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FROM MY PERSPECTIVE

Launching strategy for electric vehicles: Lessons from China and Taiwan

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ABSTRACT

China has seen explosive growth in the sales of electric bikes since 1998. The boom was triggered by Chinese local governments' efforts to restrict motorcycles in city centers. However, many Chinese cities have started to extend the restriction to electric bikes. Whether China's electric bike economy will continue to develop is highly uncertain. The experience of China's electric bike boom suggests that limiting the fossil-fueled alternatives could be an effective policy tool in fostering the commercialization of electric vehicles. The failure of Taiwan's electric scooter policy, on the other hand, indicates that subsidies alone may not be a sufficient launching strategy. The policy approach of limiting the alternatives deserves serious consideration if policymakers wish to foster electric vehicles.

1. Content

China witnessed the world's most spectacular growth in electric vehicles since 1998. China's annual sales of electric two-wheeled vehicles (bikes and scooters) grew exponentially from fifty six thousand vehicles in 1998 to over twenty one million in 2008 [1]. Some reporters called this a technology revolution. A closer examination of the history of the electric two-wheeled vehicles market in China reveals that this spectacular growth was largely policy-driven. In spite of this phenomenal growth, the large-scale commercialization of electric two-wheeled vehicles in China cannot be considered a policy success. Indeed, it is a policy accident.

Before the later 1990s, there were sporadic attempts to commercialize electric bikes and scooters. Those attempts all failed. The electric bike market in China never really took off until late 1990s, facilitated by favorable local regulatory practices in the form of motorcycle bans and loose enforcement of electric bike standards [2,3]. At this time, many Chinese cities started to ban or restrict motorcycles (and scooters) using a variety of measures. Some cities suspended the issuance of new motorcycle licenses. Some banned the entrance of motorcycles and scooters into certain downtown regions or major roads. Others capped the number of licenses and then auctioned the license plates that were available. According to the motorcycle committee of the Society of Automotive Engineers of China, the use of motorcycles is now banned or restricted in over ninety major Chinese cities (Table 1) [4].

These local motorcycle bans became the ultimate driver for the electric bike boom in China. The alleged justifications of these bans include relieving traffic congestion, improving safety and reducing air pollution [4]. Chinese local policy makers believe that motorcycles disrupt traffic and are prone to accidents. The bans were imposed on all motorcycles, regardless of their power sources. However, electric bikes are categorized as non-motor vehicles and therefore exempted from the bans. There are many models of electric “bikes” that are virtually motor scooters, but they are all equipped with (decorative) pedals to qualify as “bikes.” Thanks to the loose enforcement of electric bike standards, electric bikes and some de facto scooters can therefore fill the market vacuum created by motorcycle bans. The loose enforcement of electric bike standards, however, was a result of the ineffectiveness of China's local governments, rather than of conscious decisions to support electric transportation. Frankly speaking, the boom in China's electric bike market was a policy accident rather than policy success.

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The Taiwanese government's effort at intentional promotion of electric scooters provides an interesting and enlightening contrast to the Chinese experience. The Taiwan Environmental Protection Administration (TEPA) started to promote and subsidize electric scooters in 1998. It spent tens of millions dollars (NT$ 1.8 billion) subsidizing electric scooters but without any restrictions on the use of gasoline-fueled scooters [5]. The subsidies included tax reductions for electric scooter manufacturers, subsidies for research and development, promotional activities, charging facilities, and rebates for consumers amounting to nearly half of the scooters' retail prices. With all of these subsidies, the cost of electric scooters was comparable to their gasoline counterparts. Nevertheless, sales of electric scooters remained very low. The TEPA administrator eventually acknowledged this policy failure in 2002. Taiwan has so far been unsuccessful in establishing a sustained demand for electric scooters [6].

A Taiwanese scooter retailer was quoted “for every ten consumers who purchased an electric scooter, ten of them would come back to complain.” Retailers were unwilling to recommend electric scooters to their customers because of the fear of ruining their reputation [7]. Any new technology is likely to suffer similar disadvantages vis-à-vis established technologies. There are likely unexpected glitches in novel technologies, and their supporting infrastructure is typically inadequate. Fixing the glitches may not be difficult once the manufacturers become aware of the problems. However, it takes time in real-world use before many problems become apparent. Establishing the supporting infrastructure such as charging stations and service networks is time-consuming and costly. Changing consumers' behavior may be more difficult than technological enthusiasts would expect, with many consumers unwilling to change their habits to adapt to new technologies. Consumers who experienced unsatisfactory first-generation products may lose their confidence in the technology. Leaking lead acid batteries in earlier generations of Chinese electric bikes are one example. The solutions to this technical defect were not difficult, but it took many years before the manufacturers fixed it. Unexpected glitches are typical in innovative technologies. It takes time and money to fix even small glitches. Without long-term stable demand, even a very promising technology may fail to commercialize. Chinese consumers had no choice but to try again because their alternatives (i.e. gasoline scooters) were restricted. Taiwanese consumers did not face the same constraint and the policy failed. These two examples suggest that subsidies resulting in comparable price and superior environmental performance may be insufficient to make electric vehicles a commercial success, while limiting the fossil-fueled alternatives could be highly effective in forcing the market penetration of electric vehicles.

These market dynamics may also apply to the wider electric vehicle market. Despite the widespread enthusiasm among environmentalists, the commercialization of electric vehicles faces many barriers. It is commonly recognized that the cost of batteries is the primary barrier to making plug-in hybrid electric vehicles (PHEVs) and pure electric vehicles (EVs) commercially price competitive [8]. One may hope that the costs will be reduced with experience and economies of scale. There is, however, a chicken-and-egg hurdle to achieve experience and economies of scale. Investors are not willing to scale up production until they are assured of sufficient demand for their products. But demand remains restricted by the availability of lower-priced gasoline engine substitutes. Without pioneering companies offering loss-leader products, early entrants to the PHEV markets are likely to produce with high-cost batteries and suffer from inadequate demand. A loss-leader strategy, however, is extremely risky. The history of nuclear power development in the United States provides an important lesson. In the 1960s, nuclear reactor vendors in the United States willingly adopted a loss-leader strategy in anticipation of an arriving “Atomic Age,” and never saw their profits materialize. The French utility EDF, however, successfully built that country's nuclear power industry using U.S. design a decade later.

While enthusiasts of PHEVs and EVs often appear to uncritically assume that if PHEVs or EVs are available at prices comparable to conventional vehicles, consumers will certainly be willing to buy them, Taiwan's experience with its electric scooter policy suggests otherwise. When Taiwanese consumers were provided with electric scooters that were comparably-priced with gasoline scooters, they still did not buy them. Factors other than price may likewise play a role in consumers' attitude toward PHEVs. To consumers who are not enthusiastic environmentalists, the plug-in feature for hybrid vehicles may not be an advantage at all. PHEVs must be equipped with a larger battery and cost much more than regular hybrids. If a user forgets to plug in his PHEV, the extra size and weight from this uncharged battery will only serve to lower the fuel efficiency of the car when it is running on gasoline. The design of PHEVs will likely be optimized differently from regular hybrids, with a smaller fuel tank and/or cargo space to accommodate a bigger battery. An uncharged PHEV would not just perform as a regular hybrid. It would in fact be an expensive but inferior hybrid. The need to plug it in every night is likely to be a nuisance to many (if not most) consumers and it is unreasonable to assume that users will always recharge their PHEVs. If early buyers become frustrated with the first-generation PHEVs due to their clunky design, inefficiencies or lack of infrastructure, the commercialization might be postponed for many years or even come to a complete stop.

One could argue that in order to promote electric vehicle use, governments should “buydown” the PHEV technology. Richard Duke proposed several criteria for technologies that are appropriate for a buydown strategy [9]. The criteria include: (1) competitive market structure; (2) strong experience curve with a low floor price; (3) low current sales but strong market acceleration with subsidies; (4) low market risk from substitutes; and (5) public benefits. Three flags arise from these criteria. Due to the lack of empirical data, the experience curve for PHEV batteries is virtually unknown. The Taiwanese experience in electric scooters suggests that subsidies may not be effective in accelerating market penetration. Also, there is obviously very high risk from substitutes (i.e. conventional vehicles and regular hybrid vehicles). These features suggest that a government subsidized buydown strategy may be an unreliable approach for launching PHEV and EV.

Governments of Germany and Japan have been buying down photovoltaic electricity for decades, and the day of grid parity has still not arrived in either country. In 2008, photovoltaic accounted for 0.64% of electricity generation in Germany, and 0.26% in Japan [10,11]. A similar subsidy approach for PHEVs could be costly and ineffective. Policymakers should recognized that it may takes decades and significant resources to subsidize or buydown PHEVs and EVs, and that there is a good chance that the

Table 1
Cities banning or restricting motorcycles.
Motorcycle Committee of the Society of Automotive Engineers of China.

Province-level cities	Beijing, Tianjin, Shanghai
Sub-provincial, prefecture-level, and county-level cities	Guangzhou, Zhongshan, Shaoguan, Zhuhai, Dongguan, Shantou, Shenzhen (in Guangdong Province) Shenyang, Dandong, Dalian, Tieling, Benxi, Anshan (in Liaoning Province) Nanjing, Suzhou, Wuxi, Changzhou, Zhenjiang, Nantong, Yangzhou, Yancheng, Huai'an, Xuzhou, Taizhou, Changshu, Zhangjiagang, Jiangyin, Lianyungang, Kunshan (in Jiangsu Province) Fuzhou, Quanzhou, Zhangzhou, Longyan, Xiamen (in Fujiang Province) Hangzhou, Wenzhou, Ningbo, Jiaxing, Shaoxing, Yiwu (in Zhejiang Province) Yantai, Qingdao, Jinan (in Shandong Province) Shijiazhuang, Tangshan, Zhangjiakou, Qinhuangdao (in Hebei Province) Luoyang, Zhengzhou, Xinxiang, Nanyang, Linzhou, Jiaozou, Anyang (in Henan Province) Harbin (in Heilongjiang Province) Guiyang, Anshun, Tongren, Duyun, Zunyi (in Guizhou Province) Hefei (in Anhui Province) Nanchang, Jiujiang (in Jiangxi Province) Changsha, Xiangtan, Yueyang, Zhangjiajie, Hengyang (in Hunan Province) Chengdu, Mianyang, Deyang, Yibin (in Sichuan Province) Kunming, Yuxi, Qujing, Mengzi (in Yunnan Province) Haikou (in Hainan Province) Nanning (in Guangxi Zhuang Autonomous Region) Wuhan, Xiangfan, Yichang, Zhongxiang (in Hubei Province) Xian (in Shaanxi Province) Taiyuan (in Shanxi Province) Baotou, Ordos, Dongsheng, Hohhot (in Inner Mongolia Autonomous Region) Changchun (in Jilin Province) Yinchuan (in Ningxia Hui Autonomous Region) Lanzhou (in Gansu Province) Urumqi (in Xinjiang Uyghur Autonomous Region)

sociopolitical endorsement may wear off before the technology can prevail, as exemplified by the history of the U.S. Synthetic Fuels Corporation [12]. Synthetic fuels were hailed as the technical fix that would rid the United States of its dependence on foreign oil in the late 1970s. After the oil price stabilized in the 1980s, the political endorsement waned and the Congress abolished the U.S. Synthetic Fuels Corporation in 1986. South Africa, however, established a profitable synthetic fuel industry because its oil import was sanctioned due to Apartheid. Because the technological buydown for EVs and PHEVs could require a huge budget and an extremely long time span, there is a high risk that the political endorsement for the subsidy may wear off before the electric vehicle technology can prevail. Limiting the fossil-fueled alternatives may be a more effective launching strategy for electric vehicles.

In addition to the Chinese motorcycle ban example, there are several other cases that suggest restrictions on alternatives to electric vehicles might be more effective than a policy of subsidies. Since London introduced its stringent congestion fees, alternative cars that are exempted from the charges are booming [13]. According to John Mason, head of enforcement at Transport for London's Congestion Charge, the number of electric cars in London increased from 90 in February 2003 to over 1600 in June 2008. Other eco-friendly cars, such as hybrids, also rose from 1000 vehicles in 2003 to more than 20,000 in 2008. The congestion tax in London imposes costs on conventional fossil-fueled vehicles but does not entirely remove them as an option. The congestion tax could indeed be seen as a reverse subsidy on clean vehicles. The reverse subsidy approach offers the advantage of not draining the government budget and therefore may be more financially sustainable than a direct buydown approach.

Norway also recently declared its intention to ban gasoline cars [14], although whether the policy will be implemented remains uncertain. Whether governments will adopt restrictive policies on conventional fossil-fueled vehicles may a crucial determinant in the future of electric vehicles. Despite the impact of its motorcycle bans on demand for electric bikes, China may now be moving in the opposite direction. As a response to the increasing popularity of electric bikes, several city governments are starting to impose bans on electric bikes due to the same concerns that led to banning motorcycles [15]. Currently more than ninety Chinese cities

Table 2
Cities banning or restricting electric bikes.

2001	Wuhan banned electric bikes from city roads. [17]
2003	Fuzhou banned the sale of electric bikes. [18]
2005	Zhuhai banned electric bike from entering the city. [19]
2006	Guangzhou suspended issuing licenses for electric bikes and banned electric bikes from entering the city. [20]
2007	Changzhou suspended issuing licenses for electric bikes, and scheduled all existing licenses to expire in 5 years. [20] Dongguang banned electric bikes from entering the city. [21]
2008	Shengyang banned electric bikes from 12 major roads. [22] Foshan banned from city downtown. [23]
2009	Shenzhen banned electric bikes from certain zones in the city. [24] Changsha suspended issuing licenses for electric bikes purchased after May 1, 2009. [25]

ban motorcycles while only about ten of them also restrict the use of electric bikes, but the restrictions on electric bikes have been gradually spreading (Table 2). Although the Chinese government announced that it wants to become the world's largest producer of electric cars [16], it has not expanded this goal to include a coherent national policy in support of the use of electric bikes. Safety and traffic congestion are certainly legitimate concerns, but there are ways other than an outright ban that may address these concerns. If the bans on electric bikes become widely adopted, the electric bike boom may soon come to an end.

In China, electric bikes are an important mode in electric transportation and the experience there offers important lessons on a possible launching strategy for electric vehicles. Restrictive policies on conventional fossil-fueled vehicles deserve more serious consideration if policymakers wish to create stable demand for clean vehicles.

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