International Journal of Economics, Business and Accounting Research (IJEBAR)
Peer Reviewed – International Journal
Vol-3, Issue-4, 2019 (IJEBAR)
E-ISSN: 2614-1280 P-ISSN 2622-4771
https://jurnal.stie-aas.ac.id/index.php/IJEBAR

ANALYSIS OF FACTORS AFFECTING THE DEMAND FOR KEROSENE IN URBAN HOUSEHOLDS IN INDONESIA

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Abstract: *The government has been converting kerosene to gas since 2007. However, households that use kerosene for cooking purposes are still found in urban areas in Indonesia, even though access to gas is already very easy. This study aims to investigate the factors that influence the demand for kerosene in urban households in Indonesia. Based on the March 2018 Susenas data from BPS, it was found that 15,143 urban households still use kerosene, 80.20 percent of them use kerosene as the main fuel for cooking. Using multiple linear regression, it was found that the price of kerosene and the gender of the head of the household had a negative effect on the intensity of kerosene use in urban households. Meanwhile, income per capita, age of the head of the household, number of household members, and education level of the head of household have a positive effect on the intensity of kerosene use in urban households.*

Keywords: ***Demand, Kerosene, OLS, Household, Urban, Susenas***

1. Introduction

Energy has a crucial role in human life. Human daily activities cannot be separated from dependence on energy, both in activities related to household and business activities. Domestic energy needs are still very dependent on energy sources derived from petroleum whose supplies are limited and dwindling.

In Indonesia, the household sector occupies the second position as the largest energy user after the industrial sector (BPS, 2019a). Energy has very important role for the household. Energy becomes a catalyst so that households can feel easier and more efficient in carrying out their daily activities. The usage of energy in households includes cooking, lighting, heating/cooling, and various other household applications.

Prior to 2006, the majority of households in Indonesia used kerosene as the main choice of cooking fuel for both urban, suburban and rural households (World Bank, 2013). Historically, the government provided subsidies so that people can buy kerosene at cheap prices, but there is extreme increase in oil prices over the last few decades, especially the oil price increase in 2005–2006. This situation puts a financial burden on the government, so the government significantly reduces the amount of subsidized kerosene on the market by carrying out conversion of kerosene to gas on a large scale in 2007. The program can also be declared successful because it reduces the use of kerosene by 92% in less than 10 years (Thoday, Benjamin, Gan, & Puzzo, 2018).

Recent data shows that the majority of Indonesian households have used LPG as the main fuel for cooking (BPS, 2019b). The use of kerosene is no longer recommended based on the WHO Air Quality Guideline because it is considered a polluting fuel (WHO, 2014). However, the use of kerosene as the main cooking fuel is still found in some households in urban areas in

Indonesia. Based on data from the March 2018 Susenas, 15,143 urban households used kerosene, of which 80.20 percent (12,144 households) used kerosene as the main fuel for cooking. In fact, the accessibility of urban households to obtain LPG and electricity is very easy. Therefore, this study aims to investigate the factors that influence the demand for kerosene in urban households in Indonesia using micro data from the March 2018 National Socio-Economic Survey (SUSENAS).

2. Literature Review

Law of Demand

In everyday life, human as consumers always make various demands for various goods and services needed. Demand made by consumers is their way to get satisfaction in meeting their needs. This consumer demand can be described through the demand curve. The demand curve shows how the demand for an item by consumers depends on its price or can be described in the following equation.

$$Q_D = Q_D(P) \ldots\ldots\ldots\ldots (1)$$

The equation generally shows that demand is a function of price. The equation can also be depicted graphically through the demand curve (Figure 1). The demand curve represents the maximum price that consumers are willing to pay for goods vary in quantity per unit of time. The demand curve is depicted by a line that runs from top left to bottom right so that the slope is negative, assuming other variables are constant, which means that consumers will buy more goods when the price decreases. Demand caused by price will cause a movement along curve D. However, demand can also be caused by variables other than price that cause the curve to shift to the right or to the left, such as income, weather, prices of other goods, and so on.

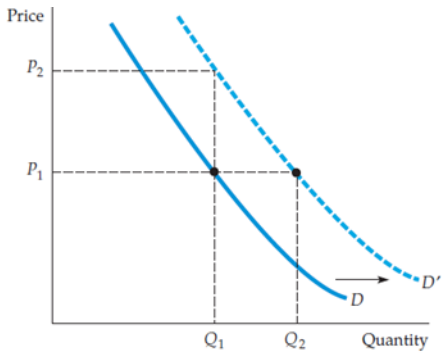

Figure 1. Demand Curve (Pindyck & Rubenfield, 2012)

Previous research

Kerosene as a source of household energy has attracted the attention of many previous studies (Rahut et al., 2017; Danlami, 2017; Ogwumike et al., 2014; Lee, 2013; Mensha & Adu, 2013; Nnaji et al., 2012).). For example, Rahut et al. (2017) found that the age of the head of the household, the male head of the household, the higher education level of the household head and the area of land tenure were positively related to the use of kerosene as the main energy

source, while tractor ownership was found to have a negative relationship with household use of kerosene. Danlami (2017) in an analysis of the intensity of kerosene use in households in Bauchi State concluded that the age of household heads, residence in urban areas, fuelwood prices and income had a significant positive impact, while the price of kerosene and neighboring lighting sources had a negative impact. on the intensity of household kerosene use. In addition, Ogwumike et al. (2014) found that per capita expenditure, the head of the household is male and the level of education achieved; significant positive effect on the adoption of kerosene. On the other hand, household size and ownership of housing units have a negative impact on the use of kerosene as the main energy source for households.

In contrast, Lee (2013) used the tobit model to analyze the household energy mix in Uganda. The results of the study concluded that the gender of the head of the household, education level and the price of firewood were positively related to the intensity of the use of kerosene, while the price of kerosene had a negative effect on the intensity of the use of kerosene. Furthermore, Mensah and Adu (2013) prove that educational attainment and an increase in household income increase the possibility of using kerosene as the main source of household energy. This is in line with the findings of Nnaji et al. (2012). Furthermore, this study concludes that the marital status of head of household, household size and head of household who work as farmers or traders reduce the possibility of using kerosene as the main cooking fuel.

In Indonesia, studies on household kerosene demand have also been conducted previously by Putriyani & Oswari (2005), Kakisina (2003), and Koshala, Kosal, Boyd, & Rachmany (1999). Putriyani & Oswari (2005) conducted a case study on kerosene consumers in Sukmajaya District, Depok. The results showed that the demand for household kerosene consumption in Sukmajaya District, Depok was significantly influenced by household income factors, the number of family members and household tastes in energy use for household purposes. The most dominant factor influencing the demand for household kerosene consumption is the household taste factor. Kakisina (2003) in her thesis concludes that household kerosene demand in Salatiga City is negatively and significantly affected by the price of kerosene and fuelwood prices and positively and significantly influenced by income and LPG prices. Koshala et al. (1999) using annual data for the period 1957–1992, statistical results show that in addition to past conditions, kerosene prices, price elasticity, and per capita income are the main determinants of kerosene consumption in Indonesia.

Research model

The research models proposed in this study are:

$$KER_i = \beta_0 + \beta_1 PRC_i + \beta_2 \text{Ln}EXPCAP_i + \beta_3 HHSZ_i + \beta_4 AGE_i + \beta_5 GNDR_i + \beta_6 EDU_i + \varepsilon_i \quad ...(2)$$

where

KER_i = the intensity of the use of kerosene by households

PRC_i = kerosene price

$\text{Ln}EXPCAP_i$ = household income per capita

$HHSZ_i$ = household size

AGE_i = age of head of household

$GNDR_i$ = gender of the head of the household

EDU_i = education level of head of househo

3. Research methods

This study uses micro data from the March 2018 National Socio-Economic Survey (SUSENAS). The March 2018 Susenas is a national-scale survey that includes 300,000 sample households that can produce estimators up to the district level. The data was filtered on urban households and found that 15,143 urban households used kerosene. This study investigates all urban households that still use kerosene even though these households do not use kerosene as the main fuel for cooking so that it can describe the demand for kerosene in urban households. This study uses the Ordinary Least Square (OLS) analysis tool with STATA 13.1 software. The variables and definitions of variables used in this study are described in Table 1.

Tabel 1. Variabel Dependen dan Variabel Independen dalam Penelitian

Variabel	Keterangan	Definisi Variabel
Dependen		
KER	Intensity of use of kerosene (Liter)	The amount of kerosene used by household in a month
Independen		
PRC	Kerosene price (Rupiah)	The price of kerosene paid by household per liter
LnEXPCAP	Household income per capita (Rupiah)	Earned per capita income households in a month approximated by per capita expenditure data
HHSZ	Household size (Person)	The number of members living in one household
AGE	Age of head of household (Years)	Age of head of household
GNDR	Gender of the head of the household (0 if male and 1 if woman)	Gender of the head of the household
EDU	Education level of head of household (0 if education is less than college, 1 if college high up)	The highest education completed by the head of the household with proof of a diploma

4. Results and Discussion

Summary of Descriptive Statistics of Variables and Socioeconomic Characteristics

The summary of descriptive statistics for the variables is shown through the mean, standard deviation, minimum, and maximum values in Table 2. These values show a natural description of the variables (in Danlami, 2017).

Table 2. Summary of Variable Descriptive Statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
PRC	15.143	6.399,062	3.226,732	1.266,667	35.900,000
LnEXPCAP	15.143	13,959	,62	11,876	16,816
AGE	15.143	47,751	13,729	12	97
HHSZ	15.143	4,053	2,041	1	23
GNDR	15.143	-	0,394	0	1
EDU	15.143	-	0,356	0	1

Socio-economic characteristics of kerosene users by households in urban areas of Indonesia can be seen in Table 2. Table 2 shows that the majority of household heads are male (80.72%). This shows the paternal culture in Indonesia which still considers men as the breadwinner in the family. A total of 72.02% of the age of the head of the household is in the age range of 31-60 years, 50.16% of the head of the household has studied up to college and above, 32.86% of the household has a household income per capita ranging from 500,001 - 1,000,000 rupiah per month, and 80.37% of households have household members ranging from 1 – 5 people.

Table 3. Socio-Economic Characteristics of Urban Households Using Kerosene

Characteristics	**Frequency**	**Percentage**	**Cumulative Percentage**
Gender			
Man	12.224	80,72	80,72
Woman	2.919	19,28	100,00
Age of household head			
≤ 30	1.501	9,91	9,91
31 – 45	5.414	35,75	45,66
46 – 60	5.493	36,27	81,94
> 60	2.735	18,06	100,00
Level of education			
No/Not yet in school	418	2,76	2,76
Elementary School/Equivalent	1.975	13,04	15,80
Middle School/Equivalent	2.920	19,28	35,09
High School/Equivalent	2.235	14,76	49,84
College	7.595	50,16	100,00
Income per capita			
≤ 500.000	1.346	8,89	8,89

500.001 – 1.000.000	4.976	32,86	41,75
1.000.001 – 1.500.000	3.717	24,55	66,29
1.500.001 – 2.000.000	2.247	14,84	81,13
> 2.000.000	2.857	18,87	100,00
Number of Household Members			
1 – 5	12.170	80,37	80,37
6 – 10	2.865	18,92	99,29
> 10	108	0,71	100,00

Correlation Analysis

In this section, correlation analysis is conducted to explore the nature of the correlation that exists between the variables used in this study, and also to ascertain whether there are two or more variables that explain the same phenomenon (ie variable multicollinearity). Usually the value of the correlation coefficient ranges from 0 - 1. A correlation value of 0.7 indicates a high correlation between variables. Furthermore, a negative value indicates a negative relationship between variables and a positive value indicates a positive relationship between variables. Table 3 shows the correlation value of the variables in this study.

Table 4. Correlation Matrix

Variables	KER	PRC	LnEXPCAP	AGE	HHSZ	GNDR	EDU
KER	1.000						
PRC	-0.332	1.000					
LnEXPCAP	0.127	0.047	1.000				
AGE	0.060	0.066	-0.045	1.000			
HHSZ	0.315	-0.199	-0.374	0.038	1.000		
GNDR	-0.109	0.078	0.043	0.172	-0.243	1.000	
EDU	0.112	-0.063	0.265	-0.063	0.032	-0.044	1.000

OLS Regression Results of Urban Household Kerosene Demand

The results of the OLS regression of kerosene demand in urban households can be seen in Table 5. Table 5 shows that all the independent variables proposed in the model have a significant effect on the dependent variable. The PRC, LnEXPCAP, AGE, HHSZ, and GNDR variables were significant at the =1% level, while the EDU variables were significant at the =5% level. From the equation model formed, the R-Squared value is 0.247, which means that the intensity of kerosene use in Indonesian urban households 24.7% is influenced by price variables, per capita income, age of the head of the household, gender of the head of the household, and education level of the head of the household. households, while the remaining 75.3% is influenced by other variables outside the model.

Table 5. OLS Regression Results Intensity of Urban Household Kerosene Use

KER	**Coeficient**	**Standard Error**
PRC	(0,001)***	0,000
LnEXPCAP	4,101***	0,119
AGE	0,056***	0,004
HHSZ	1,606***	0,037
GNDR	(0,634)***	0,175
EDU	0,398**	0,194
Constant	(49,274)***	1,754
R-Squared		0,247
Prob > F		0,000

Note: *** significance at = 1%, ** significance at 5%

Table 6. Classical Assumption Test

Normalitas	**Multikolinieritas**	**Homoskedastisitas**
Jerque-Bera p=0,000	Varian Inflation Factor (VIF) HHSZ = 1,31 LnEXPCAP = 1,28 EDU=1,11 GNDR=1,10 PRC=1,05 AGE=1,05	Breusch-Pagan/Cook-Weisberg heteroscedasticity test *p-value* 0.000

Table 6 shows the results of model testing against classical assumptions in linear regression. Based on the results of the Jarque-Bera normality test, the assumption of a normally distributed residual is not proven significantly (p-value < 5%, reject H_0). The multicollinearity test displays the Variance Inflation Factor (VIF) value of less than 10. If the VIF value is less than 10, it can be concluded that there is no multicollinearity. The heteroscedasticity test is a test that assesses whether there is an inequality of variance from the residuals for all observations in the linear regression model. Testing the assumption of homogeneous residuals using the Breusch-Pagan test with a p-value less than 5% (failed to reject H_0). The results of the classical assumption test above can be concluded that two of the three classical assumptions in OLS are not met. To overcome the violation of these assumptions, a regression with Robustness Standard Error was carried out.

Table 7. Estimation Results with Robustness Standard Error

KER	**Coeficient**	**Standard Error**
PRC	(0.001)***	0.000
LnEXPCAP	4.101***	0.133
AGE	0.056***	0.004
HHSZ	1.606***	0.048
GNDR	(0.634)***	0.169
EDU	0.398*	0.209
Constant	(49.274)***	1.972
R-Squared		0,247
Prop > F		0,000

Note: *** significance at = 1%, ** significance at 5%

Table 7 shows that all the independent variables proposed in the model have a significant effect on the dependent variable. The price variable *(PRC)* has a negative and significant effect on the intensity of kerosene use in urban households in Indonesia. The higher the price of kerosene, the intensity of household use of kerosene will decrease, and vice versa. This is in accordance with the law of demand which describes a negative relationship between price and demand. The results of this study also support the findings of Danlami (2017), Lee (2013), and Dubin & Daniel (1984). In addition, the gender of the head of the household *(GNDR)* also shows a negative and significant effect on the intensity of urban household kerosene use. That is, if the head of the household is gender

For women, the intensity of urban household use of kerosene will decrease. This shows that women are more considerate in the use of kerosene. The variables of income per capita *(LnEXPCAP)*, age *(AGE)*, household size *(HHSZ)*, education level of the head of household *(EDU)* showed a positive and significant effect on the intensity of household kerosene use. The higher the per capita income, age, number of household members, and the education level of the head of the household, the more intensive the use of kerosene in urban households is. The higher the per capita income, the higher the household's ability to buy kerosene. The higher the age of the head of the household, over time, the income of the head of the household has increased and the number of household members has also increased, resulting in the use of kerosene in the household. In addition, the higher education taken by the head of the household indicates the higher income earned by the head of the household so that the use of kerosene will also increase. These findings support the findings of Danlami (2017), Ogwumike et al. (2014), Lee (2013), Mensah & Adu (2013), and Nnaji (2012).

5. Conclusion

The regression results show that all the independent variables proposed in the model have a significant effect on the intensity of kerosene use by urban households in Indonesia. The price of kerosene and the gender of the head of the household have a negative effect on the demand for kerosene in urban households. This means that the higher the price of kerosene, the demand for household kerosene will decrease, and vice versa. The factor of kerosene price which has a significant effect on household demand shows that currently the price of kerosene circulating in the Indonesian market is still affordable and its availability is still easily obtained by the household, although currently access to obtain LPG is also easier.

The variables of income per capita *(LnEXPCAP)*, age *(AGE)*, household size *(HHSZ)*, education level of the head of household *(EDU)* showed a positive and significant effect on the intensity of household kerosene use. The higher the per capita income, age, number of household members, and the education level of the head of the household, the more intensive the use of kerosene in urban households is.

There is a violation of classical assumptions from the regression estimation results in this study, so that for further research, parameter estimation methods or other statistical methods can be used to produce more efficient model coefficient estimates.

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