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The prospects of electric vehicles in cities without policy support

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Abstract

The developments in electric vehicles (EVs) are driven by the agenda of cleaner and more efficient transport. The manufacturing cost of EVs are higher than that of internal combustion engine vehicles (ICEVs) mainly due to cost of batteries. The fuel economy of EVs are much better than ICEVs when measured by kilometers per unit of energy consumed, but the total mileage of EVs are much lower than that of ICEVs on a full-tank or full-charge. With the current state of developments in technology and infrastructure, the total vehicle cost of an EV is much higher than that of an ICEV. In the case of Singapore, vehicles are also subject to the Certificate of Entitlement, which restricts the lifetime of a vehicle to a maximum of ten years from the date of registration. Vehicles sold in Singapore are also subject to tax/rebate on the basis of the Carbon Emission-Based Vehicle Scheme (CEVS). In this study, we attempt a challenging question whether there is a business case for EVs in the absence of policy support. This paper presents our preliminary findings based on the cost of vehicle ownership in Singapore under the current policy environment.

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Keywords: electric vehicle; tax structure; cost of ownership; incentives; internal combustion engine vehicles

1. Introduction

The developments in electric vehicles (EVs) are driven by the need for cleaner and more efficient transport. The manufacturing cost of EVs are higher than that of internal combustion engine vehicles (ICEVs) mainly due to cost of batteries. The fuel economy of EVs are much better than ICEVs when measured by kilometers per unit of energy consumed, but the total mileage of EVs are much lower than that of ICEVs on a full-tank or full-charge, again constrained by the energy density of current battery technology. In addition, the time taken to fully charge an EV is

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much longer than that to refuel an ICEV. Constrained by the physical bottleneck in electric energy storage technologies, installation of dedicated chargers for EV owners at home and office is almost absolutely necessary. As such, it has been shown that EVs are cost-disadvantaged compared to ICEVs.

In many large cities, reining the growth of vehicle population to ease road congestion is critical. In Singapore, the city state imposes a heavy levy, named Certificate of Entitlement (COE), to all vehicles registered in the country, including EVs. The COE has demonstrated an effective measure for controlling the growth of vehicle populations in Singapore without affecting tax revenues from the private transport sector. As shown in Fig. 1 (figure drawn based on data published in [1] and [2]), the sharply rising COE premium between 2009 and 2012 has substantially restricted the growth in vehicle population. In response to the need for cleaner private transport for cities, a study is conceived to explore possible avenues to improve the economic competitiveness of EVs without damaging the tax revenues. This paper presents some preliminary findings of this study in the context of Singapore.

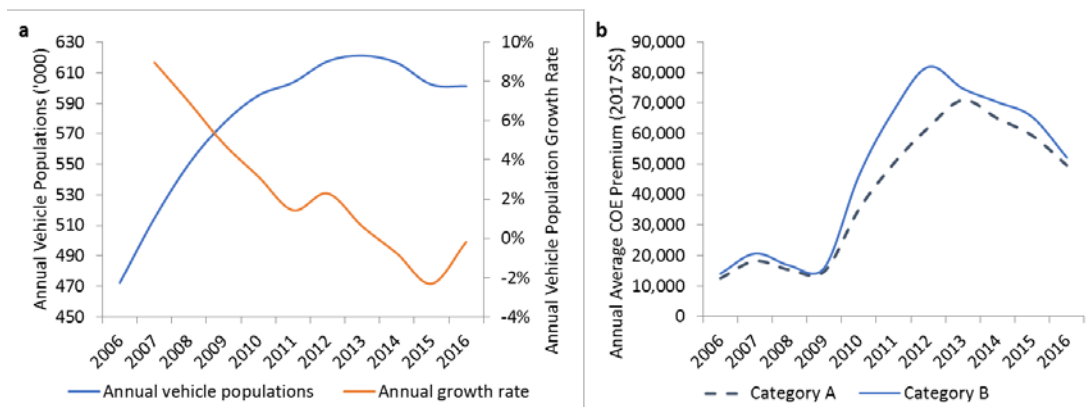


Fig. 1. (a) private vehicle populations in Singapore from 2006 to 2016; (b) annual average COE premium.

Nomenclature

ARF	additional registration fee
CAPEX	capital expenditure
CEVS	carbon emission-based vehicle scheme
COE	certificate of entitlement
EV	electric vehicle
GST	goods and services tax
ICEV	internal combustion engine vehicle
OMV	open market value
OPEX	operating expenditure
RF	registration fee

2. Singapore vehicle tax structure

A complex tax structure is applied to all cars sold in Singapore (ref. [3]). First, the open market value (OMV) is assessed by the Singapore Customs, taking into account manufacturing, freight, insurance and all other costs incidental to the sale and delivery of the car from country of manufacture to Singapore. Next, a flat S\$140 registration fee (RF) and an additional registration fee (ARF) pegged to the OMV, and a goods and services tax (GST) are added to the OMV. Third, an exercise duty at 20% of the OMV is further added. Last and the heaviest tax, the COE is determined

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