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Innovation at the middle of the pyramid: State policy, market segmentation, and the Chinese automotive sector

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ARTICLE INFO	A B S T R A C T
Keywords: China Frugal innovation Cost innovation Automotive Industrial upgrading Base of the pyramid Industrial policy	While emerging markets are widely seen as a favorable environment for cost innovation, the existing literature has difficulty explaining why in some cases cost innovation provides a solid foundation for upgrading but in other cases it does not. This paper focuses on how different market segments (low-, medium-, and high-end) within an industrial sector each play a unique role in the development process, and how the absence of any segment may inhibit the upward trajectory of emerging market firms. The low-end offers new entrants "natural" protection from foreign firms with higher cost structures, and allows local firms to cultivate their capabilities, engage in cost innovation, and gain scale. The high-end is dominated by foreign firms that have better access to human resources, capital and technology. The middle segment is a crucial pathway for the development of new ways so as to achieve the exact ratio of price and quality demanded by "value for money" customers. Because market segmentation is shaped by a range of state policies that affect both the demand- and the supply-side, the state may inadvertently restrict the growth of segments that contribute crucial ingredients to the process of capability-building, and adversely affect upgrading outcomes.

1. Introduction

Innovation at the middle of the global economic pyramid is widely believed to provide emerging market firms with an initial step on the path towards global competitiveness (Gadiesh et al., 2007; Zeng and Williamson, 2007; Jaiswal, 2008; Govindarajan and Ramamurti, 2011). The innovations that are required are not as radical as at the base of the pyramid, but consumer demand is sufficiently unique to provide emerging market firms with an advantage over the global firms that dominate at the top of the pyramid. By altering processes, business models, and/or products, these new entrants are able to offer "good enough" quality at a low price. It is assumed that over time, sustained improvements will enable these firms to compete with global firms in successively more demanding market segments, and in some cases they may be able to "disrupt" established markets (Hart and Christensen, 2002; Christensen and Raynor, 2003).

While emerging markets are widely seen as a favorable environment for cost innovation, a term that is broadly defined to include any innovation that improves the price/performance ratio, these opportunities do not always translate into sustained growth. The global auto industry provides a range of examples. Toyota and Hyundai are classic examples of cost innovation that ultimately disrupted global markets (Christensen, 1997: 190). The Tata Nano is a successful product innovation that has had limited impact on global markets (Ray and Ray, 2011).

The empirical focus of this paper is the Chinese auto industry. Although China was widely expected to be fertile ground for new lowcost competitors, the outcome has been decidedly mixed: Chinese firms have struggled to compete with global firms in passenger vehicles, while commercial vehicles and components firms have successfully used cost innovation to compete with global firms. Why, despite similar opportunities, does cost innovation provide a foundation for successful upgrading in some sectors but not others?

The existing literature helps to explain how emerging market firms employ cost innovation to succeed in resource-constrained market segments, but has difficulty explaining the upgrading of capabilities that enables movement between market segments. The literature on innovation in resource-constrained markets looks to the firm-level to explain variation in outcomes within low-end market segments. Entrepreneurial new entrants overcome the lack of resources that is characteristic of the base of the pyramid and solve previously insoluble problems through improvisation, flexibility, and radical innovation (Prahalad and Mashelkar, 2010; Ray and Ray, 2011; Hang et al., 2015). Given the immense size of these market segments, there is no shortage of opportunity for cost innovation, and the burden is on firms to respond entrepreneurially (Prahalad and Hart, 2002). Why this sort of

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innovation sometimes flourishes and other times does not is not readily apparent.

The literature relating to disruptive innovation explains how global incumbents are restricted by their resource allocation incentives (Christensen and Raynor, 2003), their organizational competencies (Henderson, 2006), and/or their failure to understand the impact of new technologies in these low-end market segments (Schmidt and Druehl, 2008), but provides less insight into how new entrants develop the sustaining technologies that allow them to move upmarket (Christensen, 1997).

Building on earlier work by Brandt and Thun (2010, 2016), this paper focuses on how different market segments (low-, medium-, and high-end) within an industrial sector each play a unique role in the development process, and how the absence of any segment may inhibit the upward trajectory of emerging market firms. The low-end offers new entrants "natural" protection from foreign firms with higher cost structures, and allows local firms to cultivate their capabilities, engage in cost innovation, and gain scale. The high-end is dominated by foreign firms that have better access to human resources, capital and technology. The middle segment is a crucial pathway for the development of new capabilities because it forces foreign and local firms to combine and re-combine their respective resources in new ways so as to achieve the exact ratio of price and quality demanded by "value for money" customers. Because market segmentation is shaped by a range of state policies that affect both the demand- and the supply-side, the state may inadvertently restrict the growth of segments that contribute crucial ingredients to the process of capability-building, and adversely affect upgrading outcomes.

The next section reviews the literature on cost innovation and development in emerging markets, and introduces a framework for understanding the interaction of policy, market segmentation, and cost innovation. After a discussion of the case study methodology in Section 3, the data on passenger vehicle original equipment manufacturers (OEMs), commercial vehicle OEMs, and auto component firms in China is presented in Section 4. The variation in outcome is discussed in Section 5, and the implications for practice, policy, and theory are considered.

2. Innovation in resource-constrained markets

The base of the pyramid (defined as daily income levels of less than US \$5) is characterized by extreme and subsistence poverty, often in remote areas that are constrained by institutional voids. "Frugal innovation" is a response to the extreme challenges of this environment, and requires firm to radically re-think business models, products, and services (London and Hart, 2004; Prahalad, 2009; Rangan et al., 2011; Vadakkepat et al., 2015). The middle of the pyramid is relatively poor by developed economy standards, but the consumers at this level are distinctly middle class by global standards (defined as daily incomes between US\$10 and 100, see Brandi and Buge, 2014). This segment of the global economic pyramid demands high levels of "value for money": the same products as developed markets (e.g. cars, washing machines, mobile phones, etc.), but at lower price points. Firms lower costs through "good enough" innovation (i.e. tailoring functionality to more exactly meet consumers demand, see Gadiesh et al., 2007) or through "cost innovation" (i.e. achieving the same functionality at a lower costs by exploiting cost advantages in manufacturing, design, and/or administration, see Zeng and Williamson, 2007). The top of the pyramid is the global elite, and while this segment may demand cost improvements, consumers are unwilling to sacrifice quality and functionality below a certain level.

While the "fortune" at the base of the pyramid has received much attention (Prahalad, 2009), the middle of the pyramid is crucial both because of the economic opportunity—over the last two decades, economic growth has increased the size of the middle class in emerging markets by more than half a billion people (Brandi and Buge, 2014:

7)—and because of its crucial role as a pathway of upgrading for emerging market firms.

2.1. Firms

The literature on innovation in resource-constrained markets identifies numerous firm-level resources (e.g. assets, capabilities, knowledge, etc.) that might be sources of competitive advantage for local firms in emerging markets, allowing the highly price sensitive segments to become "crucibles" for innovation (Wan et al., 2015: 95).

First, the firm must have the technical expertise and the industry experience to detect market opportunities. Hanget al. (2015: 90) focus on the process of entrepreneurial opportunity, and find that low-end innovations are usually predicated on the unmet needs of certain customer segments, and require a firm to engage in "an experimental process that calls for improvisation in response to unexpected constraints." The firm must understand the market, and then be able to respond to it.

Second, the innovation processes within a firm are crucial. R&D processes can be used to alter the cost of products. Wan et al. (2015) argue that the industrialization of R&D activities (i.e. dividing activities into small tasks and developing an assembly line approach) and parallel processing (i.e. allowing sequential steps to happen simultaneously) are crucial resources that allow Chinese firms to engage in cost innovation. Design changes (e.g. miniaturization, simplification, etc.) can be used to alter the price/performance ratio (Yu and Hang, 2011). Changes to a product architecture that increase the degree of modularity have the potential to lower coordination costs within a firm and transaction costs between firms (Fujimoto, 2012). Modularity can lead to cost savings through parallel processing in design activities and more rapid "launchtest-improve" cycles (Ray and Ray, 2011; Wan et al., 2015).

A third resource that can be crucial is the capacity for learning. Particularly in the case of relatively mature mechanical products, where much of the knowledge is tacit, the role of experienced engineers within the firm is crucial in assimilating technologies from outside the firm, screening design ideas from the existing knowledge pool, identifying and solving problems that emerge, and coming up with new combinations that lower costs without sacrificing quality (Chen, 2009).

Highly price sensitive market segments also provide local firms with a degree of "natural" protection from global incumbents. This may be a result of a rational process of internal resource allocation on the part of the incumbents: when faced with new competitors in the low-end, the incumbents are "held captive by their [high-margin] customers" and direct investments towards existing technologies that are valued by the mainstream market segments (Christensen, 1997; Christensen and Raynor, 2003). It may also reflect a lack of necessary capabilities. The global incumbents have built knowledge and capabilities around the set of technologies demanded by global high-end segments (i.e. their home markets), and these existing resources shape the embedded organizational competencies and the firm's capacity (and lack thereof) to respond to challenges from new technology (Nelson and Winter, 1982; Henderson and Clark, 1990; Henderson, 2006).

2.2. Market segmentation

A firm's internal capacity for innovation is heavily shaped by the markets within which it competes, and as a result, the dynamics of innovation will vary by market segment. In each segment, there is a subtle interplay between the demand side (e.g. relative incomes, demographics, etc.) and the capabilities that are created on the supply side (Kline and Rosenberg, 1986: 275).

The demand side provides the incentive for innovation, as "new goods and new techniques are unlikely to appear, and to the enter the life of society without pre-existing—albeit possibly only latent—demand" (Smookler as cited in Fontana and Guerzoni, 2008). Demand characteristics shape the design choices that are made during the

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