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Joint ventures and technology adoption: A Chinese industrial policy that backfired

Sabrina T. Howell¹

NYU Stern, United States

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ABSTRACT

To spur technology transfer, emerging market policymakers often require foreign firms to form joint ventures (JVs) with domestic firms. Through knowledge spillovers, JVs may reduce technology acquisition costs for domestic firms. Yet domestic firm rents from JVs could discourage innovation through a cannibalization effect. Which force dominates is an empirical question. I address it with novel data on China's auto sector. In response to fuel economy standards requiring firms to upgrade technology or sacrifice quality, firms with JVs reduced quality and price relative to their counterparts. Consistent with cannibalization, firms with JVs drive the negative effect.

China's policy of requiring all foreign car makers to form local joint ventures is "like opium" for Chinese firms and is failing to foster world-class indigenous automakers, a former minister was quoted as saying.
– Reuters (2012) quoting He Guangyan, Former Minister of Machinery & Industry.

1. Introduction

Important technologies have historically originated in developed countries and trickled down to lagging countries (Comin and Hobijn, 2004). To hasten this process, many emerging market governments encourage technology transfer from advanced foreign firms to backward local firms. I explore how an industrial policy designed to induce technology transfer perversely disincentivized technology acquisition. To my knowledge, this paper is the first quasi-experimental evaluation of an industrial policy's effect on firm technology acquisition in an emerging market.

Developing countries often require foreign entrants to form joint

ventures (JVs) with domestic firms. JVs are supposed to increase domestic partners' access to foreign R&D and manufacturing processes, reducing the cost of technology acquisition. JVs have a second important feature: the domestic partner receives a share of foreign brand profits. I show how these two features affect the domestic partner's innovation incentives in a stylized model. First, in an adaptation of the Gilbert and Newbery (1982) efficiency effect, the JV reduces the cost of technology acquisition. Pushing in the opposite direction is a cannibalization channel, similar in spirit to the Arrow (1962) replacement effect, which deters monopolists from innovating. The threat of cannibalizing rents from foreign partner sales discourages the domestic firm from investing in substitutes to its partner's products. This can be interpreted as an economic mechanism explaining why domestic firms with JVs might have lower absorptive capacities than their counterparts without JVs. These countervailing forces exist independently of the foreign partner's technology transfer behavior.

How JVs impact innovation is relevant to policy in many countries; for example, Brazil, Mexico, India, Nigeria, and Malaysia have employed JV mandates.² As a case study, I focus on China's automotive

E-mail address: sabrina.howell@nyu.edu.

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² See UNCTAD (2003) and Blomström et al. (2000).

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industrial policy, which has called for globally competitive, high-quality Chinese firms since the late 1970s.³ The policy's cornerstone is a mandate that foreign entrants produce via JVs with domestic firms. High tariffs precluded large-scale imports, so foreign brands must establish JVs in order to access China's market.

The following example illustrates China's JV structure. Ford manufactures in China through two JVs. The larger is with Chang'an Automobile group. The Chang'an Ford JV plants produce only Ford vehicles. Chang'an helped finance the JV plants and receives fifty percent of their profits. Chang'an produces its own brands at other plants without Ford involvement. Foreign brands like Ford, Volkswagen, and Toyota have consistently dominated China's market in quality, price, and market share. Chinese firm exports to developed markets have been negligible. The failure of China's auto industrial policy to produce brands that can compete even domestically is a puzzle that goes beyond the inefficiencies associated with state ownership. In this paper, I evaluate whether the JV mandate achieved the explicit government objective of technology acquisition and upgrading among domestic firms.

China's sudden and stringent 2009 fuel economy standards provide plausibly exogenous variation in the fixed cost of technology upgrading.⁴ The standards compelled automakers to incur technology upgrading costs if they wished to produce high quality vehicles, which tend to be heavy and powerful. That is, an automaker facing fuel economy standards can either augment fuel efficiency technologies or reduce quality. The fuel economy policy imposed a fixed cost disadvantage on domestic firms because foreign firms (e.g. Ford), which already faced fuel economy standards elsewhere, incurred only the variable cost of including their efficiency technologies in local production.

I use a difference-in-differences design with novel, reliable, comprehensive model-level sales and characteristics data for the Chinese auto market between 1999 and 2013. To proxy for quality, I use four product attributes: torque (force the engine can exert, or turning power), price, weight, and the power-to-weight ratio (closely related to acceleration). These are well-established as measures of quality in the automotive sector. Product attributes offer an alternative to the conventional measures used in the literature, such as accounting-based productivity functions, R&D investment, and patents. These are more opaque measures, only distantly connected to the firm's actual products. More importantly, they are of little use in China, in part due to different patenting and data collection cultures.

While foreign firms continued on an upward trajectory, China's standards led domestic firms to reduce quality and price, without gaining market share. Variation is within firm, and foreign firms are treated as the "control" in most specifications. I assume foreign firm technology transfer behavior did not change immediately around the policy. Relative to foreign firms, the policy reduced domestic model price by 15 percent, torque by 11 percent, weight by 5 percent, and power-to-weight by 6.5 percent. I confirm the main result in a triple-differences design exploiting the standards' staged implementation in 2008 and 2009 for new and continuing models. Robustness tests, including placebo, alternative time spans around the policy, and varying fixed effects provide further confirmation. I also demonstrate pre-policy parallel trends across firm types.

The negative effect is strongest for firms with JVs. It is present but smaller for state-owned enterprises (SOEs) without JVs, and insignificant for private firms. Although few firms are SOEs without JVs or private with JVs, I establish significance across effects in specifications that interact the policy with firm status. The policy's effect is 16–18 percent larger among firms with JVs than among SOEs. This analysis

assumes that changes in model attributes across domestic firms with and without JVs would have been the same after relative to before the change, had the policy not occurred.

If a cannibalization threat disincentivizes innovation, the effect should be larger among domestic firms that compete more intensively with their partner. This concept is similar to the diversion ratio in merger analysis of differentiated products, as in Shapiro (1996). Indeed, I show that the policy had much stronger negative effects on domestic firms that operated in similar price segments or vehicle classes as their foreign JV partners prior to the policy. In sum, the negative effect of increasing own quality on the share of JV profits appears to outweigh any advantage from knowledge spillovers.

The JV mandate and the fuel economy policy were successful in two senses: foreign firms brought new technology to China, and fuel efficiency improved. However, *both* policies explicitly aimed to increase technology upgrading among domestic firms. I find that both had precisely the opposite effect. This contrasts with the government's intentions. My findings are consistent with the literature documenting that (a) private firms are more productive than SOEs in China; and (b) JVs are negatively correlated with technology diffusion.⁵ JVs can lead domestic firms down the manufacturing quality ladder, helping to reconcile FDI's positive role in the endogenous growth literature with mixed empirical findings at the country level.⁶

This paper argues that the JV policy "failed" *only* from the perspective of the government's explicit goals that the JV mandate encourage domestic firm innovation. I do not address the JV mandate's broader welfare effects, including on employment, brand variety, and government revenue. I also cannot assess whether the post-fuel economy policy decision to go down-market was profit maximizing. Further, my analysis addresses short term responses to a technology cost shock. In the longer term, domestic Chinese firms may reach the global technology frontier; my results suggest these will likely be private firms without JVs. Finally, my empirical results may not generalize to voluntary JVs or those in which partners have similar technical capacity. However, the cannibalization channel that I propose may exist in JVs more broadly, and my results do indicate the difficulty of contracting knowledge spillovers.

Despite these limitations, this paper contributes to our understanding of government's mediating role in technology diffusion, which is central to economic development (Young, 1991; Lucas, 1993). A story in which JVs lead domestic firms *down* the manufacturing quality ladder helps to reconcile FDI's positive role in the endogenous growth literature with mixed empirical findings at the country level, where industrial policy regulates FDI.⁷ More broadly, my results speak to a debate about post-World War II growth. New growth theory advocates trade and investment openness to close technology gaps (Coe and Helpman, 1995; Baldwin, 1969). Conversely, new institutional economists attribute the success of East Asian "Tigers" to government direction (Rodrik et al., 2004; Amsden (1991)). In my setting, the most innovative firms are the least touched by industrial policy.

I also contribute to the literature about JVs, which has found both positive and negative effects on participating firm outcomes (Lyles and Salk, 1996; Inkpen and Crossan, 1995). The literature on FDI in China has not addressed domestic partner learning (Lin et al., 2009; Nam, 2011; Du et al., 2011). In developed country context, research has focused on the potential for joint ventures, particularly those focused on

⁵ On (a), see Lin et al. (1998), Allen et al. (2005), Khandelwal et al. (2013), Chen et al. (2015), and Fang et al. (2015). On (b), see Ramachandran (1993), and Moran (2002). However, other studies find evidence of positive spillovers from JVs, like Dimelis and Louris (2002) and Javorcik (2004).

⁶ See Bloom et al. (2016) and Aitken and Harrison (1999). Key theoretical work includes Bardhan (1971), Romer (1993), and Melitz (2005). Related to this paper is Müller and Schnitzer's (2006) theoretical model of technology transfer in international JVs.

⁷ On industrial policy broadly, see Grossman and Helpman (1994), Nunn and Trefler (2010), and Arnold and Javorcik (2009). For the mixed results on FDI, Hale and Long (2011) for a review.

³ See, for example, State Council.

⁴ China imposed fuel economy standards in phases from 2005 to 2009, but binding standards came into force in 2009 (see Section 5).

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