A Systematic Literature Review: Fuel subsidy and consumer environmental awareness in urban road transport

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Abstract
Using a systematic literature review, we explore fuel subsidies and consumer environmental awareness among users in urban road transport. Fuel subsidies given by the government to the public have to some extent brought them to more using own transport as the fuel cost is now cheaper. A growing number of vehicles and usage in the urban road transport sector worldwide has increased CO2 emissions and impact on environment. The misalignment of benefits from the implementation of fossil fuel subsidies and high emissions has grown attention to limit global warming since the Paris Agreement 2015 was signed. Nonetheless, consumer environmental awareness is interesting to bring forward for future research.

Keywords: Fuel Subsidy, Consumer Environmental Awareness, Urban Road Transport, Systematic Literature Review

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1.0 Introduction

The transportation sector is seen as a critical enabler of the country's economic growth and development. For example, the growth of road transportation has aided in the socio-economic benefits and wide development of both urban and rural areas. Increases in carbon emissions and greenhouse gas (GHG) emissions result from the rapid expansion in the number of automobiles on the market. Emissions have a variety of effects on the environment, including (1) direct impact, which causes direct harm such as noise; (2) indirect impact, which is a result of direct impact, such as health and lung problems; and (3) cumulative impacts, which are a combination of direct and indirect effects that are often unpredictable, such as climate change (Rodrigue, 2020).

According to Bai, Sze, Liu, and Haggart (2020), the mode of transportation chosen will be determined by the individual's level of awareness. Environmental awareness is made up of four elements: environmental concern, environmental attitude, environmental knowledge, and behavioural intention. The issue of road transport emissions has received a lot of attention from the government, industries, academics, and the general public. People have recognised the necessity of environmental awareness as one strategy to alleviate the sector's detrimental consequences due to the huge effects of road transport emissions (Fu et al., 2020).

Fuel subsidy has its different structures across countries. Generally, fuel subsidy is designed to reduce the fuel prices for the consumer, increase welfare and the relationship between citizens and government will be improved. The implementation of fuel subsidy is seemingly easy however, the truth is fuel subsidy contributes to global warming, local pollution, and increased congestion (Asare et al., 2020). The distribution of fuel subsidies may encourage wasteful consumption of fuel as well as lower the chance for consumer to adopt or invest in fuel-efficient vehicles (Asare et al., 2020; Coady et al., 2017; Rentschler & Bazilian, 2017). Hence, fuel subsidy is a vital policy that needs to be defined carefully because its application may directly contribute to climate change (Ariyanti, 2017).

Even though fuel subsidies improve the welfare of the society with the benefits of lower fuel prices, the distribution of fuel subsidies has an adverse effect on the environment that accelerates climate change. The provision of fuel subsidy does
impose huge environmental degradation with an increase Co2 emissions due to overconsumption. This has been supported by (Coady et al., 2017; Rentschler & Bazilian, 2017) which found that fuel subsidy encourages wasteful consumption of fuel that creates barriers to clean energy investment which therefore worsen local pollution by increasing the CO2 emissions. Ramli, Kadir, Ismail, Othman, and C.Melo (2021) in their study highlighted that the fossil fuel subsidy contributes to excessive use of petrol, which then impedes climate change and greenhouse gas mitigation. This is in line with (Sasana et al., 2017) who found that the fuel subsidy will encourage consumers to utilize their vehicles thus leading the carbon emission increases from time to time.

Fuel subsidies may encourage wasteful fuel consumption that creates barriers to clean energy investment therefore, local pollution becomes exacerbated due to increased CO2 emissions (Rentschler & Bazilian, 2017 and Asare et al., 2020). Therefore, consumers who have environmental awareness are very necessary to conserve the environment.

This study aims to explore fuel subsidy and environmental awareness among users in urban road transport. The fuel subsidy distribution and environmental awareness will be highlighted in this systematic literature review (SLR). Studies on fuel subsidies are numerous, however, the objectives of this study are focused specifically on fuel subsidies and public environmental awareness which brings little interest to look ahead as a result of the environmental impacts posed.

2.0 Methodology and Sample Identification

The SLR adopts a transparent reporting of Systematic Reviews and Meta-Analyses known as Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) which is used to search, filter, select, and analyse the research question of the article. Scopus and Web of Science are used as a database for searching relevant literature required for the study. One research objective was identified which is exploring fuel subsidy and environmental awareness among public. A thorough identification was used to find key terms including ‘fuel subsidy’ and ‘environmental awareness’, nevertheless only 23-related articles were found indicating a very limited topic area where the majority focused on subsidy reform.

Therefore, we broaden the definition of subsidy by not only concentrating on fuel subsidy or fossil fuel subsidy, whereby other types of subsidies i.e. green subsidy, low-carbon subsidy, end-of-life vehicles subsidy, and electric vehicles subsidy are acceptable and applied in the study. In response to the above matter, the new key terms have been used to get such a huge number of articles to fulfill the research objective. It then includes ‘subsid*’ and ‘environmental awareness’, which imply all articles discussed any issue related to green subsidies and environmental awareness are considered. The search was conducted on 29 September 2021 and gained a total of 47 manuscripts. Interestingly, the topic of fuel subsidy that we had searched previously is included among them.

For a screening process, it was done by excluding all 4 duplicate articles and 1 source from a book, which then left 42 articles for abstract analysis. In the abstract analysis process, all of them were screened accordingly for eligibility. The sources used are either journal articles or proceeding papers, while source from books is not included. Articles must be published in English from years 2009 to 2021. As mentioned, the literature review focuses on the study related to subsidy and environmental awareness in a city road transport sector. Therefore, any papers that are out of the scope will be eliminated. The elimination papers for instance emphasis on farmland, household energy consumption, agricultural and green supply chain system. Of these, 29 articles were excluded from the analyses, leaving 13 publications for the SLR review process.

All the empirical researches are synthesized through thematic analysis which is useful in identifying, analysing, organising, describing, and reporting themes. This qualitative data produces trustworthy and insightful findings (Nowell, Norris, White, & Moules, 2017). Hence, identifying the main themes or patterns of these 13 articles is very interesting to ensure that it is in line with green subsidies and environmental awareness in urban road transport even though fuel subsidy itself is not literally applied.
3.0 Findings

The literature related to the fuel subsidy and environmental awareness appears to be very limited then the study has applied all types of subsidies - which specifically focuses on green subsidies (i.e. electric vehicles subsidy, low-carbon subsidy, and end-of-life vehicle subsidy) to fulfill the research goal. Table 1 provides a list of articles obtained from the screening and elimination processes. From the table, it shows that all 13 articles discuss our main issues; subsidies and environmental awareness, while only 6 articles concentrated on the relationship between them.

<table>
<thead>
<tr>
<th>No</th>
<th>Authors</th>
<th>Geographic Region</th>
<th>Method</th>
<th>Subsidy</th>
<th>Environmental Awareness</th>
<th>Existing Relationships</th>
<th>Distinctive Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Austmann, L.M., Vigne, S.A. (2021)</td>
<td>27 member states of the European Union</td>
<td>Quantitative</td>
<td>✓</td>
<td>✓</td>
<td>-</td>
<td>Electric vehicle</td>
</tr>
<tr>
<td>6</td>
<td>Ouyang, J., Fu, J. (2020)</td>
<td>-</td>
<td>Quantitative</td>
<td>✓</td>
<td>✓</td>
<td>-</td>
<td>Optimal strategies for improving energy efficiency</td>
</tr>
</tbody>
</table>
Considering subsidies and environmental awareness that have been the focus in this article, it brings the findings towards some conclusions. The study reveals that there are 3 themes that can be developed, the first theme is eco-friendly vehicles (Austmann, Vigne (2021); Wan, Liu, Zhang (2020); Xu, Prybutok, Blankson (2019)); the second theme is green products (Zhou, Hu, Xiao (2020); Liu, Zhang (2020); He, Deng (2020); Zhang, Zhang (2017); Yu, Han, Hu (2016); Zhang, Wang, You (2015)); and the last theme is related to various aspects of the study which mainly discuss the measurement of optimal price and optimal tax, energy efficiency, and waste electrical and electronic equipment (WEEE).

It demonstrated that the publications focusing on the topic related to subsidies and environmental awareness in urban road transport can be included in the first theme - a study involving electric vehicles or environmentally friendly cars. Moreover, topics related to green products revealed to be the largest number of publications were categorized under the second theme. The research also found that most of the papers discussed the issue of mechanism i.e. subsidies mechanism taken by manufacturers, optimal pricing, optimal tax strategies, and some particular policies undertaken.

Based on the year of publication, research on subsidies and environmental awareness has the highest number of publications in the year 2020 with six. It also shows that the growth of publication activities of this subject from 2019 to 2020 and it seems the topic gained much interest among scholars. The data pertaining to the topic is only available from 2015. In addition, for the geographical distribution, it is found that the most active country is China which covers the Chinese market, and it is followed by the United States and the European Union. As presented in Table 1, the only method of analysis used for these publications is quantitative research analysis.

### 4.0 Discussion

One study found that the transport sector recorded the second-largest share of emissions in developing countries. This is led by lower fuel prices which contribute to the cost of congestion with higher fuel consumption. The subsidy provided by the government are varied and it is implemented according to certain needs required by the market and society. The government allocates subsidies for environmental protection such as subsidizing electric vehicles as mentioned by (Austmann & Vigne, 2021) or subsidizing end-of-life vehicles (Wan et al., 2020). A growing number of motor vehicles may result in a huge number of end-of-life vehicles in the future that has considered to be helpful in mitigating carbon emission and developing sustainable circular economic. Wan, Liu, and Zhang (2020) indicated that the level of environmental awareness among citizens will affect the total subsidy invested by the government for end-of-life vehicles. It is suggested that as government subsidies for end-of-life vehicles increase, the number of recycled end-of-life vehicles increases significantly. They also stressed that when there is a high consumer environmental awareness, the government should not spend higher spending on green subsidies.

In terms of green products, a study shows that subsidizing green products, in general, would help to increase the intention to purchase green products. A high level of green products will emit fewer emissions though, the cost of production is high, and the products are more expensive. However, consumers with high environmentally conscious levels are willing to pay higher prices for more eco-friendly products. On top of that, subsidizing green products increases social welfare and increases firms' profit as portrayed by Zhang & Zhang (2017). Accordingly, the green subsidy allocation to a consumer is beneficial to some extent when there is a low number of potential green consumers with high environmental technology. Thereby in contrast, when the potential green consumer increase, the subsidy should shift to the manufacturer. In other words, subsidizing the manufacturer would be more relevant and useful when the consumer environmental awareness is very high. Other analysis does show that when the consumer environmental awareness is high, the optimal low-carbon subsidy rate might tend to decrease (Zhou et al., 2020).
Concerns over environmental degradation have raised more intentions among people to opt for green and environmentally friendly products affected by recent climate change. He & Deng, (2020) and Zhang & Zhang, (2017) emphasize consumer environmental awareness which is found to be an important determinant in influencing green purchasing behavior leading them to demand green products. Higher environmental awareness can be contributed by underlying factors such as environmental attitudes, subjective norms, and perceived behavioral control as discussed extensively in the theory of planned behavior.

Xu et al., (2019) believe that the intention to buy an eco-friendly car is based on environmental awareness, and influenced by the level of knowledge they have. Moreover, they found environmental attitudes have a significant effect on purchase intention i.e. environmentally friendly cars. In China, it is recognized that people who have purchased battery-powered electric vehicles have a strong awareness of environmental protection (Wei et al., 2020). Nevertheless, Austmann & Vigne (2021) found that consumer environmental awareness did not significantly influence the purchase of electric vehicles. Although high levels of environmental awareness have a high interest in electric vehicles, they have a low environmental awareness rather than a demand for electric cars. This is influenced by other factors. Moreover, it shows other variables such as subsidies for electric vehicles appear to have a significant influence on its market.

5.0 Conclusion and Recommendation

This SLR focuses on studies that investigate green subsidies and consumer environmental awareness related to the urban transportation sector. In general, environmental awareness has been heavily discussed in the literature but then, when associated with fuel subsidies or green subsidies, it is shown to be very limited. The established keywords of green subsidies and environmental awareness have shown it is measured from various angles. Therefore, we found 3 themes represented by the study area. The first is environmentally friendly vehicles; the second is green products; and the third is pertaining to various aspects that we grouped into one theme, such as measurement of optimal level, energy efficiency, and WEEE. Among all, only the first theme is related to urban road transport.

Moreover, the study significantly differs based on their market structure even though the geographical regions are almost identical to a limited number of countries thereby the implications vary. It was also found that various statistical methods were used but all of them captured quantitative analysis. When looking at consumer environmental awareness, demand is greatly increased for environmental vehicles and green products, a common finding that can be observed which contribute to lower CO2 emissions.

As well, this study enhances understanding of environmental awareness literature by integrating different products and market segments in accordance with the subsidies distribution to several types of environmental vehicles such as electric vehicles, battery electric vehicles, and end-of-life vehicles that have played different roles in reducing climate change as consumers shift towards green-type of products. In addition, the consumers’ awareness is not much influenced by the integration of optimal pricing mechanisms since their environmental awareness is high. Hence, we should pay great attention to increasing environmental awareness to protect the environment.

6.0 Limitations of Study and Directions of Future Research

This study has a few limitations. Firstly, it employed specific key terms of fuel subsidy and environmental awareness in the study which resulted to be very limited. Although it covers the subject area, it still needs to be extended to a very specific and focused topic as - consumer environmental awareness. Secondly, the study needs to cover the public transportation services provided in a city which is interesting to study. The urban transportation system is complex with extensive transportation networks releasing carbon dioxide into the air, which has been a central issue highlighted in this research.

Therefore, future study is recommended to capture the above mention, thus we can explore a wide variety topic of the consumer environmental awareness in accordance to the public transport services. In addition, further studies are also suggested by undertaking a different type of review such as scoping or content analysis to address the knowledge gap on
consumer environmental awareness in various markets that are not only limited to the transportation sector. Additionally, factors associated with consumer environmental awareness should be paid attention.

Implications of Study
Our study contributes to existing literature. The foregoing results imply that providing subsidies would have a beneficial impact on climate change and society. Therefore, consumer environmental awareness is important to preserve the environment.

Paper Contribution to Related Field of Study
This paper contributes to the body of knowledge in the areas of green economy, carbon emissions, transport economics, and consumer environmental awareness.

Acknowledgements
We are grateful for the research grants awarded by the Malaysian Ministry of Higher Education under the Fundamental Research Grant Scheme referenced 223/2019.

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