Market performance implications of modularization: Evidence from global auto firms operating in China

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A B S T R A C T

Auto firms play an increasingly important role in national economies. However, their internationalization strategies, especially the trend towards modularization has been underexplored in the international business literature. Drawing on the resource based theory, we develop hypotheses on the link between modularization and market performance. Analyzing a sample of 262 auto parts suppliers in China, the study shows the positive influence of modularization on firm performance and the moderating role of knowledge sharing tools and physical proximity in this relationship. In addition, these relationships are channelled by firms’ strategic actions to maintain superior business performance against competitors (firm positional advantage).

1. Introduction

Modularization (MD) in the auto industry is relatively new when compared to its application in other industrial areas. It is regarded as the third revolution in the history of the auto industry after Henry Ford’s assembly line production system and Toyota’s JIT (just in time) management (Collins, Bechler, & Pires, 1997; Sako, 2003). Modularization brought a major reorganization to the automotive parts supplier industry by realizing a firm’s strategic positional advantage through mass customization (Pine, 1993; Pine, Bart, & Andrew, 1993; Ro, Liker, & Fixson, 2007). While academic interest in this area has experienced significant growth in recent years, few empirical studies have been conducted because it is a difficult task to operationalize the multi-faceted, complex modularization (Fixson, 2003; Hoetker, 2006; Sako, 2003; Salvador, 2007).

Modularization refers to the degree to which the production system is decomposable into modules, which then can be assembled as one unit. It is a strategy for organizing complex products and processes and is applied to both technological and organizational design. Product modularity involves the assembly of final products from a number of predetermined and interchangeable modules (Kotabe, Parente, & Murray, 2007; Langlois, 2002; Sako, 2003). Modularization helps firms to upgrade components with newer and better variations from suppliers as well as to provide opportunities for mixing and matching of components in a modular product design (Hsuan, 1999).

Although modularization has become a global trend in the auto industry, studies show that different characteristics of modularization are exhibited in various international automobile markets (Doran, 2003; Doran, Hill, Hwang, & Jacob, 2007; Kotabe et al., 2007; Lin, Zhou, Shi, & Ma, 2009; Ro et al., 2007; Takeishi & Fujimoto, 2001). China (which is the largest market and automobile manufacturing country since 2009) has a different industrial structure and automobile policy from that of other countries (role of state-owned enterprises and performance requirements such as joint ventures). Despite the importance and uniqueness of the Chinese auto market, only a few scholarly works have been conducted touching on the concept of modularization (Lin et al., 2009; Liu, Sui, & Gu, 2008; Zhu & Zhang, 2005). Existing studies on China tend to focus on isolated case studies (Lin et al., 2009; Wang, 2008).

Although some research has been conducted on modularization in various industries in different countries, existing literature has focused on examining specific modules (Fixson, Ro, & Liker, 2005), or studied modularization in the context of technological upgrading and global value chain integration (Liu et al., 2008). Prior empirical studies also show that the impact of modularization on firm performance is still inconclusive. While some studies show the positive impact of modularization on performance (Kotabe et al., 2007; Parente & Gu, 2005), other studies highlight the risks of value migration and erosion of component specific knowledge which is critical for long term competitiveness (Jacobides, Macduffie, & Tae, 2016). The findings on the role of certain contingency factors on the relationship between modularization and performance also show inconsistent and contradictory results. Some studies show the positive effects of knowledge sharing tools (Cabigiosu, Zirpoli, & Camuffo, 2013; Kotabe, Martin, & Domoto, 2003).
and physical proximity (Kotabe et al., 2003) on the relationship between modularization and firm performance while other studies show their effects to be negative or marginally significant (Fixson et al., 2005; Parente & Gu, 2005; Tiwana, 2008). This study attempts to fill this gap with an empirical analysis of modularization on the automobile industry in China. Furthermore, prior studies have examined modularization as one variable (construct) (Parente & Gu, 2005) and have not analyzed it in terms of its components (product architecture, tacit knowledge isolation, supply chain integration). This study provides an integrative framework by examining the various factors (including moderators and mediators) simultaneously. The study shows modularization as an important framework to examine the strategic vision of automakers in China in their attempt to create dynamic capabilities, i.e., the integration of resources and competencies in a way that allows suppliers to deliver value producing products and services that satisfy customer requirements.

We propose that, in order to enhance their competitive advantage, firms have to either develop some specific ownership advantages or undertake specific strategic actions in response to the institutional characteristics of the emerging economy. We first highlight that the advantages of firms are not just limited to firm capabilities (product architecture, technology/know-how) but also relational assets achieved through supply chain integration. Second, possession of such advantages through modularization alone is not sufficient to explain automobile firms’ market performance in China. Instead, such relationships are moderated by knowledge sharing tools and awareness of the importance of physical proximity to suppliers. In addition, these relationships are channeled by firms’ strategic actions to maintain superior business performance against competitors (strategic positional advantage). A firm’s strategic positional advantage resides in its capability of creating superior value to customers (differentiation) or capability of offering the same value at a lower cost to consumers (cost advantage) (Porter, 1998).

The resource based view (RBV) offers opportunities to investigate the relationship between modularization and firm performance. The theory suggests that firms outperform their competitors by utilizing strategic assets and capabilities. They extract value from resources that are not fully owned or controlled by its internal organization. Firms seek to achieve synergies by employing complementary resources.

Overall, this article contributes to the literature in several ways. First, the study relates modularization (and its components) to firm performance and tests the mediating and moderating factors affecting the modularization-performance relationship. Secondly, the study contributes to fill the theoretical gap on capacity building and sourcing strategies in the context of modular production by extending the research on modularity by Schilling (2000), Parente and Gu (2000), and Kotabe et al. (2007). Thirdly, the study contributes to the literature by examining the implications of modularization on firm performance in the Chinese automobile industry thus extending the geographical reach of empirical research on an important emerging economy.

The study is based on a survey of module suppliers in China. Three of the largest automakers in the Chinese market (FAW Group, FAW Jilin auto and Daihatsu) distributed the questionnaire to their module suppliers, gathered the responses and forwarded them to the researchers.

The paper is organized as follows: We develop literature review and a conceptual framework. We then describe methodology and finally, we present our findings.

The following terms are used synonymously in this study. Terms “firm performance”, “relative firm performance”, “market performance” are synonymously used. “Positional advantage”, “strategic positional advantage” “firm relative positional advantage” as well as “Knowledge management tools” or “knowledge sharing tools” are synonymously used in this study.

2. Literature review

The literature on modularization has grown in recent years and can be classified into three major categories. The first focuses on the concept and theory of modularization, such as the factors that pull to or push firms away from increasing modularization (Baldwin & Kim, 2000; Langlois, 2002; Schilling, 2000) as well as its application in a wide range of industries such as air conditioning (Furlan, Cabiguisou, & Camuﬀo, 2014), textiles (Castro, Remmerswaal, & Reuter, 2003) and home appliances (Worren, Moore, & Cardona, 2008).

The second approach addresses the relationship between modularization and other variables such as product performance or product development, organizational coordination/ﬂexibility, information sharing and innovation (Kotabe et al., 2007; Lao, Yam, & Tang, 2010; Liu, Xie, & Wu, 2015; Sanchez, 1995; Sanchez & Mahoney, 1996; Squire, Cousins, Lawson, & Brown, 2009; Tiwana, 2008).

The third category of research investigates the impact of modularization on supply chain design, efﬁciency and coordination (Chiu & Okudan, 2014; Fixson, 2003; Howard & Squire, 2007; Lao et al., 2010).

Modularity is described in different ways ranging from modularity as a design property of product architecture, to an ongoing learning process about how best to manage interdependencies across and within modules. It is also sometimes described as a frame that delineates the changing boundaries of the firm in terms of allocating tasks, investment and risk with suppliers (MacDuffie, 2013).

Modularity as a strategy is used for different functional purposes: modularity in design, production and use. Modularity in design entails separating a product system into relatively independent components and specifying the interfaces of the product system across interacting components (Sanchez, 1995; Schilling, 2000). Modularity in production is the process of building complex products from smaller subsystems that can be designed independently and yet function as a whole (Baldwin & Clark, 1997; Doran, 2003). Modularity in use provides opportunities for high product variety by offering consumers the choice to “mix and match” options that meets their taste. This paper focuses on modularity in production. Research on modularity in production focuses on the efficiency and flexibility gains stemming from the decoupling of the main and module flows.

Inconsistent with the extant literature, Tiwana (2008) ﬁnds that modularity lowers the need for knowledge sharing in the software industry. Some studies also show that the standards inherent in modularity take too many degrees of freedom from engineers and would force them to back away from the frontier of what is technologically possible (Christenson & Raynor, 2003; Jacobides et al., 2016). They state that disaggregation of the value chain through modularization could undermine automakers responsibility for regulatory compliance, brand distinctiveness and valuable interactions with consumers and pose a risk in value migration. Zirpoli and Becker (2011) identify potential problems that arise from outsourcing the development of complex products: erosion of component-speciﬁc knowledge due to lack of learning by doing. They state that this situation will lead to the loss of the capability to take performance trade-offs regarding performance of the product as a whole (Table 1).

3. Theoretical base

A number of theories have been developed to explain how firms internationalize. Transaction cost analysis suggests that ﬁrms internationalize in order to reduce transaction costs (Williamson, 1975). The basic premise underlying transaction cost is that ﬁrms tend to organize international operations through hierarchical organizations due to market imperfections and asset speciﬁcity (Brouthers, Brouthers, & Werner, 2003). However, Williamson (1975) observes that vertical integration is not necessary insofar as complex contracts between parties can be written and enforced. Modularization enables ﬁrms to link resources and capabilities of other ﬁrms together at a lower cost. It also
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