# IS FUEL CONSUMPTION AMONG TWO WHEELERS INCOME DETERMINED?

*A Study from Puinan village of West Bengal*

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**Abstract:**

Energy is approximate factor of production since the advent of the human society. Low energy use implies a low level of production and low supply of goods services. Similarly, high level of energy use implies a high level of production and high supply of goods and services. Therefore, efficient use of energy is a targeted social accomplishment since the beginning of our society. The rich people are using energy in an inefficient manner. Fossil fuel is most important source of energy. People have to utilize this energy in such a manner that our future generation also gets a chance to use this energy. Fossil fuels are continually being formed by the use of natural processes, and they are generally considered to be non-renewable sources of energy. Fossil fuels are depleted very faster.

Energy consumption is unswervingly related to the standard of living. Rich countries have the benefit of high standard of living because of towering entitlement of goods and services. High energy use implies elevated supply of goods and services. Poor countries, not only lacks as much as energy needed to produce sufficient amount of goods and services, but also citizens are not so rich to supplement their labour supply to purchase high-valued goods and services to maintain standard of living as par that of high income countries. Keeping in mind this idea, the study is entrusted to find out the relationship between household energy consumption and their annual income.

Keywords: ***Fossil Fuel, Energy consumption, Standard of living, Annual Income.***

## 1. **Introduction:**

In this study, we have tried to put up an idea about the fuel economics. Energy economics studies energy resources and energy commodities. Energy economics includes forces motivating firms and consumers to supply convert, transport and use energy resources and to dispose of residual market structures and regulatory structures distributional and environmental consequences and economically efficient use. There are several studies confirmed the relationship between the consumption of fuel and annual income. In Puinan Village we observed that the consumption of fuel is according to the income of the Puinanites. This paper is entrusted to find out the association between annual fuel consumption and per capita annual family income in the Puinan Village.

## 2. Literature Review:

HUNG in his article "Traffic Management in Motor Cycle Dependent Cities" (2006): Hang assessed traffic management measures using multiple criteria and accordingly he listed strategies for motor cycle dependent cities. Asian countries like Hanoi, Bangkok and Taipei experiences a special situation and is called motor cycle dependence. Urban transport system is being very much dominated by motor cycle. This domination influences urban form and land use pattern of the cities by remaining and growing of many two wheelers accessed blocks.

Ye Et Al in his article "Case Study of Motorcycle Use and Policy Analysis in Huizhou, China" (2011): Ye Et Al estimated the impacts of a motor cycle ban policy using travel preference data of local residents in Huizhou, China. This study analysis the potential impact of motor cycle demand management. It has contributions to the transportation market in Yangon, Myanmar where motor cycles have been banned since 2003.

William A. Pizer in the article "The Economics of Improving Fuel Economy" (2006): This paper says that improving fuel economy offers us the assurance of dropping our oil use without requiring us to give up driving our vehicles. Reduced oil use, in turn, means both fewer carbon dioxide ($CO_2$) emission and a smaller economic impact when oil prices rise, thereby humanizing both the environment and our economic security. Despite this promise, the average fuel economy of new light-duty vehicles (Cars and Light Trucks) in the United States has deteriorated over long-ago 20 years as sales of larger and more powerful vehicles have risen.

Stephen Grinwis in the article "Fuel Cell Economics vs Batteries" (2014): We've been investigation a lot about fuel cell electric vehicles (FCEVs) lately, thanks in Large part to Toyota and its Mirai. There are a couple of main pieces that have to look at when looking at the economics of fuel cells:

1. The actual cost of the fuel cell stack, which is the important bit that actually turns hydrogen into electricity.
2. The cost of the hydrogen fuel itself.
3. The cost of the fuelling infrastructure.

The fuel cell stack is actually not that horribly expensive.

Tadit Kundu in the article "will politics trump economics on petrol, diesel pricing?" (2017): High prices of petrol and diesel are the new biased boiling potato. Opposition parties are violating the government for not short-lived on the remuneration of low crude oil prices to consumers. Current price of one litre in Delhi is more or less similar to what it was in January 2014.

## 3. Objectives of the study:

In developed countries the fuel consumption is greater because the residents of the developed countries are experiencing a fair amount of salary. The amount of fuel consumption is dependent on the income, where as in the less developed countries the

amount of fuel consumption is low because their wages are fairly low and they don't have enough money to spend their money on various resources. We have preferred to find out the relationship between annual fuel consumption and per capita annual income in the Puinan village.

As a result, it is expected that if the income of the villagers increase simultaneously the fuel consumption will also increase. The objective of our study in the following:

➢ On the basis of the sample observation of 59 household, we have tried to uncover if there exists any relationship between the per capita annual family income and the annual consumption of fuel in the Puinan Village of West Bengal.

Table: No-1. Demographic features of Puinan Village

| Particulars | Total | Male | Female |
|---|---|---|---|
| Total no. of houses | 977 | | |
| population | 4449 | 2234 | 2215 |
| Child (0-6) | 438 | 225 | 213 |
| Scheduled Caste | 1543 | 786 | 757 |
| Scheduled Tribe | 625 | 305 | 321 |
| Literacy | 79.61% | 87.01% | 72.18% |
| Total Workers | 1930 | 1357 | 573 |
| Main worker | 1204 | 1204 | 0 |
| Marginal worker | 726 | 331 | 395 |

Source: http:// www.census2011.co.in retrieved on December 9, 2017.

## 4. Model and Methodology of data collection:

The purpose of this study is to identify the connection between "annual consumption of fuel and per capita annual income" in Puinan Village of Dadpur block. To carry out the study, we have employed simple random sampling without replacement (SRSWOR).

We had constructed a set of questionnaire for our survey. The questionnaire was invented by Statistical Society of London (1838). They are sharply restricted by the fact that respondents must be able to read the questions and respond them. While constructing our questionnaire we had followed the basic rules of making it. There are various modes of questionnaire administration viz

- Face-to-face questionnaire administration, where an interviewer presents the items only.
- Paper –and –pencil questionnaire administration, where the items are presented on paper.
- Computerized questionnaire administration, where the items are presented on the computer.
- Adaptive Computerized questionnaire administration, where a selection of items is presented on the computer, and based on the answer of those items, the computer selects following items optimized for the testing trait.

Following, the answers of the respondents we had entered our data set for the further validation of our model taken.

## 4.1. Econometric Model

### Specification and Definition of Variables:

In this paper we chose two variables which are annual fuel consumption denoted as Y and the per capita family income of the family in the Puinan Village denoted as X.

Energy economics is the field that studies human utilization of energy resources and energy commodities. Energy economics studies energy resources and their part within society. Energy economics studies the government and market forces that prompt the use of energy sources by consumers and industries.

On the other hand, per head family income is the amount of money brought in by entire household in a year. Per head income of household is calculated as gross amount rather than net, which means before any taxes of withholding are deducted.

This paper aimed to show that the relation between per capita income of the family (X) and the annual consumption of fuel (Y), whether it is possible or not.

## 4.2. Analytical Framework:

Now we consider a two variable linear regressions model

$$Y_i = \alpha + \beta X_i + u_i \qquad (4.2.1)$$

Where $Y_i$ represents per head fuel consumption and $X_i$ is the per capita family income of *i*th family of the Puinan Village. As per assumption of Classical Linear Regression Model (CLRM), $u_i$ follows the following assumptions.

1. $E(u_i)=0 \quad \forall j= 1,2,\ldots\ldots,n$
2. $E(u_i^2)= \sigma_u^2 \quad \forall j= 1,2,\ldots\ldots,n$
3. $E(ui,uj) =0 \quad \forall j \neq j$
4. $E(u_i,u_j = \sigma_u^2 \quad \forall j =j$ (4.2.2)
5. Independent variable X is non-stochastic.

If (4.2.2) satisfies then we can estimate $Y_i = \alpha + \beta X_i + u_i$ through OLS.

Then the estimated linear regression model becomes:

$$\hat{Y}i = \hat{\alpha} + \hat{\beta} X_i \qquad (4.2.3)$$

Where $\hat{\alpha}$ and $\hat{\beta}$ are OLS estimators of α and β such that

$$\hat{\beta} = \frac{\sum_{i=1}^{n} x_i y_i}{\sum_{i=1}^{n} x_i^2} \qquad (4.2.4)$$

and $$\hat{\alpha} = \bar{Y} - \hat{\beta}\bar{X} \qquad (4.2.5)$$

Now, $$var(\hat{\beta}) = \frac{\sigma_u^2}{\sum_{i=1}^{n} x_i^2} \qquad (4.2.6)$$

and $$var(\hat{\alpha}) = \sigma_u^2 \frac{\sum_{i=1}^{n} X_i^2}{n\sum_{i=1}^{n} x_i^2} \qquad (4.2.7)$$

We have to test the null hypothesis,

$$H_0: \hat{\beta} = 0 \qquad (4.2.8)$$

Against the alternative hypothesis,

$$H_1: \hat{\beta} \neq 0 \qquad (4.2.9)$$

To test hypothesis, we can apply two tests and they are

1. The t-test
2. The F-test

**1. The t-test**

The t-test can be determined as follows:

$$t = t_{n-2} = \frac{\hat{\beta}}{\frac{\hat{\sigma}}{\sqrt{\sum_{i=1}^{n} x_i^2}}} \qquad (4.2.10)$$

which has t-distribution with degree of freedom (n-2).

**2. The F-Test**

The F-test is carried on to determine the overall significance of the economic model. That means this test bears the responsibility to suggest the overall effects of independent variables on the dependent variable. If we compute the null hypothesis as

$H_0$: No slope coefficients are simultaneously zero,

Then, $$F = \frac{(b-\beta)^2 \Sigma x^2}{\Sigma e^2/(n-2)} \sim F(1, n-2) \qquad (4.2.11)$$

The calculation of correlation regression coefficient $r^2$ is our task.
We do calculate $r^2$ by using the formula $r^2 = \frac{ESS}{TSS}$

In this study area we could find families of various income groups. By the method of random sampling we have selected the households. Motor Cycle play an important role in transferring goods and people from one place to another. In Puinan village we saw that people use their motor cycles to go too far for their work and they also use their motor cycles for carrying the vegetables from their home to the market place and sells those vegetables in the market place. So this is how they earn their livelihood.

Our aim is to check whether there lies any relationship between the fuel consumption and the annual income. We had a questionnaire for the survey, on the basis of which we would get our required data. To make interferences about the regression coefficients that t statistic is calculated. It is used to test hypothesis on coefficient test. It means that if the null hypothesis is zero it means that the correspondent term is insignificant versus the alternative hypothesis that the coefficient is different from zero. We have taken the data set for 59 households as our final data for our further calculations. In our next chapter, using the data set for our calculated observations, we will test the model to check the validation of our mode.

## 5. EMPIRICAL ANALYSIS

In this chapter we will present the empirical analysis and results of the econometric model which was estimated previously. In Puinan village a household survey was done to test the econometric model. In Puinan village we saw that the families with high income have tended to consume more fuel and those families whose income is fairly low they do consume less amount fuel. So by any means, if the income of the Puinanites rises their consumption of fuel also rises. We will try and found out whether the model which we have constructed is valid for the residents of the Puinan village or not.

Table No-2.
Summary Statistics Using the Observation 1-59

| Variable | Mean | Median | Minimum | Maximum |
|---|---|---|---|---|
| ANNUAL FUEL CONSUMPTION (Rs) | 21842 | 16500 | 3500 | 36500 |
| ANNUAL INCOME (Rs) | 23171 | 17143 | 5000 | 65000 |
| Variable | Std. Dev | C.V | Skewness | Ex. Kurtosis |
| ANNUAL FUEL CONSUMPTION (Rs) | 16293 | 0.74592 | 1.7527 | 3.4667 |
| ANNUAL | 16364 | 0.70624 | 1.3539 | 1.0655 |

| | | | | |
|---|---|---|---|---|
| INCOME (Rs) | | | | |

Source: Own calculation from survey data.

This table provides summary statistics of the quantitative variables of this study i.e., annual fuel consumption and per capita annual family income. From the data it is observed that annual income of those surveyed households in Puinan village varies from a minimum amount of Rs 5000/-to a maximum of Rs 65000/. The standard deviation values are Rs 16293/ and Rs 16364/ for annual fuel consumption and annual income. The co-efficient of variation for annual income is 0.70624 and annual fuel consumption is 0.74592. The skewness of annual fuel consumption and annual income are 1.7527 and 1.3539 respectively. The ex-kurtosis value is obtained to be 3.4667 and 1.0655 respectively.

## 5.1. ECONMETRIC ESTIMATION

We have considered our econometric model as mentioned in the last chapter. After calculating our results in excel our estimated equation takes the form,

$$Y_i = 5795.03 + 0.6925X_i$$
$$(2679.96) \quad (0.09474)$$

The parentheses are the Standard Error (S.E) of $\hat{\alpha}$ and$\hat{\beta}$.
Therefore there exists a relationship between annual fuel consumption and annual income.

We have to test the null hypothesis,

$$H_0: \hat{\beta} = 0$$

Against the alternative hypothesis,

$$H_1: \hat{\beta} \neq 0$$

### 1. t-Test

After performing the calculations, we get the calculated value of 1-statistic of $\hat{\alpha}$ is found to be 2.162 and that of $\hat{\beta}$ is 7.310

$Y_i = 5795.03 + 0.6925X_i$
(2679.96) (0.09474)

t= 2.612 7.310
p= 0.0348 9.68e-010

r= 0.3848
d.f. =57

f (1, 5) =53.435 which is greater than the corresponding table value 3.84 at 5% level of significance.

The figure in the first set of parentheses is the estimated standard errors of the regression coefficients. The figures in the second set are estimated t values. Under the null hypothesis the true population value of each regression coefficient individually is zero (e.g. 2.612=5795.03÷2679.96), and the figures in the third set are the estimated p values. Thus for 57 d.f. the probability of obtaining a t value of 2.612 or greater is 0.0348 and the probability of obtaining a t value of 7.310 or larger is about 9.68e-010.

By presenting the p values of the estimated t co-efficient, we can see at once the exact level of significance of each estimated t value. Thus, under the null hypothesis that the true value is zero, the exact probability (i.e., the p value) of obtaining a t value of 2.612 or greater is only about 0.0348. Therefore if we reject the null hypothesis, the probability of our committing a Type 1 error is about 34 in 10.00 a very small probability indeed. For all practical purpose we can say that the true population intercept is different from zero. Likewise, the p value of the estimated slope coefficient is zero for all practical purposes. We showed the intimate connection between the F and t statistics. Under the null hypothesis that the true β= 0, shows that the F value is 53.435 and the t value is about 7.310(57df); as expected, the former value is the square of the latter value , except for the round off errors.

### 5.2. Correlation Regression Coefficient

The correlation regression coefficient r is calculated to be is 0.6203 and the coefficient of determination of $r^2$ is 0.3848. The correlation coefficient is moderate

### 5.3.P-Value

The p-value of $\hat{\alpha}$ is calculated to be 0.0348 which is not very low which signifies that we can take the estimated value of $\hat{\alpha}$ as 5795.03 at 97% level of confidence. The p-value of $\hat{\beta} =$ is 0.000000009 which is very low which signifies that we can take the estimated value of $\hat{\beta} =$ is 0.6925.

## 6. Conclusion and Policy Suggestions

### 6.1. Introduction:

Fuel Consumption is inevitable to run our society. But fossil fuels are decreasing day by day which signifies that our future generation may not be able to use this power. So we have to use fossil fuels in a limited way so that our future generation should get chance to use it. Our study established that the families which are endowed with higher income are expected to use more fuel relatively to the families who have fairly low incomes.

People in the developed countries are mainly belonging to the high income group so they are expected to consume fuel much more than the people in the underdeveloped countries who

have low income and they are unable to consume fuel as much as developed countries. In this work it is already proved that the higher income groups are consuming more fuel relatively the low income groups. Therefore, the government should place some restrictions on the use of fuel which will be great advantageous to our future generation.

In order to discuss the policy relating to fuel consumption in Puinan village we have to take into consideration the finding of the study as computed in the previous chapter in our study.

**6.2. Basic Findings of the Study:**

This study confirms the positive relation between the annual income and the consumption of fuel. As per the result of our study we come to a conclusion that the higher income group people tends to have more consumption of fuel than the lower income group people. We can say that by any means if the income of the Puinanites increases, the consumption of fuel also increases. The next section of this chapter deals with some policy suggestions.

**6.3. Some Policy Suggestions:**

Efficient energy use, also called energy efficiency, is the goal to reduce the amount of energy required to provide goods and services. Installing fluorescent light, LED lights and natural skylights reduces the amount of energy required to attain the same level of illumination as compared to using traditional incandescent. Improvements in energy efficiency are generally achieved by adopting a more efficient technology or production process.

There are many motivations to improve the energy efficiency. Reducing energy use is also seen as a solution to the problem of reducing green house emissions. Improved energy efficiency in buildings, industrial process could reduce the world's energy needs in 2050 by one third and help to control the emissions of green house gases, according to International Energy Agency. Energy efficiency and renewable energy are said to be the twin pillars of sustainable energy policy. In many countries energy efficiency is also seen to have a national security benefit because it can be used to reduce the level of energy imports from foreign countries and may slow down the rate at which domestic energy resources are depleted. Energy efficiency has proved to be a cost effective strategy for building economies without increasing energy consumption. For example, insulating a home allows a building to use less heating and cooling energy to achieve and maintain a comfortable temperature. Reducing energy use reduces energy costs and may result in a financial cost saving to consumers.

i) Energy Tax- energy tax is a fee on fuels such as coal, natural gas and oil. The aim of the energy tax is to give consumers and business incentive to use alternative energy sources. Introduction of energy tax will affect severely high income group and thereby may limit energy use.

ii) Price Discrimination- Charging high price of energy to the high income people and low price of energy to the low income group may limit the tendency of overuse of energy by high income group.

iii) Use of Non-conventional and Renewable Energy- Escalating the use of renewable and non-conventional energy such as wind power, solar power may escort the way of decreasing exploitation of fossil fuel.

iv) Alternative Energy- It is an energy source that is alternative to fossil fuels. These alternatives are projected to address concerns about such as fossil fuels such as its high carbon dioxide emissions. Marine energy, hydroelectric, wind, geothermal and solar power are all alternative sources of energy.

v) Ethanol as an alternative to fossil fuels- Ethanol can be produced from a miscellaneous stock of array feed stocks and involve the use of the whole corp. This approach should increase yields and reduce the carbon foot print because the amount of energy- intensive fertilizers.

vi) Atomic Energy- The need for nuclear energy is more widespread today than it has been for decades. Comprehensive climate change and the rising prices of fossils fuels such as oil have made many scientists seek an alternative energy source. Although nuclear energy has been around for decades, the use of nuclear energy could bring disaster for any country involved in the process. Events like Three Mile Island, Chernobyl, and Japan's Fukushima accident are reminders of how nuclear energy can go wrong. However, the continued use of fossil fuel cans enchantment disaster for the international and domestic security of any country that is dependent on the energy source. Fossils fuel is a limited source of energy.

In this study we found association between per capita annual income and per head fuel consumption. Therefore we found a positive relationship between the per capita annual income and per head fuel consumption. So, we can conclude that as the income of the Puinanites increases the consumption of will also increases.

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