



Platform intermediation to sponsor alternative fuel vehicles



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ARTICLE INFO

JEL classification:

L150
L920
L980
O330
Q550
Q580

Keywords:

Network effects
Two-sided markets
Platform intermediation
Alternative fuel vehicles
Climate change
Regulation

ABSTRACT

Many governments promote green technological innovation within the automobile sector as a means of combating climate change. Most of these innovations are driven by alternative fuels. Subsidies for buyers and governmental investment in service infrastructure are widely used. This paper investigates the question of efficient market intervention by considering the two-sided market character of the automobile market. This study shows that network effects, competitive effects triggered by an increase in automobile users, decreasing marginal utilities of additional service stations and, in the case of governmental support, environmental externalities determine the welfare-efficient extent of platform intermediation. Regarding green technologies, the results of the analysis indicate that governmental promotion of service infrastructure is reasonable, although governments should be cautious about subsidizing buyers. Intervention in favor of dirty technologies is rarely justifiable.

1. Introduction

To reduce greenhouse gas emissions in the transport sector, many governments promote alternatives to the currently dominant powertrain technology, namely, the gasoline-driven internal combustion engine. For example, the British and French governments are offering buyers credits for low-carbon vehicles, and both governments invest in new service infrastructure for electric vehicles. Recently, the German government also established a program to promote electric vehicles. The program includes subsidies for buyers and investments in service infrastructure. The subsidies are offered for purchases of a new electric or hybrid car between June 2016 and June 2019. The rebate for electric cars amounts to 4,000 euros and for hybrid cars is 3,000 euros. The rebate is half-paid by the government and the automobile manufacturer. The purchase of models with a list price of more than 60,000 euros is not included in the scheme. In sum, the government and the car industry have allocated a budget of 1,2 billion euros for this purpose. Additionally, 200 million euros are available for installing DC fast charging and 100 million euros for normal AC charging stations. Against this background, this work addresses the question of efficient market intervention to promote alternative powertrain technologies.

This study argues that the automobile market is two-sided. Based on this approach, it examines a platform-driven standard setting in the infant market for alternative fuel vehicles. The analysis shows that, first, a government seeking to sponsor alternative fuel vehicles should

focus on supporting service infrastructure and that subsidies for vehicle purchases are critical. Second, such a government should also refrain from supporting polluting technologies. Two cases are developed that differ in the support for the powertrain fuel standard. In the first scenario, standard setting by a private monopolistic platform agent is discussed. Unlike the classic two-sided market models, such as Armstrong (2006), the marginal network utility for car buyers is decreasing in the number of fuel retailers. Additionally, competitive effects in the market for fuel are considered. A second scenario addresses the case of governmental standard setting. It derives the possibilities for a governmental agent to promote new standards in the car market. Thereby, welfare effects, such as environmental externalities, are considered. This is the second unique contribution of the paper.

2. Literature

This work is driven by earlier analysis of markets with network effects and two-sided markets (see Economides, 1996; Shy, 2011; Rysman, 2009). Network effects arise if the utility of consuming a good increases in the number of others consuming the same good (Katz and Shapiro, 1985). This definition implies direct network effects as observed in telecommunication markets, for example. In contrast, indirect network effects occur in the case of complementarity. Originally, researchers analyzed this phenomenon in the consumer

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<http://dx.doi.org/10.1016/j.tranpol.2016.12.001>

Received 21 July 2016; Received in revised form 4 December 2016; Accepted 9 December 2016

Available online 29 December 2016

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electronics market, in which buyers prefer hardware with a large variety of complementary software and in which more software is developed for hardware with a large number of users (see Gandal et al., 2000; Park, 2004 or Lee, 2013). Markets for complementary products with indirect network effects can face several problems. If innovations are not compatible with the established installed base of compatible components, they face substantial barriers to entry. Potential consequences include path dependency and technological lock-in. Even excess inertia can emerge, in which a Pareto-superior technology cannot enter the market because it is not compatible with the installed base (Farrell and Saloner, 1986). Furthermore, because of indirect network effects, the market might be a multi-sided market. In this case, platform intermediation is necessary to enable the different sides of the market to interact with one another. Recent literature (Armstrong, 2004, 2006 or Rochet and Tirole, 2006, for example) states that a platform intermediary usually has market power and is able to determine strategic price setting, thereby internalizing network effects in the market and facilitating interaction.

In the network literature, it is widely recognized that the automobile market exhibits network effects (see Katz and Shapiro, 1985; Arthur, 1989; Foray, 1997; Church et al., 2008, for example). In particular, indirect network effects arise because vehicles need fuel to be driven, and therefore, a compatible service infrastructure is needed for area-wide use. If innovations are not compatible with the installed service network, they face substantial barriers to entry that could lead to the above-mentioned problems. Furthermore, the automobile market is two-sided. Platform intermediation occurs because automobile users and fuel retailers interact with one another via a common powertrain fuel standard. In other words, automobile users can interact with all retailers that offer the appropriate fuel for their vehicles. Therefore, allowing for interaction, the powertrain fuel standard satisfies the criteria for being a platform intermediary.

Especially in the infant market¹ for alternative fuel vehicles, such as electric or hydrogen-powered cars, there are network externalities that could be internalized by a platform. Because these alternative technologies cannot be served by the installed service infrastructure, each new alternative fuel retailer generates benefits for automobile users and increases the numbers of users choosing alternative fuel vehicles. Network effects need to be considered. As car users and fuel retailers interact via a new powertrain fuel standard, two-sided platform intermediation is also relevant. Therefore, the following analysis of the market for alternative fuel vehicles uses the two-sided market approach.

From a policy perspective, this analysis contributes to the research on alternative technologies in the car market. Apart from reducing anthropogenic greenhouse gas emissions, alternative vehicles should also reduce environmental and harmful externalities, as well as the dependence on fuel imports. Therefore, status quo regulations in the transport sector often address these topics (see Santos et al., 2010a, 2010b). The market entry of alternative fuel vehicles is analyzed from various perspectives. Conrad (2006?) or Greaker and Heggedal (2010), for example, analyze the market entry of vehicles powered by alternative fuels, such as natural gas or hydrogen, under competition. Schwoom (2007) and Melaine (2003) estimate the minimum number and distribution of hydrogen filling stations. Other researchers, such as Achtnicht et al. (2012), study the determinants of the potential demand for alternative cars. All analyses recognize the importance of positive feedback, namely, network effects caused by a compatible service infrastructure, for the successful market entry of alternative fuel vehicles. Hence, it is known that new technologies have a competitive

disadvantage relative to conventional technologies that rely on a dense service infrastructure, such as gasoline-powered cars. However, while Conrad (2006, 2009) recommends governmental intervention, Greaker and Heggedal (2010) posit that regulation should focus on environmental externalities alone. Addressing regulatory questions, Sartzetakis and Tsigaris (2005) and Dietrich and Sieg (2014) use a dynamic approach to show that there is excess inertia in the automobile market that could be an argument for governmental intervention. Sartzetakis and Tsigaris (2005) suggest a combination of taxing dirty technologies and subsidizing green technologies. Dietrich and Sieg (2014) find that even the promotion of green but ultimately dead-end technologies could enhance welfare. Nevertheless, the question of efficient governmental intervention has not yet been completely answered. By using the two-sided market approach, this work provides further insight into this topic.

3. Methodology

The following analysis is based on a standard two-sided market approach as developed by Armstrong (2006), for example. It is chosen to consider the network externalities occurring in the infant market for alternative fuel vehicles. Thereby, it argues that fuel retailers and car users need a common powertrain fuel standard to interact with one another. Therefore, in addition to the fuel retailers and car users, a third agent has an important impact on whether the market entry of alternative fuel vehicles is successful or not. The agent providing the powertrain fuel standard is able to internalize the network externalities in the car market. By the two-sided market approach it is called platform intermediary. In general, it has market power which is determined by setting prices to implement a certain standard.

In recent models (Armstrong, 2004, 2006 or Rochet and Tirole, 2006, for example), the platform intermediary is a private agent with a rent seeking calculus. That means, the private platform intermediary maximizes its profit and sets prices for joining the platform standard according to it. These membership fees have to be paid by both market sides and depend on the network externalities in the market. The following approach takes the simple case of only one platform intermediary with the monopolistic power to set prices. Furthermore, a scenario with a governmental platform intermediary is created which intervenes in the market for alternative fuel vehicles instead of a private one. If this happens at the early stage of market development, the governmental agent acts as a platform intermediary when implementing or rather sponsoring a new powertrain fuel standard. But instead of maximizing private rents, it searches for the welfare efficient solution. Thereby, it considers buyer and seller surpluses and environmental externalities, too.

The further analysis is structured as follows: First, the two groups of agents in the market, automobile users and fuel retailers, are introduced and their objectives are explained. They are representing the two market sides. Second, the case of a monopolistic platform setting is discussed and, thereby, the way of platform intermediation is explained in details. Furthermore, it is recognized that there is a lack of private platform intermediation in reality. For that reason, third, the case of governmental platform intermediation is introduced. Finally, the policy implications of the theoretical approach are illustrated by comparative statics and discussed, and a conclusion is given.

4. Modeling

4.1. Group setting

There are two groups of agents in the market. Both gain benefits from interacting with one another. Hence, the more members of group two that there are in the market, the greater the benefits for group one, and vice versa. This statement implies positive network effects. This group setting refers to the analysis of Armstrong (2006). Applied to the

¹ For the automobile market in general, one could argue that it has already reached its maturity. Thus, the service infrastructure has reached a certain density, and no further externalities arise when another service station is established. Strategic pricing is no longer possible. Platform intermediation without strategic pricing is called an open platform by Hagiu (2006).

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