

CHAPTER 5 CONCLUSION

This chapter presents a summary of the findings in the comparative study of HEV and eco car diffusion in Thailand and recommendations for further research.

5.1 Summary of the Research

5.1.1 Objectives of the Study

The objectives of the research were to find out similarities and differences of diffusion pattern of HEV and eco car in Thailand and to suggest government policies which are able to encourage their adoptions.

5.1.2 Data and Procedures

The statistical data used in this study obtained from Transport Statistics Sub-Division, Planning Division, and Department of Land Transport. The number of new registered vehicle was used as a proxy for sales. The HEVs' data covered the period during January, 2007 – March, 2013 while the eco cars' data covered the period during April 2011 – March 2013.

The methodology used in this research can be classified into 3 sections.

1. Mathematics

1) Percent of new registered vehicles: to find ratio of HEV/eco car sales to passenger car (type 1) sales in each quarter

2) Percent of accumulated registered vehicles: to find ratio of HEV/eco car on roads to passenger car (type 1) on roads

3) Percent change of the number of new registered: to find growth patterns of HEV and eco car sales relative to growth of passenger car (type 1) sales

2. Bass model

1) Use statistical data to find fit curve so as to solve for Bass model equation

2) Use quadratic formula to solve for p, q, m

3) Use all the parameter to predict HEV and eco car sales

3. Government policy analysis and comparison with foreign government policy

5.2 Conclusion

The ratio of new registered HEVs to new registered passenger car (type 1) fell down during Q4/2008 and Q2/2009 (from 0.24% in Q3/2008 to 0.09% in Q2/2009) which was the period that retail oil price went down. This implied that low oil price made HEV less attractive. After that the ratio and the oil price went up altogether. The ratio fluctuated in a small gap (1.24 – 2.53%) in last 3 years. The main factor made this ratio increased is to put new products on sales, especially Camry Hybrid and Prius. The Camry was introduced into market in Q2/2009 and made the ratio grown up rapidly from 0.09% to 0.15% in Q3/2009, 0.91% in Q4/2009 and 1.86% in Q1/2010.

This situation happened when Prius generation 3 was debuted in Q4/2010 and the ratio grew from 1.25% to 2.05% in Q1/2011 and 2.53% in Q2/2011. However, this situation did not occur when Prius with minor change, Prius C and all new Camry Hybrid was introduced in Q1/2012. It made the sales increase but not enough to gain more ratio of market share of passenger car (type 1).

The ratio of new registered eco cars to new registered passenger car (type 1) has grown up continuously (except Q1/2011) since the first eco car, Nissan March, was introduced to market. In Q4/2011, the ratio reduced from 8.75% to 6.87% due to flooding. After that the ratio increased dramatically in every quarter whether there is new car debut. This implied that the first car scheme (financial incentive) can encourage the vehicle adoption. The ratio from latest data (Q4/2012) was 19.3%.

The percent of accumulated registered vehicles in each quarter is the good index to show the ratio LEVs (HEVs and eco cars) on the road relative to other passenger cars type 1. The ratio shows the good signal that the ratio of LEVs gradually increases. The ratios from latest data (Q4/2012) were 0.63% in case of HEV and 3.69% in case of eco car.

The percent change of the number of new registered vehicles relative to previous quarter shows pattern of change. Normally, $\% \Delta$ new registered HEV and $\% \Delta$ new registered eco car should conform to $\% \Delta$ new registered passenger car (Type 1). However, there are some periods that they are distinct disparities especially in case of HEV. In Q4/2009, $\% \Delta$ new registered HEV was 379.09% while $\% \Delta$ new registered passenger car (Type 1) was -25.87%. This is the consequence of placing Prius Generation 3 on sales.

Using mathematics, the results show that the factors influenced on HEV adoption were oil price and new products on sales while the factors influenced eco car adoption were new products on sales and financial incentive such as the first car scheme. These results were also obtained when analyzed the data which significantly deviated from the fit curve (Bass model equation).

Based on assumption of Bass model that HEV and eco car are the durable products which once are adopted and not repurchased for many years, the result shows that p of HEV (0.00225568) is 3.68 times greater than which of eco car (0.000613347). On the contrary, q of eco car (0.410744376) is 1.65 times greater than which of HEV (0.248559732).

However, both HEV and eco car adopters are mainly imitators and the importance of innovators diminishes monotonically. This makes the time eco car used to diffuse to saturation point faster than the time used by HEV. The saturation point without continuous repeat purchasing of eco car (~1,137,361) is 18 times greater than which of HEV (~62,683). This is why the number of first adopters (innovators) at time period 1 (which equal to mp) of eco cars more than which of HEVs. This can be described by using five attributes influencing on rate of adoption. Eco car has more relative advantage, compatibility but less complexity than HEV because eco car is only downsizing vehicle with additional standards while HEV is more expensive vehicle with advance technology.

Using the Bass model equations, the projected result shows that HEV sales passed the peak whereas sales of eco car will reach its peak in a half year. Thus, if Bass model parameters (p , q , m) remain the same, HEV sales trend is downturn while eco car sales trend will continue to grow up for a half year and reverse its trend afterwards. Moreover, the result also shows that adoption ratio of HEV and eco car will reach 90% of potential adopters in about two years and 13 months respectively. The short time left

shows how necessary it is to make any strategic plans in advance so as to get them ready for the near future.

To encourage fuel efficient vehicle adoption, there are many policies enforced or used to be enforced in many countries. Anyways, all the policies can be classified into 3 groups as follows.

1) Financial incentives such as tax exemption/reduction/rebate/deduction and other privilege with monetary value.

2) Non-financial incentives by giving some privileges which do not have monetary value such as special lanes and car pool lane usage regardless of the number of passenger.

3) Financial disincentives for other vehicles (“Polluter Pays” principle)

However, due to the limitation of law and facilities, only financial incentives and financial disincentives are recommended to be used. Researcher suggests 3 rectified policies/laws.

The first one is tax rebate. If the government has a plan to encourage adoption of fuel efficient vehicles in the future, type of vehicles, fuel economy and CO₂ emission are recommended to use as criteria.

The second one is new excise tax structure. This section of act still based on the present excise tax structure based on engine size on the assumption that larger engines use more fuel. With new technologies, the theory may no longer true because some large engines are more fuel-efficient and emit less CO₂ than smaller ones. Thus, it is better to exclude cylinder capacity from criteria or to include CO₂ emission band in the largest size of each vehicle type so as to make manufacturer of such vehicles concern with CO₂ emission.

The third one is vehicle license tax (annual circulation tax). This law has been enforced since 1979 and has never been revised. Thus, to make this law efficiently to reduce carbon dioxide emission rates, CO₂ emissions should be put under consideration so as to make fuel-efficient vehicle such as HEV and eco car pay less vehicle tax and/or use “Polluter Pays” principle to put burden on vehicle with high CO₂ emissions.

5.3 Recommendations for Further Research

1) In the future, many advance vehicles like PHEV and BEV may be adopted in Thailand. It is recommended for other researchers to use Bass model to predict their adoption by using historical HEV data so as to make guideline for both government and vehicle manufacturers.

2) Each government policy has different impact on adopters. Thus, it is interesting to use survey study so as to find the most effective policy that encourages HEV and eco car diffusion.

3) Government normally uses both demand-push and supply-pull policies to encourage sales of specific vehicle. This research focuses only on demand side so the researcher would like to recommend those who are interested to further study the policies for the supply side.

4) The next research could use the result obtained from this research with the projective equation of adoption of all types of vehicle to make more proper policy.