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Role of local governments in fostering the development of an emerging industry: A market-oriented policy perspective

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Abstract This research investigates the role of local governments in stimulating an emerging industry and focuses on the specific growth of the new energy vehicle industry in Hangzhou, China. This research confirms that enabling firms to access emerging technology, acquire financial support, and touch customers and/or suppliers are critical to foster the emergence and development of industries. Moreover, the primary contribution of this study is to emphasize the support of the local government in the development of emerging industries on the perspective of the creation of a large-scale market demand. The creation of large-scale market demand may inspire actors to be proactive in responding to these incentives; thus, public and private actions may help increase the accessibility to technology, infrastructure, and finances. Hence, a market-oriented policy that incentivizes the creation and expansion of market demand among diverse public and private actors should be seen as the key issue for the emergence and growth of emerging industries. Policies should also be adopted promptly with the development of the market.

Keywords market demand, local government, new energy vehicles

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1 Introduction

New energy vehicles (NEVs) are a sustainable technology (Bohnsack et al., 2014) that would satisfy social and environmental concerns (Midler and Beaume, 2010). Although this promising industry is ideal for society, it struggles to penetrate the mainstream vehicle markets (REN21, 2013; Bohnsack et al., 2014). Governments worldwide have implemented policies to support the development of this industry (van Rijinsoever et al., 2014). The issue of fostering the development of an emerging industry—particularly ones that fulfill sustainability goals, such as the new energy vehicle industry—is an important issue for policymakers and theorists.

China aims to become one of the world leaders and the largest markets in the world's new energy vehicle industry (Bloomberg, 2016). Innovation in new energy vehicles has become one of the priority innovation areas in China since the implementation of the 12th Five-Year Development Plan and the Chinese Science and Technology Plan (Jin et al., 2012). The main objective for China's aim to grow a strong NEV industry that attracts Chinese companies and government agencies (Midler and Beaume, 2010) is to promote the transformation and enhancement of the auto industry and gain a promising competitive advantage from its first-mover status in the industrial development of NEVs.

As an emerging interdisciplinary technological industry heavily based on science, the development of NEVs require the support of the government and policies in the regional innovation system (Asheim and Coenen, 2005; Buesa et al., 2006), globally and domestically. The development of NEVs in China has attracted the attention of industries, academics, and government agencies. Most existing research on NEVs in China focuses on policies (Jin et al., 2012; Fang et al., 2013; Li et al., 2016a; 2016b) and industrial development (Xue et al., 2016; Jin and McKelvey, 2019). Research on science parks revealed the importance of market access for in-park companies (Chan

and Lau, 2005) to shorten the life-cycle products of many tech-based industries (Löfsten and Lindelöf, 2002). However, studies on the role of the government in stimulating innovation and spurring the economy from the perspective of regional innovation systems (RISs) focused on financial support, the network-like public private partnership, and infrastructure (Asheim and Coenen, 2005; Hodge and Greve, 2007; Chaminade and Vang, 2008).

Moreover, the strategic niche management (SNM) approach encourages the establishment of a pilot niche market in the process of a social-technological transition (Kemp et al., 1998; Schot and Geels, 2008; Jin and McKelvey, 2019). However, the role of the local government in the market of emerging industries and the evolutionary roles and policies of the local government are ignored. Thus, this study will answer the research question of how the local government of a developing country would foster the growth of an emerging industry from the market perspective. This study will address the current emerging industries in China by focusing on NEV industries in Hangzhou, China.

This study will provide insights into theory of regional innovation systems and proposes a research framework in Section 2. Section 3 introduces the research methodologies. Section 4 introduces the development of NEVs in China, and specifically in the city of Hangzhou. Section 5 analyzes the role of the local government in the market creation and development of NEVs in Hangzhou. Section 6 provides the conclusions and implications of this research.

2 Literature review

This literature review examines the literature that are related to regional innovation systems and public policy in the context of emerging industries.

Emerging industries based on new waves of technology have provided opportunities for firms in developing countries to compete with firms in developed countries and achieve the goal of catching up (Mytelka, 2004). The development of emerging industries has relied on RISs. An RIS is an institutional infrastructure within a specific geographical area that allocates resources to the generation and spread of knowledge to support innovation within the production structure of the region (Asheim and Coenen, 2005; Buesa et al., 2006). An RIS can greatly influence the local industrial economic environment by reducing costs, increasing productivity, and improving innovation ability. Thus, the industries influenced by RIS performs well in the market (Belussi et al., 2010) through interactions among a loose alliance of governmental institutions, firms, and other organizations (Cooke et al., 1997; Andersson, 2013). These impacts occur because no single actor can generate technological innovation effectively (Chung, 2002).

An RIS has two types of actors: Firms and other actors.

Other actors may refer to universities, research and development (R&D) institutes, technology transfer agencies, training organizations, business associations, and financial institutions (Asheim and Coenen, 2005; Chaminade and Vang, 2008). The behaviors of companies and their interactions with other companies and other actors in an RIS may influence the conditions that would eventually lead to innovation (Karlsen, 2013).

The research on RIS is focused on the role of actors, the interactions in RISs, government policy that forms RISs, and the significant functions of RISs. However, only a few studies have analyzed the role of RISs from the perspective of the market. The market aspect of RISs was, to some extent, controlled by the government. A region is a unique space with its own special environment. Government policy is a core component in forming the total environment. Currently, an increased amount of attention has been garnered by policymakers to think rationally about RISs (Chaminade and Vang, 2008). Many studies have concluded that RISs should be constructed by policymakers seeking to enhance the rate and speed of innovations (Rubach, 2013).

The studies on government focused on what the government can do to stimulate innovation and spur the economy. Capacity is one aspect of RISs that governments can promote. Financial, learning, and productive “cultures” may facilitate systemic innovation at the regional level (Cooke et al., 1997). Local governments can play a prominent role in fostering the development of emerging industries by developing detailed policies (Vecchiato and Roveda, 2014). For instance, technology policies may enhance the development and competitiveness of the Chinese wind energy industry worldwide (Kristinsson and Rao, 2008). An overview of the existing literature shows that the policies supported by governments can be divided into three categories: (1) financial support and support for R&D or other technology-based activities, (2) support for the innovation network with close interactions among universities and other institutions, and (3) the provision of information and infrastructure by founding business (Kihlgren, 2003).

In the NEV industry, specific types of scientific and technological knowledge are crucial to industrial development (Feng and Figliozzi, 2012). Considering the characteristics of knowledge intensity in emerging industries, the development of entrepreneurship in emerging industries, including the emergence of industries, the formulation of industrial networks, and industrial performance, was driven by access to technology and financial support (McKelvey and Lassen, 2013). It is similar to the Chinese nanotech industry (Jin et al., 2015; Zhang et al., 2017) that the technological and financial supports from the local government contribute to the development of nanotech industry in the Suzhou Industrial Park. Thus, we have provided the following proposition.

Proposition 1: The role of the local government is to

promote the technological access and financial support of firms, which leads to the development of emerging industries.

Jin and McKelvey (2019) found that NEV market creation is important in the development process of NEVs in Hangzhou, which was untested in their work. We assumed that market creation is a factor that influences the activities of firms in emerging industries. The market role of the local government in emerging industries should not be ignored by the government or its policies. Therefore, we suggest the following propositions with regard to market creation.

Proposition 2-1: The local government aims to create an initial market for emerging industries, in which one of the roles of the local government is market creation.

Proposition 2-2: Market creation advances the role of the local government on technology access and financial support.

Figure 1 illustrates Propositions 1, 2-1, and 2-2.

In the research of emerging industries that have an environmental impact, such as the auto-industry (Geels, 2002), an evolutionary concept known as SNM (Nill and Kemp, 2009) is widely used in the analyses of pilot policies and practices to accelerate the diffusion of ecological innovations and sustainable development. For example, Foxon (2011) proposed the co-evolution of technologies, institutions, and technological and business strategies to promote transition to a low-carbon economy. Rydin et al. (2013) specified the co-evolution between various modes of energy production and consumption in urban energy systems. Taylor et al. (2013) proposed that co-evolution occurs between ecosystems, users' practices, business strategies, institutions, and technologies in the energy storage industry. Jin and McKelvey (2019) recommended comprising the co-evolution with niche policies, the NEV market, industrial development, and the actors and their activities in the innovation system to promote the development of the NEV industry. In the research of sustainable development, public policies are seen as devices that would help actors explore the possible alignment of technology, user demands, and sustainability goals (Schot and Geels, 2008) and become evolved in the process of social-technological transition (Geels and Raven, 2006; Nill and Kemp, 2009). Policies are updated according to the growth of market and the change of the

policies' purpose in emerging industries. We defined the situation of iteration of policies as result of the adaptability and resilience of a policy. Therefore, we propose Proposition 3 on the adaptability and resilience of the policy in emerging industries.

Proposition 3: A co-evolutionary relationship exists between policies and market purposes in the development process of emerging industries (Fig. 2).

Figures 1 and 2 provide structures that describe the empirical findings of the case studies and analyze and focus on the roles of government in the development of emerging industries, such as NEVs.

3 Research methodology

3.1 Research method

Case studies are widely recognized as a method for explorative research (Yin, 2009). The case study methodology can help answer the research question of our study, according to the principles of engagement with practice (Herriott and Firestone, 1983; Yin, 2009). Case studies can also enlighten and explain complex real-life phenomena for tightly structured designs or prespecified data sets (Herriott and Firestone, 1983; Yin, 2009). Moreover, case studies are suitable for unravelling concepts (Yin, 2009). The key advantage of using case studies is that the interactions between the variables in the research framework (Fig. 1) can be analyzed over time in relation to the development of a knowledge-intensive venture and emerging industries. This research focuses on how the RIS led by the local government affects emerging industries, including one based on knowledge-intensive ventures in China, and uses the variables defined above to describe the development of these processes.

The case description presented below was based on a data set that consisted of in-depth interviews and documentary materials. We conducted interviews with one manager of a NEV service company (Mr. L) and an administrative officer of the Hangzhou government (Mr. H) in 2013. The interviews were one to two hours each in duration. By employing a question-and-answer format, an email correspondence with Mr. L in 2016 was used to update and confirm the development situation and

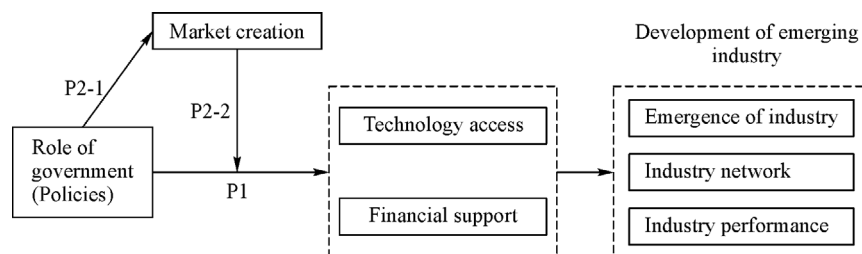


Fig. 1 Role of government/policies on the development of an emerging industry.

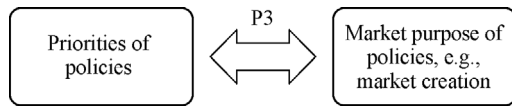


Fig. 2 Co-evolutionary relationship between policies and market purpose of policies.

incentives for the NEV industry in Hangzhou. The interviews focused on policies and their impacts on the development of the NEVs ecosystem in Hangzhou. Furthermore, we interviewed three managers (Mr. D, Mr. S, and Mr. Y) from three auto firms about their strategies on NEVs in 2018 and 2019. Two of the interviewed auto firms produced petrol vehicles and NEVs, while the other firm is a new NEV entrant that only focuses on NEVs. The two interviews with the manager of the new NEV firm (Mr. Y) were conducted in the fall of 2018 and the summer of 2019.

We collected 79 national NEV policies and action plans from 2001 to 2019, 24 NEV policies and action plans of Hangzhou and Zhejiang from 2010 to 2019, 21 that of Shanghai from 2012 to 2019, and 22 that of Shenzhen from 2015 to 2019. The other study information included a half-day lecture by Mr. L on the development and future trend of NEVs, which focused on the market and technology of this industry in January 2018. Additionally, we had three informal communications with engineers working in various auto makers to understand the impact of NEVs on auto makers' plans. All documentaries were used as background and complementary information to triangulate the data.

This empirical material was used in two ways. First, it was used to develop a chronological study of the overall policies. Second, it was used to code the key items into the main categories of our conceptual framework, which includes market size, infrastructure, and incentive policies. Then, we combined these analyses to reveal the co-evolution of policies and market development.

3.2 Measures of variables

The items in the Draft Notice of the NEV Charging Infrastructure Construction and the NEV Promotion section of the 13th Five-Year Plan indicated that the NEV market size (e.g., sales volume), industry scale (e.g., production volume), and infrastructure (e.g., the number of charging piles) are the key evaluation indicators in the NEV industry in China. In our view, the actors are linked to the policy targets because an increasing number of users

represent the market, the development of manufacturers represents industrial growth, whereas the interactions among users, manufacturers/research institutes, and policymakers correspond to those between market formation, industrial growth, and infrastructure. This study proposes two elements to indicate the performance of the NEV industry: (1) infrastructure development and (2) industrial growth. The number of charging piles and charging stations may refer to infrastructure development. Industrial growth is measured by the penetration rate of NEVs in the Chinese auto industry and the production volume of NEVs. The sales volume of NEVs in the Chinese auto industry is seen as an indicator of the emergence of the NEV industry. The industrial network could also be recognized as the number of various actors in an industry.

Access to technology and development refers to the participation of universities and research institutes in NEV industries. Financial resources include the government's financial subsidies and incentive policies, as well as venture capitals or investment willingness in the NEV industry. As obtaining specific data on venture capitals is difficult, venture capitals in this study will be operationalized as increased start-ups or new joint projects by existing companies in NEV industries. Market creation is analyzed as the ownership of the first group of buyers.

4 Policies and development of the NEV industry in China and Hangzhou

This section details the development of NEVs in China and the related situation in Hangzhou to explain the influences of the local government in Hangzhou on NEV development in terms of access to technology, financial support, and market creation.

4.1 Policies of the NEV industry in China

Since the beginning of the 2000s, China has invested in the R&D and commercialization of NEVs. In 2001, the National High-Tech Research and Development Program (the 863 Program¹) focusing on NEVs was issued to support the research and demonstration of NEVs. Subsequently, as part of the National Five-Year Plans (since the 10th Five-Year Plan), the development of NEVs has become one of the priorities of the vehicle industry. The level of support was increased after the State Council identified NEVs, together with six other sectors, as the strategic emerging industries of China in 2010² in the release of the Notices of Energy Conservation and New

1) The 863 Program or the National High-Tech R&D Program is a program funded and administered by the Chinese government. It is intended to boost innovation capacity in the high-tech sectors, to strive for breakthroughs in key technical fields, and to achieve "leap-frog" development in key high-tech fields. Partners of the 863 Programme include universities, institutes, and companies. Available at: www.863.org.cn/english/annual_report.

2) The strategic emerging industries were decided by the State Council of China in October 2010 (The Decision on Accelerating the Cultivation and Development of Strategic Emerging Industries (in Chinese), available at: www.gov.cn/zw/gk/2010-10/18).

Energy Vehicle Industry Development (2012–2020) (known as the 2020 Plan)¹⁾. In October 2015, the State Council issued a guideline to expedite the construction of electric car-charging infrastructures to support the development of the new-energy automobile industry²⁾ and a series of rules for its implementation from various ministries. Currently, China is working on a NEV industry development plan (2021–2035). Moreover, the dual-credit scheme (2021–2023), which is designed to support the NEV industry and reward or penalize automakers with positive or negative credits on their car models' fuel consumption, will be launched soon³⁾. Subsidies to consumers and producers of NEVs will also be eliminated in the coming years.

Regarding the priority of policies, Chinese policies on NEVs could be divided into three stages. Before 2015, although the infrastructure and R&D were addressed in the NEV policies, Chinese policies on NEVs have emphasized NEV consumption, such as subsidies for the production and purchase of NEVs and vehicle licenses. Since 2015, the infrastructure of NEVs, including charging piles and stations, has become the core of the incentive policies. Although the implementation of a dual-credit scheme to automakers, which was initiated as the NEVs carbon quota system in 2016, has been postponed to 2020 or 2021, a new NEV industry development plan (2021–2035) with the dual-credit scheme would transform the new vehicle sector of the innovation system in China. Figure 3 shows the three stages of the priorities of NEV policies in China.

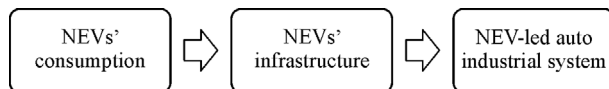


Fig. 3 Change of priority of NEV policies in China (2010–2019).

4.2 Development of NEVs in China and Hangzhou

Encouraged by policies and large electric vehicle bids from important public events, such as the Beijing Olympic Games in 2008 and the Shanghai World Expo in 2010, an increasing number of entire-car and automobile-component manufacturers are entering the NEV and pure-electric vehicle sector, for example, Chery, Dongfeng, Chang'an, and Shanghai Volkswagen. However, the NEV industry developed slowly before the Notice was issued in 2012, as shown in Fig. 4. The NEV market in China has grown rapidly since 2012 (as shown in Figs. 4 and 5), with the sales volume of NEVs reaching more than 1256000 units

in 2018. Moreover, in the first six months of 2019, a total of 617000 NEVs were sold, which is an increase of 49.6% from the same period last year⁴⁾. Moreover, the NEV penetration rate in China has increased to nearly 4% in 2018, as shown in Fig. 5. The increasing penetration rate of NEVs in the Chinese auto industry indicated the growth of the NEV market in China. China has become one of the top three largest NEV markets in the world.

The charging piles are the main infrastructure in the NEV industry. Without the well-established charging pile system, charge the NEVs and driving the NEVs for long distances will be difficult. With the development of the Chinese NEV market, the number of charging piles has increased every year, from nearly 1100 in 2010 to 310000 in 2018. By the end of June 2019, approximately 1 million charging piles or charging stations have been built in China, with 410000 public charging piles and 590000 private ones operating across the country⁴⁾. As mentioned above, the charging piles and stations became the priority of Chinese NEV policies in 2015. Thus, the number of charging piles in 2016 was almost three times of that in 2015 (Fig. 6).

As one of the pilot cities for the NEV industry in China, the Hangzhou municipal government offers incentives to support the development of NEVs in Hangzhou. As Jin and McKelvey (2019) have analyzed, the priority of the NEV niche policies in Hangzhou is the use of new energy in public transport, such as buses (the new energy bus of 2007), electric taxis, and moving from the battery swap to the micro-public transportation program, under the business model of NEV-renting and NEV-sharing. Guided by national policies, Hangzhou has encouraged the construction of NEV charging piles and stations since the end of 2015. Approximately 56400 units of NEVs⁵⁾ were sold in Hangzhou in 2018. The number of NEVs on Hangzhou's roads have reached more than 150000 by July 2019, with 42% of NEVs owned by individual consumers⁶⁾. Moreover, Hangzhou had built more than 4000 charging piles by the end of November 2018⁷⁾. Approximately 124 fast-charging pile stations were built near the service stations along the entire length of the highway in Zhejiang Province by October 2016.

The market of electric taxis, NEV-renting, and NEV-sharing, has attracted firms to compete in the NEV industry. More than 20 firms specialize in the R&D and production of the energy systems and core components of NEVs or the services for power stations for NEVs, which reveals the explosive trends of the NEV industry. For example, to develop NEV vehicles, the Wanxiang Electric

1) This notice was issued by the State Council of China on June 28, 2012 (in Chinese), available at: www.gov.cn/zwqk/2012-07/09.

2) This guideline was issued by the State Council of China on October 9, 2015, available at: english.www.gov.cn/policies/latest_releases/2015/10/09.

3) This dual-credit scheme is thought of as the previous auto carbon quota system, available at: english.www.gov.cn/state_council/ministries/2019/07/05.

4) The data are from the news *Electric charging piles top 1 million across the country*, available at: english.www.gov.cn/news/topnews/201907/15.

5) in Chinese, available at: www.asianev.com/news.

6) in Chinese, available at: js.zjol.com.cn/ycxw_zxtf/201908.

7) in Chinese, available at: auto.zjol.com.cn/zjcw/jtjs/201811.

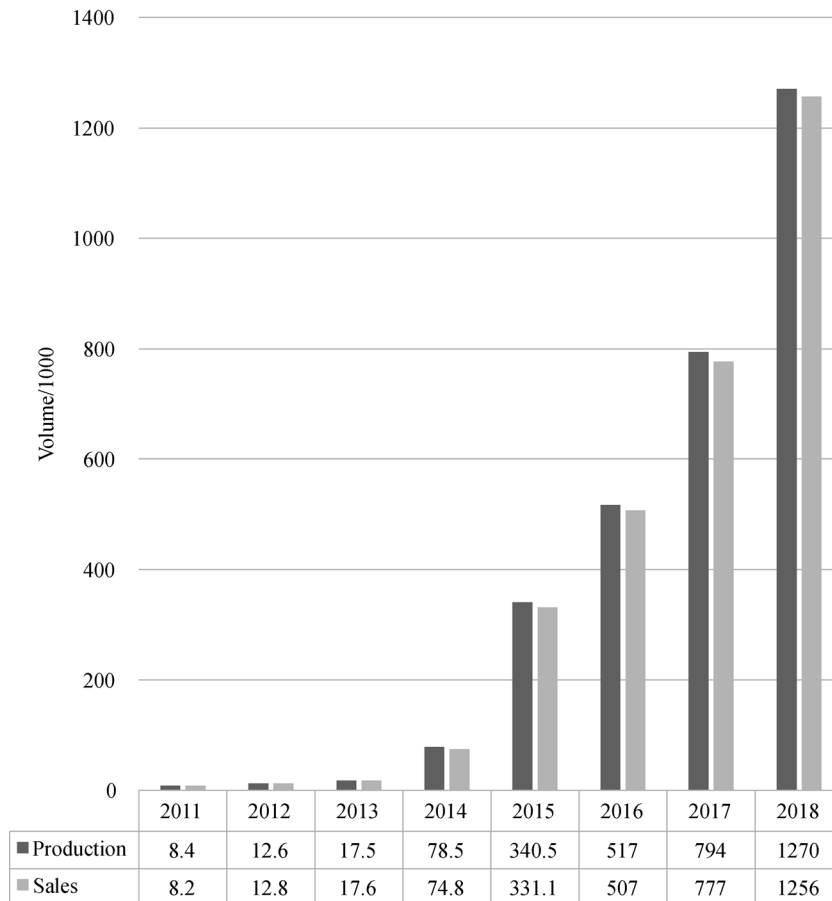


Fig. 4 Production and sales volumes of NEVs in China from 2011 to 2018 (adapted from the China Association of Automobile Manufacturers).

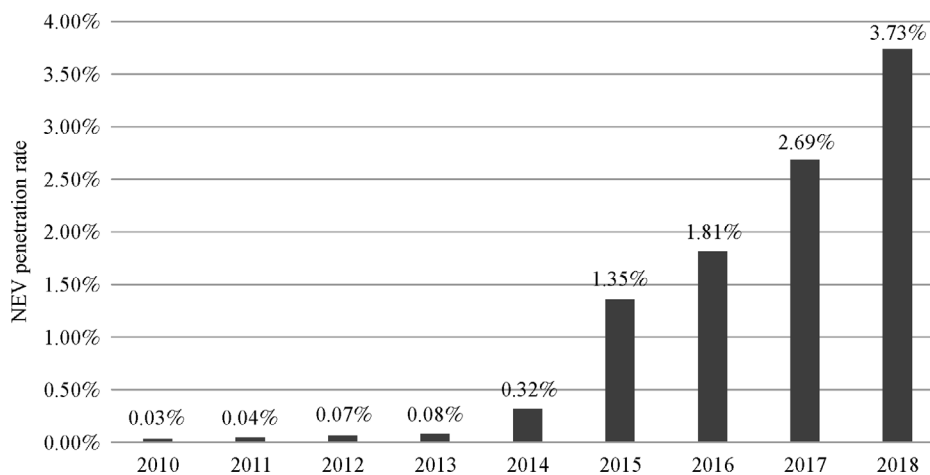


Fig. 5 NEV penetration rate in China from 2010 to 2018 (adapted with permission from Zhu (2017)).

Vehicle Co., Ltd. was formed in 2002. Spower, which was founded in September 2009, does well in the development and production of the battery systems, control systems, and drive systems of NEVs. Their products are sold worldwide. Six battery firms have begun operating in Hangzhou. The

Kandi Electric Vehicle Co., Ltd. and the micro-public bus (service) firm established by Geely and Kandi will contribute to the development and transformation of the Hangzhou automobile industry by innovating the NEV-sharing pattern. Some firms, such as Kandi and Zotye, the

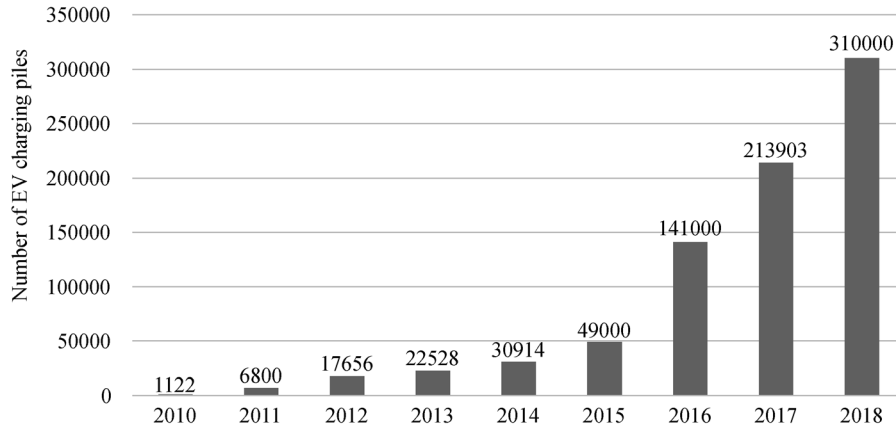


Fig. 6 Number of EV charging piles in China in 2010–2018 (adapted with permission from Zhu (2017)).

main vendors of NEVs in China, are developing with the growth of the NEV-renting and NEV-sharing markets in Hangzhou. Thus, the upstream and downstream companies in the NEV industry have developed and slowly moved toward the goal of forming a NEV industrial network.

5 Role of government in the development of emerging industries

Section 4 reveals the emergence of the NEV industry, an increasing industry performance, and the growing industry network of NEVs in China, particularly those in Hangzhou. This section will test the three propositions shown in Figs. 1 and 2, which would concern the role of government in the three aspects of access to technology, financial support and market creation, and the co-evolution of policies and market purposes based on the development of NEVs in Hangzhou.

5.1 Role of government in the NEV industry

5.1.1 Access to technology

The first role of local governments in the development of emerging industries is to make access to the technology convenient. The case of NEVs in Hangzhou reveals that for emerging industries, access to technology was realized through two methods. One method was through the scientific background of the founders or key persons in a company or the technological experience of a company. The other method was through the stimulation of the scientific and technological environment in the region that enables companies to access technologies from other institutions and companies.

From the aspect of the technological experiences and backgrounds of actors in the NEV industry, as battery changing was the priority model in Hangzhou from 2012 to

2015 in an effort to maintain a balance among charging time, safety, and earnings, the technical requirements for the batteries intended for the changing stations influenced the design and development of the electric vehicle. Mr. L, the technology manager of a NEV service company since its establishment, has expertise in the electric vehicle industry. “We knew how to make the battery changing and charging systems that connected with the state grid safely, so we set up the technical requirement of battery changing in cars,” said Mr. L in the interview in 2013, “The key part of the electric car is the battery system and the leading battery firm did not respond to our requests on time. Therefore, we cooperated with small companies for the car production and the China Academy of Art for the design.” With the development of fast-charging technology, fast-charging piles are built in Hangzhou. “Guided by government policies, charging has become the dominant method. However, we still retained the battery changing stations and services,” said Mr. L in the interview in 2016.

Furthermore, active firms in Hangzhou’s NEV industry generally have technological and production experience with the key components of NEVs. For instance, Kandi (the NEV vendor of NEV-sharing) has a technological background in batteries for vehicles, which is similar to that of BYD, one of the leading NEV makers in China and the world.

From another aspect of the scientific and technological environment, although the case of NEVs in Hangzhou does not directly demonstrate the involvement of technological institutions, and Hangzhou is not an important automobile manufacturing base in China, many universities that excelled in and are renowned for technological research (e.g., electricity, control system, and design) are located in Hangzhou and neighboring cities, such as Zhejiang University and the China Academy of Art in Hangzhou and Tongji University in Shanghai. “We invited professors from the China Academy of Art to design the first vehicle for NEV-renting and NEV-sharing,” said Mr. H, which was confirmed by Mr. L.

Thus, the current case study indicated that companies are linking with technological institutions and universities and building the RIS (Löfsten and Lindelöf, 2002; Asheim and Coenen, 2005; Chaminade and Vang, 2008), which is a significant determinant of the development of technology and influences the direction of innovation (Hekkert et al., 2007). Moreover, the case study confirms the importance of access to technology in the development of industries in emerging countries (Cho and Lee, 2003; Mu and Lee, 2005).

5.1.2 Financial support

Financial support plays a critical role in the development of emerging industries (McKelvey and Lassen, 2013), which is confirmed by the development of NEVs in Hangzhou. Research has found that the local government can boost the contribution of financial support. Financial support for the penetration of NEVs in China includes subsidies, allowances, tax deductions, manufacturers, purchasers, and users in the NEVs industry, which may stem from the central and local governments. For instance, manufacturers in the NEV industry from component providers to whole vehicle makers can apply for funds to support their research and development of NEVs from the state and local governments, such as the 863 Program for NEVs (Jin et al., 2012) and the financial resources in the 2020 Plan (Jin et al., 2016). As the infrastructure determines the formulation and growth of the auto industry (Geels, 2002; Harrison and Thiel, 2017) and the priority of policies moved toward the infrastructure (Fig. 3), financial support can adjust the lens to focus on building the infrastructure, such as charging piles and the expansion of the NEV market since December 2015. Mr. L remarked, “Because of the incentive policies of the infrastructure, many private firms enter this market. ... We (The State Grid) built more new charging piles and fast-charging piles, too.”

Apart from the financial support from R&D, the infrastructure and the market, advanced funds are allocated from the Ministry of Finance (MOF) of China to NEV makers, according to their productivity and sales. For instance, approximately 59.60 million USD of funds was given to Kandi in 2015 because of its NEV production and sales¹). Additionally, the dual-credit scheme provides new NEV firms with opportunities to obtain financial returns indirectly. “We cooperated with a traditional auto maker to produce NEVs for us. They can use the number of our NEVs towards the quota of their petrol vehicles. ... As a high-tech firm in the NEV industry, we received funds, tax reductions and other incentives from the local government. ... Because of the better financial support from Chongqing, we moved to Chongqing in September. ... Perhaps we will keep an office in Hangzhou,” related Mr. Y.

Similar to other emerging industries, the firms’ capitals are attracted to the NEV industry. The start-ups and joint projects by existing firms in the NEV industry indicated the investment temptation of NEVs to firms. For example, the largest shareholder of the new energy taxi company and the new energy service company in Hangzhou is the State Grid of Hangzhou. The NEV-renting and NEV-sharing businesses in Hangzhou have drawn various firms, from auto makers to IT firms and hotels, to conduct their cross-industry investments on the NEV network, covering the IT sharing system, the service system, and the battery charging and changing system.

This case study of NEVs in Hangzhou and China divulged that the direct and indirect financial support has been used to consolidate the growth of NEV industrial networks and markets, as well as the R&D investment in NEVs. Moreover, the allocation of subsidies and the increasing investments boosted the NEV industry and market. Therefore, the growth of NEVs in Hangzhou reinforced the role of local governments in the growth of new emerging industries via diversified financial support (Feng and Figliozzi, 2012).

5.1.3 Market creation and expansion

As indicated in previous research (Jin et al., 2016; Jin and McKelvey, 2019), market creation can be seen as fundamental to the development of emerging industries, and governments can play a critical role. We assumed that this role was resulted from that the created market made it easy for start-ups to access the market and revenue. Thus, even a small number of sales during a company’s startup phase will help entrepreneurs increase their self-confidence and further their commercialization process. The created market will attract others to invest in the emerging knowledge-intensive industries at an early stage and build an industrial network.

The case of NEVs can be seen as a good example of the importance of market creation in the growth of emerging industries. Given the weaknesses of immature NEV technology and the tough transitional situation for the auto industry, NEVs could not occupy as important a position in the market as that of cars or alternative transportation. The purchase subsidies alone are insufficient for an individual to purchase an NEV, which increases the inconvenience and the price of NEVs. The issue of developing NEVs and building the NEV market has become a problem in all countries.

This problem has also occurred in Hangzhou. “Although there are purchase subsidies for individuals, the market growth has been quite slow. It is hard for individuals to make a NEV purchase decision if they do not have any ideas of NEVs. ... The electric taxi on the road will help more citizens accept this new product. That is the reason

1) The information can be found at the firm’s official website: en.kandivehicle.com/NewsDetail.aspx?newsid=139.

why we stress the creation of NEV users in the public transportation system,” said Mr. H. Therefore, the electric taxi, NEV-renting, and NEV-sharing in Hangzhou are recognized as supplementary to public transportation, which is controlled by the government. Publicity for the rental model also helps promote the people’s desire to purchase the vehicles, thus creating a consumer market. In turn, this market need to drive the scale of production, which helps reduce costs and encourage consumers to buy the vehicles, given a well-designed charging system. Thus, Proposition 1 and Proposition 2-1 are confirmed.

From the case of NEVs, before the promotion of NEVs, no market for NEVs, no NEV factories, and no related industries existed in Hangzhou. As the government wanted to use NEVs as a substitute for traditional vehicles to solve the energy crisis and air quality problem, policies are in place to attract citizens to use NEVs. By cooperating with the State Grid to establish the Hangzhou New Energy Taxi Co., Ltd., the need for electric taxis gradually developed. What followed was the order of NEVs for use in this company and the need for auxiliary equipment. Thus, the related NEV market has slowly attracted people’s attention. Public bidding for equipment and cars may lead many automakers to transfer their attention to NEVs. At the same time, to ensure the continuous promotion of the market, the grant from the government was continuously adjusted. Furthermore, more investment and M&As (merger and acquisitions) on the R&D of NEVs have been garnered because of the bright future of the NEV market in China. For example, BAIC merged with Saab for innovation related to NEVs, which contributed to the production and sales of NEVs. As reported in the news, BAIC BJEV, which is the electric vehicle subsidiary of the BAIC Group, sold 49076 of its EU series in the first half of 2019, achieving an impressive 1506.9 percent growth from the same period last year¹⁾. Moreover, the companies and institutions that participated in the development of NEVs indicated that the market is a visual platform that was attracting public and private cooperation. For instance, the development of the NEV-sharing business in Hangzhou made NEV makers collect and analyze NEVs running data to improve NEV technology, design, and production. “From the collected operation data of our own drivers of NEV-sharing firms, our firm (the automaker) will know the average distance driven, popular areas from which people call to use a NEV, the running system of the NEVs, and so on. Then, we can improve the R&D and design on our NEVs,” said Mr. S.

The development of the Chinese NEV market attracts more investment in NEV technology in China from joint ventures. “We invested in the NEV development in China and we are going to launch our NEV in the Chinese market early next year, which was not in our previous plan,” declared Mr. D when he spoke about the attraction of the

Chinese NEV market and the influence of the dual-credit scheme.

Therefore, market creation enhances the role of government policies on technology access and financial support. Thus, Proposition 2-2 was confirmed.

5.2 Adaptability and resilience of policy: Evolution of policies and market

As introduced in Section 4.1, the priority of policies in various stages was shifting with the development of the NEV industry in China (Fig. 3). With the change in key issues in policies, the market purpose of NEV policies also changes, as illustrated in Fig. 7. As shown in the case study, at the early stage, encouraging the use of NEVs in public transportation and sharing is for market creation to improve the NEV awareness of consumers. Then, the focus of policies can move to the infrastructure of the NEVs, such as the charging pools and charging systems of the NEVs, which is for market expansion and maintenance. The latest policies on the dual-credit system, which was understood as a quota of NEVs in sales and new industry plans, will push the vehicle industry to be an NEV-led industry, which could be seen as a policy for industrial transformation.

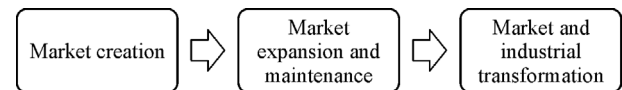


Fig. 7 Change of the market purpose of policies of NEVs.

Although Jin and McKelvey (2019) proposed the co-evolutionary concept for niche policies, which may refer to the anatomy of the policies for market creation in this research, we adopted the evolution concept in the current analyses. Integrating Figs. 3 and 7, we proposed the co-evolutionary nature of the market purpose and priority of policies, as shown in Fig. 8. We defined this nature as the adaptability and resilience of policies in the emerging industry. Therefore, Proposition 3 was confirmed.

6 Conclusions and implications

This study has explored how local governments can play a role in the growth of emerging knowledge-intensive industries in China, such as the NEV industry. Local governments may contribute to the development of NEV industries, such as that in Hangzhou, which confirmed previous research findings that the policy aspect plays a critical role in the development of benign environmental industries (Kemp et al., 1998; Schot and Geels, 2008). This

1) The data are from the news *Electric charging piles top 1 million across the country*, available at: english.www.gov.cn/news/topnews/201907/15.

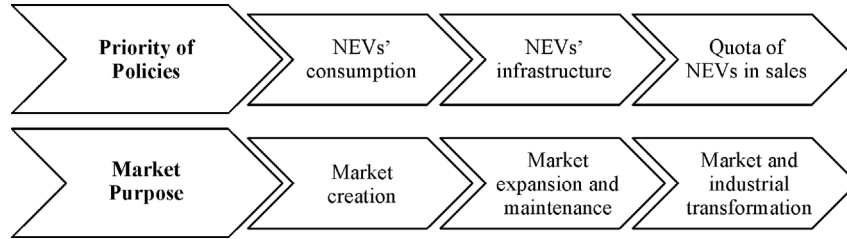


Fig. 8 Co-evolutionary concept of the priority of policies and market purpose in the NEV industry.

research indicated that fostering the development of the emerging industry is critical to enable firms to access the emerging technology, recruit talent, and find customers and/or suppliers to foster the emergence and growth of emerging industries, which verifies the findings of McKelvey and Lassen (2013) on knowledge-intensive entrepreneurship.

The case of NEVs in Hangzhou indicated the importance of market-oriented policies as tools to employ the role of local governments in the growth of the emerging industry. This research proposes two perspectives of market-oriented policies, namely, market creation as the centralization of market-oriented policies as one aspect and the adaptability and resilience of policies as the other aspect.

We assumed that market creation is one of the key roles of local governments in the regional innovation system in promoting the development of emerging industries, such as the new energy industry. In the long-term, companies can obtain a return on their investment from the market, the potential market will accelerate the commercialization of the new technology, and the investment in technology will attract talents that would work in the industry. The creation of a large-scale market would inspire actors to be proactive in responding to these incentives. Thus, public and private actions may help increase access to technology, infrastructure, and finances. The market creation leads to a sustainable innovation system of the industry. The barriers faced by the photovoltaic (PV) industry in China and the global strategy of PV firms (Jin et al., 2019) indicated the importance of building a well-designed local market. Therefore, the government should play a role in creating the markets for emerging industries, which has been ignored in previous research, as markets for emerging knowledge-intensive industries, such as markets for NEVs and PVs, could not be developed on the basis of individual demand alone.

Furthermore, this research signifies the co-evolutionary process of policies and the emerging industry, which indicated the adaptability and resilience of policies. With the development of the market, the target of policies may change from incentives to NEV consumption, to market creation and improvement of the NEV awareness of consumers, to the establishment of NEV infrastructures for market expansion and maintenance, and to the quota of

NEVs in sales for market and industrial transformation. This transition is caused by the fast-paced changes of the market. The findings are consistent with the research of Jin and McKelvey (2019) on the evolutionary nature of policies within the development of the market.

In the future, we will further develop our study to consider the future evolution of policies and technologies in the NEV industry. For instance, an industry with covert local protection is recognized because of the weakness of the long-distance driving of NEVs due to the lack of an infrastructure network across regions. How could the government work to reduce this local protection or increase the balance between the positive and negative impacts of global competitors in the open market and the economic benefits of local automakers? What should the government do to guide the green and sustainable development of the NEV industry, considering the recycling of batteries and the technology changes related to the diffusion of augmented technology and artificial intelligence? Moreover, how could the government guide firms toward investing in fuel cell technology and other new energy technologies in the future?

Appendix

Main questions asked during the interviews:

1. Which NEV incentive policies are issued in Hangzhou?
2. What is the current state of NEV development in Hangzhou?
3. What is the plan and strategy for the NEV industry in Hangzhou?
4. Why did you decide to develop the electric taxi?
5. Why did you decide to invest in battery changing, rather than battery charging?
6. How many NEV charging piles and stations are in Hangzhou?
7. Who are your partners?
8. Do you produce NEVs yourself?
9. What are the influences of the dual-credit scheme on your strategies?
10. What subsidies does your company currently receive?

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