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Electric Vehicles: Implications for Developing Countries

Archanun Kohpaiboon

1.1 INTRODUCTION

The automotive industry is of great interest to governments in developing countries. Until the new millennium, internal combustion engine vehicles (ICEVs) dominated the industry. An ICEV comprises numerous auto parts and components involving a wide range of industries, including plastics, rubber, glass, metallics, engines and electronics. Thus, a well-developed automotive industry is deemed to comprise several desirable developmental outcomes. These outcomes include extensive linkages to other upstream industries, providing an industrial foundation for technological upgrading, supporting employment generation and boosting foreign exchange earnings. As a result, many governments have actively intervened to develop the industry. The policy approaches taken have varied from the creation of indigenous car makers as national champions to establishing regional car manufacturing hubs.

In the past, large-scale automotive manufacturing was concentrated in a few developed countries, often collectively referred to as triad countries (i.e., the United States, Japan, Germany, the United Kingdom and France). Since the dawn of the new millennium, a few developing countries, such as Brazil, China, India, Indonesia, Thailand and Mexico, have made significant strides in increasing vehicle production. The automotive industries in these countries have brought about various economic benefits in terms of extensive linkages, increased foreign exchange earnings and significant job creation.

However, their longer-term impact has led to concerns about the sustainability of the industry. Production processes rely heavily on foreign technology, whereas the technology spillover effects of automotive FDI on indigenous firms are limited. In addition, the participation of indigenous firms remains narrow. Hence, the prospects for economic upgrading opportunities are bleak. This is referred to collectively as dependent market economy development in the development literature (Szalavetz 2022).

The automotive industry has undergone another tectonic shift since the mid-2000s with the advent of the large-scale production of a new generation of electric vehicles (EVs). There are many types of EVs: battery electric vehicles (BEVs), hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs) and fuel-cell electric vehicles (FCEVs). In this book, our focus is on BEVs, which are currently at the centre of policy debate. EVs encompass vehicles that are either partially or fully powered by batteries, whereas BEVs are fully battery powered. When referring to electric vehicles other than BEVs, such as HEVs, PHEVs or FCEVs, they will be specified explicitly.

In the context of developing countries, EVs are often viewed not only as a tool to decarbonize the transport sector, but also as representing an opportunity for the technological leapfrogging that can secure a first-mover advantage through targeted industrial policies. In fact, the latter is often the top policy priority. The emergence of Chinese manufacturing within EV industries (both vehicles and batteries) and the government's role through implementing industrial policy are often viewed as constituting the role model within initiatives to harness

these opportunities (e.g., Altenburg et al. 2022; IEA 2019). The EV industry is also seen as providing these countries with a second chance at developing their automotive sectors by learning from some of their previous mistakes in nurturing the ICEV industry.

Since 2020, developing countries have offered economic incentives to promote EV uptake. Most of the offered incentives are associated with EV manufacturing localization agendas. Some of them follow the example of developed countries and China by offering direct subsidies to stimulate the purchase of EVs. These policy efforts are in line with a revival of industry policy sentiments worldwide that has been observed in the past decade (*The Economist* 2023; Ohnsorge et al. 2024; Llyina et al. 2024). All initiatives are aimed at achieving first-mover advantage amid the rapid technological advancements in the EV industry.

While these economic incentives, especially direct subsidies, put a strain on governments, there are many factors to take into consideration. Firstly, certain prerequisites are needed to make them effective. The prerequisites include the government's ability to stay well-informed about technological foresight, while the country's initial technological capability in terms of materializing the benefits to be incurred from technological leapfrogging (Brezis et al. 1993). Achieving competency also takes time and involves extensive, practical hands-on experience, so policy efforts must be carried out on a continuous basis. Hence, trade-offs between government and market failure remain intact (Krugman 1994, p. 23). None of these prerequisites is often found in developing countries.

1.2 THREE ASPECTS OF EVS

There are three aspects of EVs that deserve special policy attention in the context of developing countries.

1. EV firms' internationalization
2. Formation of EVs' global value chains (GVCs)
3. Disruptive effects of EVs

1.2.1 EV Firms' Internationalization

The way to promote EV manufacturing localization in developing countries is not much different from that involved in promoting the ICEV industry. Economic incentives in both trade protection and investment promotion packages are offered to entice leading multinational EV makers to set up affiliates, conditioned by technology transfer requests and local-content requirements (LCRs). In some countries, direct subsidies are used as a part of the economic incentives designed to promote EV manufacturing localization.

It remains inconclusive whether EV makers and suppliers are ready to set up affiliates abroad. Arguably, the current technological development of EV industries is far from saturated and searching for alternative powertrains (e.g., hydrogen fuel cell) is yet to be settled (Keohane et al. 2023; Sanguesa et al. 2021; *The Economist* 2021). They could constrain EV makers and their suppliers from investing abroad. This can also be viewed through the lens of the product cycle theory postulated by Vernon (1966). In particular, EVs are at the early stages of their product's life cycle and are likely to be manufactured at home.

On the other hand, the argument above focuses solely on the technological aspects of EVs. When other economic conditions, especially the greater internationalization of the world economy, are taken into consideration, there are several investment locations suitable for launching new products outside their home countries (Taylor 1986). Some locations offer a more conducive business environment (e.g., strong intellectual property protection schemes) than others for products whose innovation process is ongoing. Therefore, overseas production can go hand in hand with that at home, whilst the production technology involved has not yet matured. As China is one of the key players in the EV industry (both EV makers and batteries) and has aggressively invested abroad so far (Luo and Tung 2007, 2018), there might be lucrative opportunities available to tap direct outward investment from these Chinese multinationals. All in all, how firms in the EV industry undertake their manufacturing tasks matters greatly in the context of the effectiveness of policies enticing them to set up affiliates.

1.2.2 Formation of EVs' GVCs

How these firms formulate their GVC is another important consideration in the context of developing countries. One of the reasons governments in developing countries want to entice the ICEV industry is due to its extensive local linkages. The GVC formation of ICEVs often takes place locally, in which a car assembling facility is at the centre, geographically surrounded by its constituent parts and components (Sturgeon et al. 2008; Van Biesebroeck and Sturgeon 2011; Kohpaiboon 2015). As a result, successfully enticing these ICEV carmakers to set up their affiliates induces their suppliers to follow their lead firm and form an extensive industrial cluster. The geographical proximity of supply networks in ICEV industries helps keep the cost of coordination low.

BEVs GVC is possibly different from that of ICEVs in both the number of parts involved and how they are sourced. BEVs use around 2,000 parts, less than one tenth of the components used in ICEVs (i.e., 20,000–30,000 parts), with a limited overlap between the two. Hence, logistics related to the parts procurement of BEVs are far less complicated compared to ICEVs. Most of the parts in BEVs, except batteries, typically have high value per weight so that they can be carried via air transport. Therefore, the agglomeration gains derived from geographical clusters like the ICEV industry are limited for BEVs. EV parts are likely to be sourced internationally, *ceteris paribus*. The exception is batteries, the most critical part for EVs, accounting for about 30–33 per cent of total costs (CRS 2022, p. 5). Their bulky nature might require battery factories to be close to vehicle manufacturing centres. The expected gain of EV manufacturing localization in terms of backward linkages might not be as large as that experienced in the case of ICEVs. Any radical policy actions, like the ban of ICEVs (Morfeldt et al. 2021), which hope to accelerate EV uptake and win the race, enticing EV makers and their suppliers, must be undertaken with caution. The adverse effects of passing through the GVCs of ICEVs and the nature of the GVCs of EVs must be incorporated efficiently within policymaking to best promote EV manufacturing localization.

1.2.3 Disruptive Effects of EVs

The rise of EVs was regarded as a disruptive technology within the automotive industry. This is in line with the sentiment of disruptive technology/innovation outlined by Bower and Christensen (1995). It generates deep concerns for developing countries currently functioning as production hubs of ICEVs. Hence, a rush to promote EVs is needed to minimize the risk of disruptive effects on their automotive industries.

In this regard, a better understanding of the key determinants of EV uptake is crucial, especially in terms of how important policies are to accelerating EV uptake. Like other products, such an EV uptake in a given country is the result of the interplay between demand and supply factors in the EV industry. For the past decade, as the supply side of the EV industry has been favourable, demand-side factors have played a pivotal role in determining actual EV uptake. This is largely owing to vehicles representing durable goods that deliver a service over a prolonged period (Padula 2000). The decision to purchase will involve consideration of the stream of costs and benefits derived over a product's life cycle. Consumers will consider user costs, covering both the price of the product itself and other expenses incurred. Consumer preferences, financial constraints and uncertainties concerning the product also matter in influencing the decision to purchase. All other things being equal, demand for durable goods like vehicles is expected to grow steadily, and so is EV uptake. Therefore, a disruptive effect of EVs is less likely to take place, and the proactive role of governments in accelerating EV uptake becomes less justified.

The proactive role of governments might be claimed on the grounds of the first-mover advantage mentioned above. In view of the nature of durable goods, the role of government is limited to lowering user costs in order to immediately accelerate EV uptake. Even though policy options like direct subsidies, tax exemptions and road privileges can be employed to lower the EV prices, the problems individual consumers may face (e.g., insufficient charging stations, high maintenance costs, safety fears) when using EVs remain to be

seen and cannot be entirely redressed by these options. Deploying public EV charging stations can help address the problems, but it also takes time and requires substantial fiscal resources for stations to be installed adequately and comprehensively. As a result, the responsiveness of consumers to the incentives offered is a crucial factor in determining how rapidly EV uptake can grow. This remains an open empirical question.

1.3 ABOUT THE EDITED VOLUME

Despite their immense policy relevance, these issues have not been examined systematically. Most of the previous studies on EVs have often been carried out from an environmental perspective based on the experience of developed countries. In these studies, EVs are regarded as the key instrument to substantially cut carbon emissions. Their key findings highlight the gradual transition from ICEVs to EVs, constrained by consumer behaviour (e.g., Duigou et al. 2014; Wager et al. 2016; Wikstrom et al. 2016), infrastructure challenges (e.g., Faria et al. 2014), and the cost-effectiveness and effectiveness of incentives granted to promote EV uptake (e.g., Shin et al. 2012; Martins et al. 2024). In addition, its net environmental gains are conditioned by the relative importance of renewable energy components in a particular country's power supply system (Karplus et al. 2010).

There are studies investigating the impact of government subsidy on EV uptake, for example, Clinton and Steinberg (2019) for the United States, Azarafshar and Vermeulen (2020) for Canada, and Li et al. (2023) for China. It is rather difficult to generalize these findings to other developing countries whose basic infrastructure readiness is far less developed than that of these countries. The fiscal space of developing countries is also limited and has been shrinking after the COVID-19 pandemic.

In addition, there has not been a systematic analysis of trade and investment conditions worldwide with respect to EV industries. For example, there are two studies examining the transition from ICEVs to EVs. These comprise Gerocs (2022) and Masiero et al. (2017),

using Hungary and Brazil as case studies, respectively. Their focus is on the transition of ICEVs to EVs, derived from firms' behaviour. The internationalization of EV firms from a broader perspective has not been examined.

Against this backdrop, this edited volume is devoted to an analysis of the EV industry in the developing countries context. There are nine chapters. Chapter 2 by Archanun Kohpaiboon contextualizes the rise of EVs in developing countries. It begins with the growth of EVs and the driving forces behind this, followed by the challenges many developing countries are confronting.

The next two chapters present cross-country analyses of EVs. Chapter 3 by Archanun Kohpaiboon and Petcharin Wongchareon gives an overview of policies seeking to promote EV uptake, as well as analysing trends and patterns within EV uptake worldwide. The last section of Chapter 3 presents an intercountry panel data econometric analysis of the determinants of EV uptake from 2015 to 2021 to illustrate the relative importance of government policies, compared with other economic fundamentals. Chapter 4, co-authored by Archanun Kohpaiboon and Wannaphong Durongkaveroj, provides a broad analysis of the trade and investment trends in the EV industry globally to cast light on GVC formation in the sector. Products related to EV industries (EVs and core parts, such as batteries, traction motors and controllers) are identified at the six-digit Harmonized System (HS) to view their inherent trade patterns from 2019 to 2023. To examine investment patterns in the EV industry, data on the investment flows of leading firms in EV manufacturing are analysed.

The next four chapters present in-depth analyses of how governments in developing countries have responded to the rise of EVs, using the experience of four Southeast Asian economies (i.e., Thailand, Malaysia, Indonesia and Vietnam). There are similarities and differences in the development of the industry across the four countries. These differences arise from path-dependence factors (e.g., Thailand's mature ICEV manufacturing hub and Malaysia's mature electrical and electronics industry), natural resource endowments (Indonesia's

rich nickel reserves) and respective levels of development (Vietnam's motorcycle EVs). Chapter 5, authored by Archanun Kohpaiboon, offers an overview of the case of Thailand and examines the policy challenges faced by the government in developing its EV industry in the presence of a mature and thriving manufacturing hub for ICEVs. Chapter 6 by Tham Siew Yean discusses Malaysia's experience in developing its EV industry. It carefully documents and discusses the implementation of trade and industrial policies that have supported the development of different segments of the EV industry in the country. Chapter 7 by Siwage Dharma Negara analyses the development of the Indonesian EV industry. It discusses the evolution of the country's industrial policies in the automotive industry and the government's current policy priorities regarding the industry, including those that draw upon its comparative advantages, such as rich nickel reserves. Chapter 8 by Pham Van Dai examines the development of the EV industry in Vietnam. It discusses how policies in the transport sector supporting zero emission targets have reinforced the EV industry and the role of the private sector in the industry. The last chapter by Archanun Kohpaiboon presents the conclusions, a comparative analysis of BEV development across four Southeast Asian economies, and the policy implications of the volume.

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