BASIC ECONOMETRICS TERM PAPER – GROUP 4

FOOD AID PROGRAMMES (POVERTY AND UNEMPLOYMENT)

INTRODUCTION & REVIEW OF LITERATURE

The right to food is one of the fundamental human rights a human cannot be devoid of. Food is of unquestionable importance for the sustenance of human life. Our constitution provides the golden rule in Article 21: Right to life. The governments of the world have a fundamental duty to protect this right.

Identifying those needing assistance is a fundamental question that the state and other organisations or individuals who would drive such programmes consider.

Poverty is, without a doubt, a determinant of food assistance. Alaimo, K., & Briefel, R. R. (2003)[1] discuss the strong correlation between income levels and nutritional diet access. Poverty affects access to food because those in poverty do not have sufficient income to purchase the food. The community poor are also substantially marginalised, affecting access to resources needed to get themselves safe and nutritious food.

One of our primary objectives was to determine how vital poverty is in providing food assistance to people.

The second factor that we consider is unemployment, which could be a key factor to be a beneficiary in Food Assistance Programmes. An unemployed is a person available to work but without a job. The unemployed are affected by income levels, which could cause a lack of safe and nutritious food access. A former study has recognised that material hardship and income stability are caused by unemployment. The disruptions caused by the same would cause a lack of access to safe and nutritious food. (Sullivan et al., 2008)[2].

These two main variables should be a factor for states to focus on food assistance programmes.

OBJECTIVES

- *Identify whether poverty is a critical factor for those needing food assistance.*
- *Identify whether unemployment is a critical factor for those needing food assistance.*

SUPPLEMENTAL NUTRITION ASSISTANCE PROGRAMME

To study the significance of these two variables on participation in food aid programmes, we choose data on SNAP participants from the year 1980 to the year 2016.

Why SNAP? A prominent nutrition assistance programme in the USA. The programme is run by the US Department of Agriculture (USDA). The beneficiaries of SNAP are identified based on households (their size, income, and expenses). We were able to locate the data on those in poverty and unemployed who are participants in the programme.

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[1] Alaimo, K., & Briefel, R. R. (2003). "Food insufficiency exists in the United States: results from the third National Health and Nutrition Examination Survey (NHANES III)." American Journal of Public Health, 93(9), 1419-1424

[2] "The Relationship Between Income and Material Hardship" by Sullivan, Turner, and Danziger (2008)

This is a perfect combination to identify the significance of poverty and unemployment on participation in food assistance programmes. SNAP itself is a very successful program. It has been impacted by lowering food insecurity in the United States. A study has identified that individuals benefiting from SNAP are less likely to experience food security than those profiting from the program. (Gundersen and Kreider, 2008)[3].

For a country like India, we need to go for more deterministic measures like poverty and unemployment in driving these types of programs and not measures like household size as in the USA, due to economic and social realities. This is why it's appropriate to test the significance of these variables and would be a more appropriate measure in different contexts.

However, we understand that the limitations, such as the definition of poverty and unemployment, may differ in different contexts.

Brief about variables

SNAP:

A federal assistance programme in the US called the Supplemental Nutrition Assistance Programme (SNAP), formerly known as the Food Stamp Programme, gives qualified low-income individuals and families money to buy food. The United States Department of Agriculture (USDA) oversees SNAP, the nation's most significant anti-hunger initiative.

Here are some key features and aspects of SNAP:

- Eligibility: The main factors determining SNAP eligibility are household size and income. Applicants must have limited resources and money to qualify. State-specific income restrictions may apply, but participants must earn less than 130% of the federal poverty line. A few elements, including household size and costs, may impact eligibility.
- Eligible Food: A wide range of food items, including fruits, vegetables, cereals, dairy products, meats, and non-alcoholic drinks, are eligible for SNAP benefits. SNAP benefits cannot be used to buy alcohol, tobacco, or hot prepared foods.
- Application procedure: Individuals and families must apply to their state's SNAP office to be considered for SNAP benefits. The application process may involve an interview and submitting the necessary paperwork to confirm eligibility.
- Outreach and Education: Several nonprofit groups and governmental organisations conduct outreach and instruction activities to tell qualified people and families about SNAP and how to apply.

Unemployment in the USA from 1980 to 2016:

Between 1980 and 2016, the United States unemployment rate had numerous ups and downs, influenced by several economic, social, and political variables. An overview of the trends in unemployment throughout this time, along with some of the leading causes, is shown below:

- 1980–1982 Early 1980s Recession
  Reasons: Due to several causes, including high inflation rates, a restrictive monetary policy, and a severe recession, this time experienced a considerable increase in unemployment. To battle inflation, the Federal Reserve increased interest rates, which accelerated the economy's decline and resulted in job losses.
- Rehabilitation and Growth (Mid 1980s to Early 1990s):

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[3] "Food Stamps and Food Insecurity: What Can Be Learned in the Presence of Nonclassical Measurement Error?", Gundersen and Kreider (2008)

Reasons: As the American economy recovered from the crisis that began in the early 1980s, unemployment progressively declined.

- Early 1990s Financial Crisis (1990–1991):
  Reasons: During this time, unemployment increased again due to the recession brought on by the Gulf War, a banking crisis, and a decline in the real estate market. Due to these circumstances, consumer spending and company investment decreased.

- Mid-1990s to Early 2000s Late 1990s Boom
  Reasons: During this time, there was a large decline in unemployment due to the strong economic growth brought on by technological advancement and greater productivity.

- Early 2000s: Dot-com Bubble Burst and Impact of 9/11:
  Reasons: The 9/11 terrorist attacks and the fall of the dot-com boom 2001 contributed to an economic downturn that briefly increased unemployment.

- Financial Crisis and Housing Bubble (2007–2009):
  Reason: 2007, the housing bubble burst, causing a severe financial disaster. Subprime mortgage lending, complicated financial products, and a lack of regulatory monitoring were some of the causes of this disaster. Businesses collapsed, and the banking industry was seriously hit, resulting in a considerable unemployment increase.

People in Poverty:

From 1980 to 2016, there were different trends and oscillations in poverty in the United States, influenced by a wide range of economic, social, and regulatory issues. An overview of poverty in the USA throughout this time, along with some of the leading causes, is provided below:

- Economical aspects:
  Economic downturns: In the early 1980s, early 1990s, and during the Great Recession of 2007–2009, many Americans experienced job losses and stagnant income, which led to an increase in the poverty rate.

- Income Disparity:
  As income inequality increased, a higher portion of the economic gains went to the wealthiest people and households, leaving a more minor part for those at the bottom of the income spectrum.

Model Equation

*SNAP participant = β0 + β1 * People in poverty + β2 * Unemployment + Error*

Hypothesis Test

Hypothesis:

1. Testing Individual Coefficients:

To test whether the coefficient of People in poverty is significant enough.

- H0: $\beta 1 = 0$
- H1A: $\beta 1 \neq 0$

Ceteris Paribus, unemployment.

To test whether the coefficient of Unemployment is significant enough.

- H0: $\beta2 = 0$
- H2A: $\beta2 \neq 0$

Ceteris Paribus, People in poverty of USA**.**

**T-test conducted

2. Overall Significance Test of the Auxiliary Regression (Heteroskedasticity):

H0: Error Term is homoscedastic i.e., $\alpha1 = \alpha2 = 0$

HA: At least one coefficient is nonzero, then an error is heteroscedastic

The chi-square test was conducted to test the Overall Significance.

3. Testing for non-linearity in the model using the RESET test:

H0: Model has no Specification error, i.e., $\Gamma1 = \Gamma2 = 0$

HA: The model has a specification error if at least one coefficient is nonzero.

**F test conducted

DATA – Description of the dataset, variables, and measurement

Data is taken for Snap participants, unemployment, and poverty from 1980 to 2016. All data are in millions.

Employment fluctuation in the data set is due to various economic conditions and shocks in these 36 years.

Poverty will also depend on the economic condition of these years; as deprivation increases, the recipient of SNAP beneficiaries should increase.

Particular	Type of data	Description
People in Poverty	Continuous	The number of people living in poverty in the USA from 1980 to 2016.
Unemployed people	Continuous	Total number of people unemployed (in Millions)
SNAP participants	Continuous	Total number of people availing of the SNAP program benefit (in millions)

METHODOLOGY

Test for Heteroskedasticity:

Our dataset demonstrated that various error terms had unique variances. Heteroscedasticity in the error term is found using the Breusch-Pagan test. Estimating the initial regression equation and collecting the residuals is the first step in this test. Then, the squared residuals are regressed on the other regressors

using auxiliary regression. The overall significance of the additional regression in this model is determined using the chi-square test. If the test statistic exceeds the critical value, we deduce that the error term is heteroscedastic.

Test for Multicollinearity:

A statistical metric called the VIF, or Variance Inflation Factor, is employed in regression analysis to evaluate multicollinearity. When two or more independent variables in a regression model have a high degree of correlation, this is known as multicollinearity, which can cause unstable coefficient estimates and make the model difficult to interpret. The VIF measures how much multicollinearity impacts the predicted coefficients' variance.

Test for Non-linearity:

The model's nonlinearity would be found using the RESET test. The goal of this test is to identify model misspecification bias. The lack of nonlinearity in the model leads to misspecification bias.

Significance test:

T-test: The estimated regression coefficients were tested for significance at the chosen probability level using the T-test.

$$t = b_i / SE(b_i)$$

Where: b_i = regression coefficients of an ith input

   $SE(b_i)$ = standard error of an ith input

RESULTS

Heteroskedasticity:

According to the Gauss-Markov assumptions, the model is BLUE (the Best linear unbiased Estimator) if it follows all the premises.

If the model is not Homoscedastic, it means the variance of the error terms is not constant across all levels of the independent variable. It violates the Gauss-Markov assumption.

Homoskedasticity $E(U^2) = \sigma^2$ (i.e., a constant variance)

If homoskedasticity is violated, then the variance of the error term is no longer constant. However, our model is unbiased but needs to be more efficient. The standard error estimates are no longer valid; hypothesis testing cannot be performed.

We performed the Breusch-Pagan test on our SNAP model to check for Heteroskedasticity.

Scatter plot of residuals of SNAP:
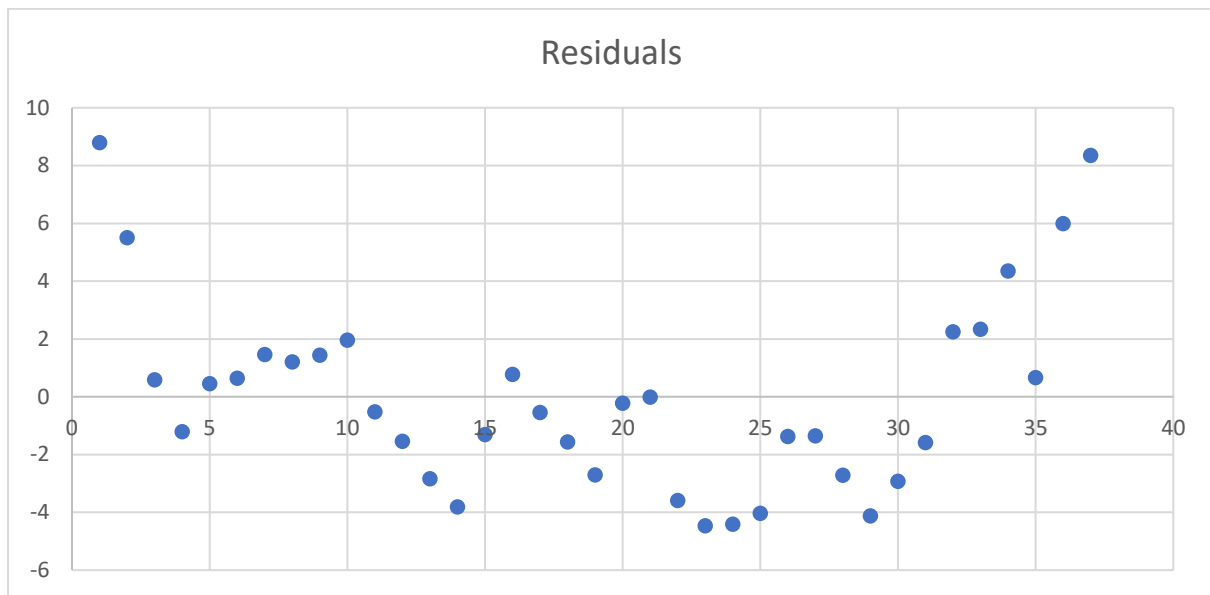
To perform the test on heteroskedasticity, we completed the auxiliary regression on the squared residuals of the Sample regression equation.

Breusch-pagan test:

$U^2 = \beta_0 + \beta_1 \,(\text{people in poverty}) + \beta_2 \,(\text{unemployment}) + \xi$

H_0 (Null Hypothesis) = Error term is homoscedastic ($\beta_1 = \beta_2 = 0$)

H_a (Alternate Hypothesis) = Error term is heteroskedastic (At least one of them is not equal to zero)

R^2	0.007819
N	37
$N*(R^2)$	0.289287

Chi-Square calculated = $N*(R^2)$ = 0.289

Chi-square critical = 3.841459

From the above test, Chi-Square calculated < Chi-square critical
This points out that we can't reject the null hypothesis.

$\therefore$ This signifies that error terms are homoscedastic in nature.

RESET Test (Regression specification error test):

It is a statistical test to assess whether a linear regression model is correctly specified. It helps to identify whether there are omitted variables or non-linear relationships that should be included in the model.

This model uses the predicted value of the dependent variable obtained through linear regression.

$Y = \beta_0 + \beta_1$ (people in poverty) $+ \beta_2$ (unemployment) $+$ error

$Y = \beta_0 + \beta_1$ (people in poverty) $+ \beta_2$ (unemployment) $+ \gamma_1$ (Predicted Y^2) $+ \gamma_2$ (Predicted Y^3) $+ \gamma_3$ (Predicted Y^4)

H_0 (Null Hypothesis) $= \gamma_1 = \gamma_2 = \gamma_3 = 0$ (No Specification error)

H_a (Alternate Hypothesis) $=$ At least one of them is not equal to zero (Specification error exists)

$$F_c = \frac{(RSS_R - RSS_{UR})/m}{RSS_{UR}/(n-k)} = \frac{(R^2_{UR} - R^2_R)/m}{(1 - R^2_{UR})/(n-k)}.$$

R^2 (REST)	0.94274497
R^2 (Restricted)	0.94274497
R^2 (Unrestricted)	0.9487709
M	3
K	2
N	37
F-stat	1.37231383

F-calculated = 1.37231383
F_c = 2.87418748

This shows the F-calculated < F-critical
We can't reject the null hypothesis.

$\therefore$ This signifies that there is no specification error.

Test for Multicollinearity:

Multicollinearity is a statistical phenomenon when a regression model strongly correlates with two or more independent variables. In other words, multicollinearity shows that the predictor variables have a strong linear relationship. As a result, it may be difficult to precisely ascertain the unique effects of each independent variable on the dependent variable when performing a regression analysis.

There are several ways of detecting multicollinearity; one is finding VIF (Variance inflation factor). How well the other independent variables describe an independent variable is determined by the R^2 value. A high R^2 score indicates that the variable and the others have a strong correlation. The VIF, shown below in the following notation, captures this:

$$VIF = 1 / (1 - R^2)$$

Our independent variables are People in poverty and Unemployed people. Now, when performing regression by taking one independent variable (Unemployed people) as a dependent variable against another independent variable, i.e. People in poverty, we get the following regression statistics:

Regression Statistics	
Multiple R	0.72344421
R Square	0.52337152
Adjusted R Square	0.50975356
Standard Error	1.58391197
Observations	37

On computing the VIF, we get the value of 2.098, which is very low and shows significantly less multicollinearity between Unemployed people and People in poverty.

High multicollinearity would have occurred when the VIF was more significant than 5 or 10.

Hypothesis Test:

Hypothesis:

1. Testing Individual Coefficients:

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.939172494
R Square	0.882044973
Adjusted R Square	0.875106442
Standard Error	3.431292916
Observations	37

ANOVA

	df	SS	MS	F	Significance F
Regression	2	2993.427735	1496.713868	127.1227254	1.65646E-16
Residual	34	400.3082166	11.77377108		
Total	36	3393.735952			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-40.86890824	4.421627934	-9.242955049	8.41688E-11	-49.85473733	-31.88307915	-49.85473733	-31.88307915
People in poverty	1.88681325	0.16360002	11.53308693	2.67811E-13	1.554338008	2.219288492	1.554338008	2.219288492
Unemployed people (r	-0.271709536	0.366178406	-0.742014089	0.463174203	-1.01587359	0.472454518	-1.01587359	0.472454518

T-Test:

The estimated regression coefficients (bi) were tested for their significance at the chosen level of probability using a student t-test:

$t = bi/ SE(bi)$

Where: bi = regression coefficients of an ith input

SE (bi) = standard error of an ith input

Check that the T-value is greater than the T critical.

For testing whether the coefficient of People in poverty is significant enough or not

- H0: $\beta 1 = 0$

- H2A: $\beta_1 \neq 0$

Ceteris Paribus, Unemployment.

- Here, People in Poverty, T-value (11.53) > T-critical (~2) - We reject the null hypothesis.
- Also, the P value of People in Poverty is small (~0), so we can reject the Null.

People in poverty significantly affect the people who avail of SNAP benefits.

For testing whether the coefficient of Unemployment is significant enough or not

- H0: $\beta_2 = 0$
- H1A: $\beta_2 \neq 0$

Ceteris Paribus, People in Poverty.

- In this case, T- Value (0.74) < t critical (~2) - Accept the Null
- P value = 0.45 of Unemployed People coefficient is higher than $\alpha=0.05$ - Accept the Null.

So, we can say that unemployment doesn't significantly affect those availing of the SNAP Facility.

F-test:

The overall significance of regression coefficients was tested using F-test.

$$F = \frac{R^2 (n-k)}{(1- \bar{R}^2)(k-1)}$$

Where,

R^2	=	coefficient of unadjusted multiple determinations
$\bar{R}^2$	=	coefficient of adjusted multiple determinations
n	=	number of observations in the sample
k	=	number of b_i (including the intercept b_0)

Hypothesis test

- **H0: $\beta_1 = \beta_2 = 0$**
- **HA: At least one of the coefficients is significant.**

F Statistic	127.1227
F Critical	3.267424

F- Statistic > F-Critical = We reject the Null, which implies that at least one of the Coefficients has sufficient explanatory power.

CONCLUSION

As we can see from testing the beta coefficients' significance, the poverty coefficient is significant.

This implies that the relationship between poverty and participants in the SNAP program does not arise due to random variations in the data.

When the number of poor people increases, the number of participants in the SNAP program also increases.

For every one-unit increase in the number of poor people (independent variable), the number of participants in the food assistance program (dependent variable) is expected to increase by 1.89 units.

This shows the significant impact of poverty on the need for food assistance while unemployment is small.

Therefore, we can conclude that poverty is a significant variable in explaining the model while unemployment is not, as random variations in the data cause the latter effect.

Hence, our theory that poverty should be the determining factor for food assistance programs is proven true.

REFERENCES

[1] Alaimo, K., & Briefel, R. R. (2003). "Food insufficiency exists in the United States: results from the third National Health and Nutrition Examination Survey (NHANES III)." American Journal of Public Health, 93(9), 1419-1424

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