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Local niches and firm responses in sustainability transitions: The case of low-emission vehicles in China

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ABSTRACT

The Chinese government has implemented a comprehensive strategy to push low-emission vehicles (LEVs). Local municipalities have played an important role in this transition. Programs such as the “Ten Cities Thousand Vehicles” (TCTV) program created protection mechanisms in local niches for the development of LEVs in which public and private actors have been able to experiment without market pressures. However, often the setup of local niches has favoured local companies which led to incompatibility across provinces and barriers to diffusion. This article aims to explore the dynamics in the local niche and how the niche has been shaped by local protection and firm responses. Heeding the call for a better conceptualization of the spatial dimension in sustainability transitions, we draw on the recent second generation, multi-scalar multi-level perspective (MLP) and conceptualize the local niche. Based on our empirical results we find four ideal type local niches – the open niche, the technology shielding niche, the market shielding niche and the closed niche – and distill respective firm responses. This has important implications for policy-makers and managers in China and for industries in sustainability transition in general.

1. Introduction

The global trend of low-emission vehicles (LEVs) has spurred ambitions among Chinese government officials that Chinese automakers could leapfrog their foreign counterparts with indigenous innovations in low-emission vehicles (LEVs, termed as New Energy Vehicles in China), reduce their dependence on foreign technologies, and at the same time improve air quality in cities through the introduction of new powertrain technologies (Gong et al., 2013). A comprehensive strategy for research and development was implemented to stimulate a transition towards sustainable transportation. In 2009, the Chinese government launched the demonstration program named “Ten Cities Thousand Vehicles” (TCTV) to stimulate LEV adoption in Chinese cities in which domestic public and private actors could experiment without market pressures (Schot and Geels, 2008). This created an interesting natural experiment for sustainability transitions (Geels, 2002; Schot and Geels, 2008; Raven et al., 2012) because the program not only spurred technological experimentation but also created several ‘local niches’ for LEVs and lead to competition between cities and provinces (Shang et al., 2015). They implemented standards that favoured local companies and protected specific technologies which led to incompatibility between technologies across provinces, barriers to diffusion and lock-in effects (Marquis et al., 2013; cf. Kolk and Tsang, 2017). As a result, the planned numbers of LEVs for the program was not achieved

(Marquis et al., 2013). Clearly, these local niche developments had a noteworthy effect on the transition towards LEVs in China. Thus, this paper sets out to explore *how the local niche affected the LEV transition in China?*

In doing so, this paper heeds the call for empirical scrutiny and better geographical conceptualization of sustainability transitions (Coenen et al., 2012; Hansen and Coenen, 2014; Smith and Raven, 2012). The spatial dimension has received increasing attention in studies on sustainability transitions and socio-technical systems (Raven et al., 2012; Coenen et al., 2012; Truffer et al., 2015; Hansen and Coenen, 2015; Bento and Fontes, 2015; Mattes et al., 2015). Until recently transitions have been conceptualized in the multi-level perspective (MLP) and did not integrate the geographical dimension (cf. Geels, 2002). In the second-generation, multi-scalar MLP, geographical dynamics have been integrated (Raven et al., 2012). Yet, while interactions between technological niches have been studied (Bakker et al., 2012), interactions across or competition between different geographically separated local niches have been neglected (Smith and Raven, 2012). Drawing on the socio-technical system literature and the multi-level perspective (Geels, 2002; Slayton and Spinardi, 2016), we fill this void and contribute to the theoretical understanding of the local niche, i.e. the micro dynamics of sub-national actors and provide a nuanced, contextualized view of protection mechanisms exerted by sub-national actors which highlight the importance of the spatial dimension

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in the multi-level perspective (Raven et al., 2012; Raven et al., 2016; Sengers and Raven, 2015; Smith and Raven, 2012). We find four ideal type local niches: the open niche, the technology shielding niche, market shielding niche and the closed niche and three respective firm responses, namely market avoidance, investment, and creativity. Our findings also add to the debate on Chinese technology policy (Hong et al., 2016; Ruan et al., 2014; Yi et al., 2017; Yu and Gibbs, 2017) and provides a rich case to understand the emergence of LEVs in China. Our findings can help policy makers to design technology policies and give guidance to managers in industries that are in a sustainability transition.

The remainder of this paper proceeds as follows. In Section 2, we provide the theoretical background of sustainability transitions, space and niches, and develop a conceptual framework. In Section 3, we present our methodology. The subsequent Section 4 presents our findings, which are discussed in Section 5. The paper concludes with Section 6.

2. The spatial dimension in socio-technical systems, protected spaces across regions and the niche in the multi-scalar MLP

In order to understand the systemic dynamics of the transition towards LEVs in China overtime, we draw on the body of literature of socio-technical systems which studies sustainability transitions (Geels, 2004; Raven and Geels, 2010). The socio-technical systems perspective complements the Technological Innovation Systems literature which tends to explain the internal dynamics of nurturing of innovations (Markard and Truffer, 2008). The socio-technical systems approach adopts a multi-level perspective (MLP) to explain transformation processes of systemic innovations such as electric cars (Geels, 2004, 2002; Pinkse et al., 2014) and assumes that sustainable technologies start their development in a niche, subsequently break into the existing socio-technical regime when a window-of-opportunity opens up, created through landscape developments and finally replace the regime (Geels, 2004). However, in contrast to the innovation systems literature (e.g. Chung, 2002), the multi-level perspective lacks the conceptualization of the spatial dimension in the technological change process (Coenen et al., 2012). In other words, the differences and consequences of developments occurring in parallel for the same technology in various geographic differences cannot be explained. So far the MLP has solely accounted for the dimensions of time and structural scale. In fact, studies have often implicitly and partly incorrectly equated the niche with the local level, the regime with the national level and the landscape with the international level (Raven et al., 2012).

Therefore, researchers have suggested the development of a more explicit spatial perspective on sustainability transitions in order to bring attention to the different institutional actors in different spaces, e.g. regional and national institutions (Coenen et al., 2012; Hansen and Coenen, 2015; Truffer et al., 2015; Raven et al., 2012). Without incorporating spatial scale, the perspective falls short of effects, such as transnational relationships, global forces and sub-national processes that influence sustainability transitions (Truffer et al., 2015). For instance, Bohnsack et al. (2015a, 2015b) illustrate in their study of the evolution of LEVs that the transition has been shaped by policies in different countries as well as the capabilities of internationally operating firms. Both have significantly influenced the trajectory of global low-emission vehicle developments. Without the conceptualization of spatial dynamics, sustainability transitions cannot be fully explained and fall short of considering spatial interaction effects as a result of local natural resource endowments (e.g. availability of hydropower), regional visions and policies, the local market, localized institutions, local industrial specialization and local consumers (Hansen and Coenen, 2015). Thus, there is a call for a conceptualization of transitions as “interdependent processes between territorialized, local and trans-local networks within the context of (changing) multi-scalar,

institutional structures” (Coenen et al., 2012: 976).

One of the first attempts of conceptualizing the spatial dimension was made by Raven et al. (2012), who suggested the development of a ‘second generation, multi-scalar MLP’. Next to the dimension of time and structural scale, a multi-scalar MLP incorporates the spatial dimension and therefore can help to explain geographical differences. First, it can help to explain the *differences between spaces*, i.e. why one technology develops in one region but not in another. This is because each ‘space’ (e.g. a city or region) develops a unique set of so-called ‘relational assets’, which are “social relations, conventions and endowments in a particular locality or region that are slow to reproduce and may be impossible to imitate” (Raven et al., 2012: 70). Second, a multi-scalar MLP can help to explain the *interactions across*, i.e. should include spatial factors, such as proximity of innovation activities, spatial differences across places, and reach across levels (cf. Coenen et al., 2012). This could also enable to account for (uneven) power relations that influence transitions across regions (Bohnsack et al., 2015a, 2015b; Smith and Raven, 2012). Understanding the *differences across space* and the *interactions between* them can be vital for sustainability transitions “because it would provide insight into how and where niches may be upscaled and come to shape regime-shifts” (Raven et al., 2012: 71).

The differences and interactions across spaces are a result of the regions’ foci on different technology and their vested interest in these technologies due to relational assets. These technologies are then protected in “strategic niches” within these regions (Kemp et al., 1998). Niches are nurturing spaces for technologies. The niche, defined as a “protective space for path-breaking innovations” (Smith and Raven, 2012: 1025), creates a space in which a technology is shielded from market selection mechanisms (Pinkse et al., 2014). In the niche, actors can learn, experiment and scale up (Slayton and Spinardi, 2016). While governments or firms can create niches, for instance through experiments, pilot projects or subsidies, their trajectory cannot be controlled (Geels and Schot, 2007; Smith and Raven, 2012; Pinkse et al., 2014). The context of niches ranges from local applications to geographic areas such as cities or regions to entire jurisdictions and depends on where the advantages of the technologies could be valued (Kemp et al., 1998: 187).

However, the addition of the spatial dimension as discussed above requires expanding the conceptualization of the protected space. That is because regions often specialize on certain technologies – i.e. they differ across space (Bai et al., 2004). What is more, regions protect the local respective specializations, for instance directly through trade barriers or indirectly through technological standards. While the niche in the MLP so far has been regarded as a room to experiment (Geels, 2002; Geels and Raven, 2006), adding the spatial dimension as discussed above would also add a competitive element, which could result in protection interactions across regions. In the classic MLP, competition occurs within the niche between technologies (cf. Bakker et al., 2012). In the multi-scalar MLP, competition occurs within *and* across niches, i.e. between national, sub-national level or local spaces, and can lead to competitive activities between actors. This is to say that actors in a ‘local’ niche would try to design the niche in a way that local interests are maintained, for instance via standards – a case in point is the protection of a specific ship design via tax regulation in the UK, which favoured local shipyards (Geels, 2002) – or trade barriers. Table 1 below summarizes the difference between the niche in the MLP and the local niche in the multi-scalar MLP.

Next to its clear practical relevance, understanding the dynamics in and between local niches is also theoretically important since the geography of transition needs to address “social-spatial embedding, multi-scalarity and issues of power” (Truffer et al., 2015: 64). Attempts to conceptualize these dynamics have already been made on an international level (Bohnsack et al., 2015a, 2015b), yet the sub-national level has received less attention but would be important to understand, or as Raven et al. put it: “A striking observation would be the focus on regional differentiation within national boundaries.” (Raven et al.,

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