bolster the program's effectiveness. Finally, complementary interventions such as skills training and improved access to formal credit could empower beneficiaries to transition towards more sustainable and higher-paying employment opportunities.

In conclusion, while the immediate impact of MGNREGA on household income appears limited, its role as a critical component of India's rural social safety net is undeniable. The program not only provides necessary employment support but also contributes to broader socio-economic improvements. Future research should explore the long-term effects of MGNREGA on asset accumulation, human capital development, and overall household welfare to fully understand its impact on rural development. Ultimately, refining and complementing the program with targeted policy reforms could enhance its effectiveness, ensuring that it better meets the needs of India's most vulnerable populations.

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