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Is cheap fuel policy a (short-term) remedy for costly transportation in rural Indonesia?

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Abstract. High fuel prices in rural regions in Indonesia have for years limited the mobility of local communities and their economic development. In addressing the problem, since 2016 the government has implemented a policy called *BBM Satu Harga* or One Price Fuel to guarantee the provision of fuels at the government's price control in the last miles. In this paper, we assess the impact of the One Price Fuel policy on averaged domestic transport costs in surrounding intervened villages to see the effectiveness of the policy implementation. Our analysis employs Difference in Difference (DD) regression model covering all villages under districts that contain at least one of the 58 intervened subdistricts and a period between 2014 and 2018. We exercise various control variables, fixed effect, and propensity score matching into the model. Although we consider the One Price Fuel policy as a short-term remedy for the problem, our estimates show that the policy has successfully reduced domestic transport costs in the rural regions by almost 65% on average. However, when we divide the rural regions into two categories: The frontier, outermost and underdeveloped villages (3T villages) and *non-3T* villages; the policy only affects the former. Also, our estimates suggest that improving transportation infrastructure in the villages is among effective policy options to reduce rural transport costs.

1. Introduction

Access to affordable modern energy sources has long become a challenge for economic development in rural regions particularly from the global south [1]. In most cases, the remoteness of some rural regions is considered the main cause of high costs of energy consumption [2]. Recently, with the growing use of motorized vehicles in the non-urban regions [3], the pressure for the provision of affordable transport fuels such as gasoline and diesel for rural communities is increasing [4].

As the largest archipelago in the world with more than 17,000 islands, Indonesia has its geographical challenges in providing affordable energy access for people across the country. This situation is complicated with infrastructure development which is largely concentrated in urban areas [5]. In the frontier, outermost and underdeveloped villages (*Desa Terdepan, Terluar dan Tertinggal* or usually called 3T villages) in Indonesia, the fuel prices often skyrocket, reaching Rp 100,000 per litre [6]. This situation has indeed affected local growth. A study of Sambodo and Novandra [7] found high transport fuel prices in rural Indonesia have significantly correlated to the number of poor households.



In response to the problem, in 2016 the Government of Indonesia rolled out a policy called *BBM Satu Harga* or One Price Fuel. In general, the policy is aimed to improve the affordability of fuels for rural communities. This policy ensures the distribution of gasoline and diesel fuels in 3T villages at equal prices across Indonesia [8]. With the policy, reduction in fuel prices should be expected to reduce transport costs and eventually would increase the mobility of rural communities and boost rural economic growth. Furthermore, a policy to sell fuels at equal prices in all Pertamina's gas stations (state-owned oil company) has been implemented since the previous governments. However, without additional regulations forcing Pertamina to open gas stations in 3T villages, the costs of distributing BBM there were passed through consumers with the presence of informal retailers.

At this stage, we limit the scope of our research to estimate the impact of the policy on domestic transport costs. We define domestic transport costs as the costs of rural communities to travel in and around their villages. We understand that fuel price reductions will obviously cut domestic transport costs. However, we observe that it is not always the case when the policy is in reality not effectively implemented. Initiatives to develop rural Indonesia have often been challenged during their implementation such as lack of finance and weak rural institutional capacity [9]. Specifically, for the One Price Fuel policy, people reported that the equal prices in rural villages in Papua lasted only a few weeks [10]. In the Mentawai Islands, informal retailers could buy large volumes of fuels at One Price Fuel's station so that fuel was still scarce and expensive [11]. Therefore, in other words, our research is simply to test whether the policy has been effectively implemented or not, by observing its impacts on domestic transport costs. In estimating the impact, we utilize Difference in Difference (DD) regression model and two strategies to control non-intervention factors that shape the outcomes. The first is whether to include a set of observed controls. The second is whether to have a fixed effect at the village level. Moreover, we include propensity score matching to have the most representative model. During the early study in late 2019, we also did interviews with respondents from government, corporation, and university to understand the context of the policy intervention.

Our findings prove that the One Price Fuel policy has successfully reduced domestic transport costs in rural areas, particularly in the 3T villages in Indonesia, meaning the policy has been effectively implemented. Although we consider the One Price Fuel policy as a short-term solution for the energy and transport problems in rural regions, we argue that the effectiveness of the implementation of the policy is still worthwhile to be evaluated. Our estimates will be able to assist other policy development to further address the problem. With the inclusion of observed controls into the model, we also have an opportunity to briefly discuss alternative policy options to fairly achieve the equivalent outcomes. This paper is structured as follows: Section 2 discusses the context. Section 3 describes the model and data used. Section 4 provides the results. Finally, Section 5 discusses the findings and conclusions.

2. Context: One Price Fuel as a short-term policy

In 2018, more than half of the total Indonesian retail fuel market (74 million kiloliters) comes from the sale of subsidized fuel (i.e., Solar) and assigned fuels (i.e., Premium and Biosolar) [12]. The quota of subsidized and assigned fuels for each region of the country is determined by the government based on regional populations. This means in reality state authorities have allocated a certain fuel quota for all Indonesian populations, including those who live in rural regions. However, distributing fuels to all regions across the country is still a huge challenge. Remoteness adds more costs to the energy supply chain [2], resulting in higher retail energy prices. In response to that, oil companies such as Pertamina are reluctant to operate gas stations in rural regions, particularly in the remote ones. This is in part because, given the government's direct and indirect control over domestic fuel prices [13], the companies cannot economically run their business there. Consequently, people from rural regions often have to travel many miles to reach the nearest gas stations. Furthermore, with the lack of fuel suppliers in rural regions, informal fuel retailers eventually emerge and charge exorbitant prices for the communities.

To address the problem, in November 2016, the government rolled out the One Price Fuel policy through the issuance of the Regulation of Minister of the Energy and Mineral Resources (*Permen*

ESDM) No. 36/2016 [14]. This policy assigns companies (Pertamina and AKR Corporindo, a national private company) to open gas stations in *3T* villages to sell the gasoline and diesel fuels at government price control at Rp 6,450 per liter and Rp 5,150 per liter, respectively. Of the total target of 500 rural regions by 2024, Pertamina and AKR Corporindo have opened new gas stations in 160 and 10 rural regions, respectively by the end of 2019 [6]. Figure 1 shows distributed fuel volume for the One Price Fuel policy from late 2016 to June 2019 by Pertamina as the company carrying the majority of targets in this policy.

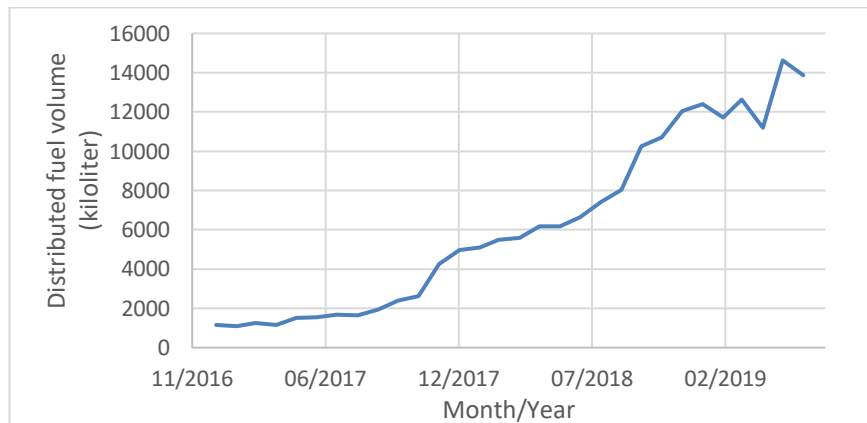


Figure 1 Distributed fuel volume for One Price Fuel policy [15]

However, by forcing companies to open gas stations in *3T* villages, the government has not prepared special budgets for the implementation of this policy. This implies the assigned companies need to bear all the costs of distributing fuels to rural regions, without clear compensation by the government. The distribution costs to rural regions are high because access to these areas is often difficult. Improved shipping infrastructure and storage facilities are actually necessary to support the least cost of the energy supply [7]. In most cases, where the proposed infrastructure investment is too high for the assigned companies, they tend to choose a short term policy to just transport the fuels by using very expensive distribution mode, such as by aircraft. Zibali Hisbul, coordinator of One Price Fuel in Pertamina revealed to the public that Pertamina spent Rp 40,000-50,000 per liter to distribute fuels by using air tractor to remote villages in Papua [16]. Since this policy is financially unsustainable, we, therefore, consider this policy as a short-term solution for the problem. In the following sections, we reveal the extent to which this short-term policy has been effectively implemented.

3. Models and data

3.1. Model

Since the One Price Fuel policy has been applied to 58 government-appointed subdistricts since 2016 (see Figure 2), all villages under the subdistricts serve as the treatment group and all other villages under the same districts are the comparison group. Let $Trans_Cost_i$ be a village domestic transport cost. Here, we mean the domestic transport costs as the prices borne by rural communities for traveling in or around their neighbouring villages. These costs are different from the distribution costs for transporting fuels or commodities from or to the villages. Furthermore, let *Policy* and *Year* be the policy implementation and time of observation, respectively. We set *Policy* = 1 for villages under subdistricts appointed for the policy and *Policy* = 0 for the comparison group, and *Year* = 1 for observation year (2018) and *Year* = 0 for the year before the policy implementation (2014). Differencing the mean value of $Trans_Cost_i$ across *Policy* and *Year* simply brings us to the following equation:

$$DD = [E(Trans_Cost_i | Policy = 1, Year = 1) - E(Trans_Cost_i | Policy = 1, Year = 0)] - [E(Trans_Cost_i | Policy = 0, Year = 1) - E(Trans_Cost_i | Policy = 0, Year = 0)]. \quad (1)$$

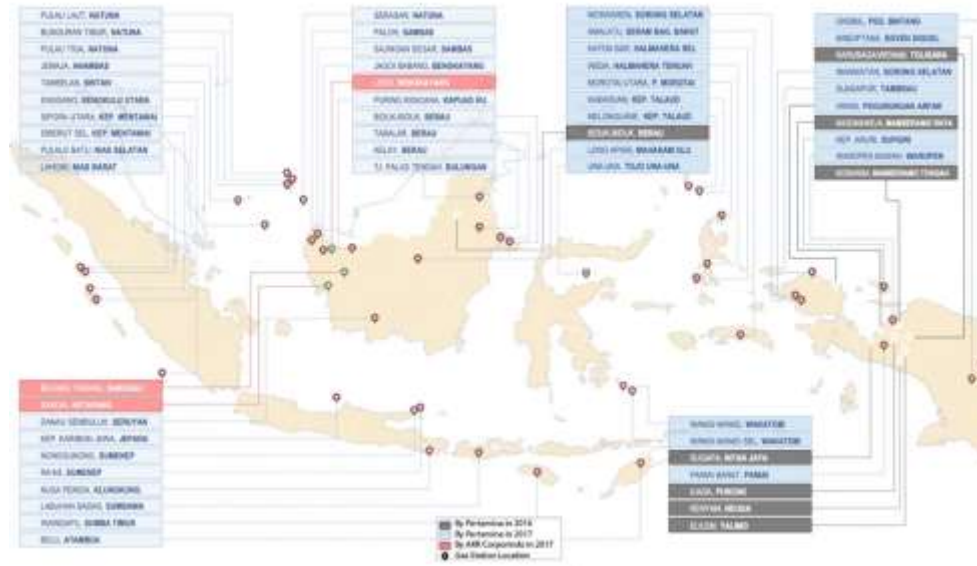


Figure 2 One Price Fuel subdistricts from 2016-2017 [17]

In this DD equation, we estimate the impact of the One Price Fuel policy by differencing the changes through time in the treatment group and comparison group. By doing so, we eliminate the effect of other policies and characteristics of the observations that might also influence the changes in $Trans_Cost_i$. In other words, this DD equation results in the nets effect of the One Price Fuel policy to $Trans_Cost_i$. We can write the basic DD regression model, as follows:

$$Trans_Cost_i = \beta_0 + \beta_1 Policy_i + \beta_2 Year_i + \beta_3 (Policy_i \times Year_i) + \varepsilon_i. \quad (2)$$

These two dummy variables, $Policy_i$ and $Year_i$, represent treatment or comparison observations and time, respectively. β_0 is a constant. β_1 is the average change in $Trans_Cost_i$ between treatment and comparison groups that are common through two time periods. β_2 is the average change in $Trans_Cost_i$ through two time periods that are common to both treatment and comparison groups. β_3 is our coefficient of interest, reflecting average changes in $Trans_Cost_i$ of the treatment group relative to the comparison group through two time periods. ε_i is the error term of the regression results.

Practically, we can also develop the DD regression model by including more control variables such as geographical conditions and socioeconomics characteristics [18], as follows:

$$\ln Trans_Cost_i = \beta_0 + \beta_1 Policy_i + \beta_2 Year_i + \beta_3 (Policy_i \times Year_i) + X_i \beta_4 + \varepsilon_i. \quad (3)$$

The natural logarithm is applied to our dependent variable to reduce the variance of $Trans_Cost_i$ with previous values ranging from hundred to thousand rupiah. X_i is a vector of our control variables that represent other time-varying factors that might also affect the dependent variables. The inclusion of control variables into the model will avoid overestimating the value of the coefficient of interest. Our X_i vector includes mainland topography, river transportation, lake transportation, number of house locations on a riverbank, village access from land, major asphalt road surface, asphalt road from production sites, community development for transportation, a fund for community development for transportation, provision of public transport, and daily use of private vehicles. The summary of all variables used in the model is in Table 1.

Table 1. Variable definition and summary statistics

Variable	Definition	Number of Observation	Mean	Standard Deviation
Transport Cost	Cost of commuting in or around villages	10,698	4617.538	12295
Policy	1 = implemented with One Price Fuel; 0 = otherwise	12,798	0.0887639	0.2844137
Year	1 = year of 2018; 0 = year of 2014	12,798	0.5	0.5000195
Mainland Topography	1 = vast land; 0 = slopes and valleys	12,798	0.6172058	0.4860877
River Transportation	1 = transport by river; 0 = otherwise	12,798	0.1713549	0.3768335
Lake Transportation	1 = transport by lake; 0 = otherwise	12,798	0.0100016	0.0995103
Houses on Riverbank	number of house location on the riverbank	12,798	0.3320831	1.205813
Village Land Access	1 = access from land; 0 = access from water	12,798	0.7508986	0.455735
Major Asphalt Road	1 = asphalt; 0 = otherwise	11,976	0.4224282	0.4939666
Asphalt Road from Product. Site	1 = asphalt; 0 = otherwise	12,177	0.4437053	1.223459
Community Dev. for Transport	1 = community dev. exists; 0 = otherwise	12,798	0.5636818	0.4959474
Fund for Community Dev.	1 = com. dev. Fund exists; 0 = otherwise	11,236	0.9029014	1.436787
Public Transportation Provision	1 = public transport exists; 0 = otherwise	12,798	0.2701203	0.4440391
Private Vehicle Use	1 = daily use; 0 = otherwise	12,798	1.326145	1.854745

We also consider including fixed effects at the village level in our DD regression model to remove the effects of village-specific factors that might influence the domestic transport costs. Hausman test shows that our DD regression model is more appropriate to be treated with fixed effects rather than random effects. Additionally, we exercise our DD regression model with propensity score matching, where the propensity score is acquired using a logit model. This propensity score matching eliminates unobserved time-invariant differences in our dependent variables between treatment and comparison groups [19]. In other words, this makes our comparison group have equivalently similar characteristics to the treatment group. Eventually, we also exercise to divide our observations into two categories: *3T* and *non-3T* villages to explore more insights for discussion.

3.2. Data sources

We mostly obtained data of the villages for the dependent variables and all control variables from Village Potential Statistics (*Potensi Desa* or PODES) 2014 [20] and PODES 2018 [21]. We gathered information about 58 intervened sub-districts from BPH Migas during the interview in late 2019. We secured a list of *3T* villages from the document of Decree of Minister of Village, Development of Disadvantaged Regions, and Transmigration (*Kepmendesa PDTT*) No. 126/2017 [22].

4. Results

Table 2 presents the estimation results for our DD regression model. In general, the results show that across scenarios (1) to (5), our coefficients of interest are negative and significant. This means either with or without control variables or with or without fixed effects or with or without propensity score matching, our model is consistent to present that One Price Fuel policy has reduced average domestic transport costs in or around villages under 58 intervened subdistricts.

Scenario (1) including no control variables, no fixed effects, and no propensity score matching, suggests an average change in domestic transport costs of -0.262, statistically different from zero at 1%. Scenario (2) including no control variables, no fixed effects, and propensity score matching, suggests an average change in domestic transport costs of -0.831, statistically different from zero at 1%. Scenario (3) including no control variables, fixed effects, and propensity score matching, suggests an average change in domestic transport costs of -0.405, statistically different from zero at 10%.

Table 2. DD regression results

Dependent variable: Ln Domestic Transport Cost _i							
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Village fixed effects	No	No	Yes	No	Yes	Yes	Yes
Propensity Score Matching Grouping	No	Yes	Yes	Yes	Yes	Yes	Yes
						Only 3T	Only non-3T
Policy _i x Year _i	-0.262*** (0.0928)	-0.831*** (0.135)	-0.405* (0.233)	-0.774*** (0.132)	-0.649*** (0.247)	-0.909*** (0.322)	-0.184 (0.766)
Policy _i	0.404*** (0.0692)	0.570*** (0.110)	0.222 (0.233)	0.534*** (0.109)	0.268 (0.535)	-0.925 (0.893)	-0.506 (1.027)
Year _i	0.233*** (0.0283)	0.715*** (0.0978)	0.192 (0.221)	0.460*** (0.110)	0.559** (0.272)	0.529 (0.341)	0.271 (0.810)
Mainland Topography _i				0.104 (0.0895)	0.0159 (0.187)	-0.0798 (0.274)	-0.0474 (0.258)
River Transportation _i				-0.419*** (0.142)	-0.280 (0.341)	0.178 (0.527)	-0.448 (0.428)
Lake Transportation _i				0.783*** (0.264)	0.0559 (0.412)	0.226 (0.585)	0.205 (0.561)
Houses on Riverbank _i				0.0446 (0.0421)	0.118* (0.0702)	0.112* (0.0589)	0.0995 (0.129)
Village Land Access _i				-0.0784 (0.0706)	-0.327 (0.204)	-0.255 (0.312)	-0.410* (0.239)
Major Asphalt Road _i				-0.276*** (0.0607)	-0.102 (0.159)	0.431* (0.235)	-0.411* (0.214)
Asphalt Road from Production Site _i				-0.0399 (0.0340)	-0.154** (0.0637)	-0.0540 (0.165)	-0.179** (0.0754)
Community Development for Transport _i				-0.182* (0.100)	-0.0767 (0.182)	-0.388* (0.219)	0.130 (0.281)
Fund for Community Development for Transport _i				-0.0483** (0.0218)	0.0359 (0.0310)	0.0710** (0.0339)	0.0275 (0.0530)
Public Transportation Provision _i				-0.187*** (0.0653)	-0.342** (0.143)	-0.461* (0.239)	-0.382** (0.186)
Private Vehicle Use _i				0.0867*** (0.0158)	-0.0412 (0.0283)	-0.111** (0.0449)	-0.0269 (0.0404)
Constant	7.594*** (0.0195)	7.496*** (0.0833)	7.814*** (0.221)	7.899*** (0.170)	8.204*** (0.430)	10.58*** (1.139)	8.677*** (0.866)
Observations	9,330	1,546	1,546	1,546	1,546	504	1,042
R-squared	0.011	0.039	0.900	0.105	0.907	0.882	0.918

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Scenario (4) including a set of control variables, propensity score matching, and no fixed effects, suggests an average change in domestic transport costs of -0.774, statistically different from zero at 1%. Scenario (5) including a set of control variables, propensity score matching, and fixed effects, suggests an average change in domestic transport costs of -0.649, statistically different from zero at 1%. Principally, when control variables are added (see Scenario (4) and (5)), we find that the estimate becomes more consistent. This is because, with the exclusion of control variables from the model, we are likely to obtain an underestimated or overestimated result. Moreover, with fixed effects and propensity score matching, we can ensure that Scenario (5) is the best model we have.

In scenario (6) and (7), we actually exercise Scenario (5) with the division of rural region observations into two categories: *3T* and *non-3T* villages, respectively. Interestingly, the results indicate the policy intervention is only significant in *3T* villages, with an average change in domestic transport cost of -0.909, statistically different from zero at 1%. Furthermore, in general, the estimates also suggest that improving transportation infrastructures such as the provision of asphalt road and public transportation significantly reduces the domestic transport costs in rural regions.

5. Discussion and conclusion

Although this paper considers the One Price Fuel policy as a short-term remedy for the problem, we find that the policy has been effectively implemented. This is observed from the reduction in domestic transport costs in the intervened rural regions. The introduction of the One Price Fuel policy to rural regions has fruitfully guaranteed a provision of cheaper fuels and eventually cut the cost of transportation in these regions. However, this finding does not necessarily mean a reduction in costs of transporting or distributing commodities from or to these regions. With the current data used, our analysis is limited to estimate the domestic changes in the intervened regions.

Interestingly, we also indicate the One Price Fuel policy implementation has only a significant effect in *3T* villages, whereas it has no significant effect in *non-3T* villages. This finding makes sense; in terms of fuel prices, both village categories have a different start. Before the intervention, *3T* villages were supposed to have higher fuel prices due to their remoteness. Meanwhile, *non-3T* villages have already had relatively affordable fuel prices as they are not remote.

In general, from Scenario (5) we also identify that improved transportation infrastructure through the provision of public transportation and asphalt roads are among fruitful attempts to reduce the domestic transport costs in rural regions. This implies that improving transportation infrastructure can be alternative policies to the One Price Fuel policy. Nevertheless, at this stage of the study, although the One Price Fuel policy reduces domestic transport costs in rural regions with significantly larger reductions compared to the alternative policies, we still cannot clarify which policy is more superior over others. This is because of many other factors influencing policy outcomes. We might expect that rural infrastructure development would reduce more domestic transport costs when the investment in infrastructure policy is increased, for instance. Nevertheless, more studies need to be carried out to assess the real benefits and costs of the One Price Fuel policy compared to alternative policies available; so that we can provide more comprehensive answers for transportation and energy problems in rural Indonesia.

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