Unraveling the Mechanisms of Strategic Adaptation: A Longitudinal Study of Chinese High-Tech Firms 2000-2003

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ABSTRACT

Placed in the context of China’s transitional economy, this paper studies the role of different economic, institutional and managerial factors in accelerating or hindering high-technology firms’ pace of strategic adaptation toward a higher level of technology orientation. Drawing on a unique longitudinal data of firms in the Zhongguancun Science Park (China’s Silicon Valley) from 2000 to 2003, we find that (1) complementary assets facilitate strategic adaptation; (2) firms open to global influence exhibit higher rates of strategic adaptation; (3) managerial background matter: there is a negative effect of CEO tenure and a positive effect of the CEO’s educational level on adaptation. Overall, this study extends the strategy literature on firm-level adaptation to the context of transitional economies and thus contributes to our understanding of strategic adaptation in the midst of a gradual, continuous and large-scale environmental change.

Key Words:

Complementary assets, openness, technological adaptation
Motivation

Since the 1980s, China has embarked on a path of economic transformation that has led to profound changes in business organizations. On the one hand, firms once under the aegis of the command economy now engage in market transactions. They face the challenge to transform themselves in order to adapt to the new institutional environment (Walder, 1992; Tan and Tan, 2005). Thus, it has become essential for Chinese firms to develop building blocks of competitive advantages—capabilities in management, marketing and, especially for hi-tech firms, innovation. Still, economic transition remains a work in progress. The economic influence of the Chinese state and local governments, the persistence of a multiplicity of ownership forms and ambiguous ownership, and other institutional hangovers from the planned economy and clientele-based social relations remain ubiquitous (Naughton 1995; Nee 1992). Reform in China has also progressed slowly, creating an environment in which firms experiencing less pressure of “being selected out” were able to learn to do new things slowly (Kiester 2004). The result is a coexistence of firms with different types of behavior—those developing their capabilities rapidly to resemble and compete with firms in the West, those moving more gradually toward a market orientation, and those sticking to the old ways and resisting change. Thus, China presents an interesting setting for studying the dual processes of organizational level adaptation and population level selection in the midst of environmental change that is large-scale, gradual, and enduring (Levinthal, 1997).

To date, most research attributes China’s economic growth to an increasing role of market transactions and a shift in industrial ownership and property rights away from the state sector. These changes are achieved gradually by “growing out of plan” (Naughton,
1996), grass root invention, and dissemination of the “hybrid form.” The latter refers to collective enterprises which are neither public nor private (Nee, 1992; Walder, 1995). At the firm level, many research studies examine firm performance across ownership types (e.g., Park, Li & Tse 2000; Tan & Litschert 1994; Tan and Tan 2005). Relatively few studies, however, have focused on the development of capabilities within Chinese firms and their subsequent adaptation to a business environment undergoing dramatic changes.

Here we explore firms in the hi-tech sector and their adaptation in developing technological and innovation capabilities. In developed economies, continual investment in R&D and innovation capability has become a norm for firms in high-technology markets, since these markets are characterized by short product life-cycles and a high rate of new product introductions incorporating newer generations of technology (Penrose, 1959; Dougherty and Hardy, 1996; Henderson and Cockburn, 1994). In contrast, in many developing economies R&D constitutes a rather novel aspect of business even for firms in the hi-tech sector. In the case of China, under the planned economy, research and development has long been a government rather than a firm function. Over 90% research funding had been provided by the government and 70-80% researchers had been based in research institutes and universities. Only the late 90s was it widely recognized that R&D should be located in the firm rather than the government and, more important, the success of the firm will depend on its capacity to innovate and sustain technological progress. As a consequence, even though firms in the hi-tech parks have been subject to increasing pressure to develop technological and innovative capabilities since the mid 1990s, the capabilities remain underdeveloped and the pace of such technological development varies greatly across firms. This paper seeks to shed light on our understanding of the underlying
economic, institutional and managerial factors that account for the variation in path of
development and speed with which strategic change occurs among the Chinese hi-tech
firms.

The Case of Legend Computer¹

To understand the economic, institutional and managerial factors that account for
the variation in pace of technological adaptation, it is essential to trace the history of
Chinese hi-tech firms. At the time when hi-tech firms emerged in China in the 1980s, they
had neither access to capital nor to superior technological and marketing knowledge. As a
result, many companies in hi-tech parks specialized in selling electronic products instead
of developing cutting edge technology. Since foreign companies were not allowed to offer
direct product sales and service in China, many Zhongguancun enterprises began as agents
and distributors of these foreign brands and some established nation-wide networks for
sales and service (Wang, 2000). These networks, in turn, created the opportunity for these
companies to establish their own brand name products in the domestic market. For instance,
the Chinese PC manufacturer Legend began in the 1980s by distributing products made by
AST, HP and other foreign brands, and used the accumulated income to manufacture
Legend-branded PCs later on. Legend’s former president and founder, Liu Chuanzhi,
described the trajectory of the company as a 3-stage model of “trade, industry, and
technology,” where the trade phase, according to him, is necessitated by the earlier
institutional environment in China². The company acted as a middleman, acquiring
products from large domestic distributors or state-owned importing companies and selling

¹ Legend Computer changed its name to “Lenovo” in 2002 and in 2004, it acquired IBM’s PC unit.
² Liu Chuanzhi: Lecture at the 2002 Academy of Management in Denver.
them to government agencies and large state-owned enterprises. Legend even sold non-computer products such as TV sets and electronic watches. At that time, China had very little domestic PC manufacturing capabilities and almost all the PCs were imported. Yet foreign manufacturers had to sell their products through a complex importer-distributor arrangement where the import-export business was dominated by state-owned monopolies. Thus, these first generation hi-tech companies rose and grew by filling the gap between the domestic market demands and foreign supplies. As illustrated in the case of Legend, the trade phase lays foundation for the industry and technology phase by allowing the firm to build up necessary experience and expertise.

Legend’s experience is not unique among Chinese high technology firms. Firms like Stone and Hanlinhui also began with trade and distribution and later developed technological capabilities. Earnings from trade made it possible for firms to accumulate a capital stock necessary for product development given the insufficiency of financial institutions in China. Experience in trade also taught firms how to distribute and market products, manage and develop human resources from their trading partners, including first class multinational corporations such as HP. These capabilities, while essential to firms competing in the mature product market, were almost nonexistent in enterprises under the planned economy. Learning by trading contributed to distribution and marketing capabilities. Trading eventually led to branding, an intangible asset that is especially valuable when firms ultimately developed their own products. To summarize, Chinese firms like Legend that accumulated significant financial, marketing and knowledge resources from trading and manufacturing may be able to upgrade their technological capabilities in face of an increasingly competitive and globalized market.
Nevertheless, it should be noted that Legend is not a typical State owned enterprise and its 3-stage model of “trade, industry and technology” captures the experience of many of Zhongguancun’s successful high technology firms. In contrast, SOEs in the high technology sector such as Great Wall Computer started with technology but gradually lost its competitive edge due to its lack of distribution and marketing capabilities. In fact, Great Wall Computer was clearly the government favorite in the beginning, having been spun out from the Ministry of Electronics Industry in 1986. Interestingly, the relative sufficiency of resources in Great Wall Computer’s early development and its management of a typical state-owned enterprise have disabled the company to match its competitors’ flexibility and pace of strategic adaptation.

**Hypotheses**

**Economic factors: What constitute complementary assets?**

According to the story of Legend, resources and capabilities accumulated from trading and manufacturing had prepared the firm to enter the technology phase ultimately, with the acquisition of IBM’s PC business as the milestone. In this sense, total sales and accumulated marketing experience in any field serve as complementary assets necessary for firms’ technological development. This is consistent with the growing literature in the strategy field that examines the role of accumulated specialized complementary assets (e.g., reputations, manufacturing capabilities, distribution systems, and service organizations) in facilitating strategic change by amplifying the benefit from a new technology (e.g., Helfat, 1997; Nerkar and Roberts, 2004). Accordingly, firms that possess complementary assets would have the incentive to invest in new technological innovation (Mitchell, 1989 and 1991). In the context of China’s high technology sector, revenue (total sale) and
accumulated market experience constitute the main complementary assets for firms’ development of new technological capabilities.

Revenue and stock of marketing experience differs significantly across firms. As mentioned before, as a complementary asset, marketing experience has often led firms to invest in developing new technological capabilities by enabling firms to maximize their benefits from these opportunities (Teece, 1986; Dutta et al., 1999; Nerkar and Roberts, 2004). In the case of Legend, the fact that the company had become the No.1 PC manufacturer in the domestic market can be attributed to a large extent to the enormous marketing knowledge and experience it had accumulated as a distributor of foreign brands.³ “Legend’s competitive edge lies in an in-depth understanding of the Chinese market and customer needs,” Yang Yuanqing, the current President of the Group commented (Liu, 2000). Following this line of reasoning, firms that had larger stocks of marketing assets from the past were likely to act faster in upgrading their innovation capabilities. Therefore, we propose the following hypotheses:

**Hypothesis1:** Firms with higher revenue were likely to have higher growth rate of R&D activity.

**Hypothesis2:** Firms with larger stock of marketing assets were likely to have higher growth rate of R&D activity.

Beyond economic factors, institutional and managerial factors also shape firms’ strategic adaptation. The formulation of strategy per se reflects the incremental strategic change undertaken by an organization to adapt to a changing environment. From the perspective of emerging strategy, strategy formulation is the interplay between a dynamic environment and organizational momentum, with leadership mediating between the two

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³ In December 2004, Legend signed a definitive agreement to acquire IBM's PC division with $1.25 billion in cash and equity, which was expected to transform it into the world's number three PC maker.
(Mintzberg, 1976). To put it differently, firms respond to environmental change with strategic change, constrained by bureaucratic momentum and accelerated or dampened by the leadership. Seen in this light, features that contribute to organizational rigidity over time such as size, age, heritage of bureaucracy are likely to impede a firm from adaptation; while features such as high level of openness and visionary leadership that help overcome such rigidity may accelerate firms’ pace of adaptation.

**Institutional factors: government ownership**

Due to the legacy of planned economy, there exists today in China an array of property rights – SOEs, collective, private, JVs, foreign and other. The literature has documented a substantial variation in economic incentives, managerial systems, and government relationships across the different types of ownership structure. In general, state-owned firms lack managerial discretion and incentives compared to their non-state-owned competitors (Luo and Tan, 1998; Luo, Tan, and Shenkar, 1998; Peng, 2003; Peng and Heath, 1996). In an interview, the CFO of Legend, Ms. Ma told the media that “In most state-owned companies, there are no true owners. Nobody is responsible for profit and loss. That is the reason why most state-owned enterprises are producing great losses.” At Legend, however, managers act like owners because, in fact, they are. The company offers generous compensation packages, including stock options for senior managers. Currently, employees hold 35 percent of Legend’s shares. “Legend has mechanisms similar to other private companies, and management operates as if it owns the company,”
Ma explains. "The result is very different. Senior management runs the company as its own baby."

Meanwhile, SOEs are likely to act more conservative and defensive given higher institutional constraints (Tan and Litschert, 1994). Different types of firms experience different resource and regulatory constraints based on their institutional links. In contrast to state firms, non-state firms tend to be much more remote from state and bureaucratic influences because of their weak institutional links to the government, hence were more likely to break away from the traditional model of economic behavior and experience more dramatic changes in strategic adaptation (Zhou et al., 2003). Therefore, we would expect SOEs to exhibit a much slower pace toward technological upgrade compared to their non-state counterparts.

**Hypothesis3a:** Compared with firms where the government is the majority controlling shareholder, firms where the government is the non-majority controlling shareholder were likely to have higher R&D growth.

**Hypothesis3b:** Compared with firms where the government is the majority controlling shareholder, firms where the government is not the controlling shareholder were likely to have higher R&D growth.

**Institutional factors: Affiliation with university / research institutes**

Most of the first generation Zhongguancun firms including Legend are spin-offs of research institutes, mostly CAS-Chinese Academy of Science. The initial intention of the government is to create state research institutions sponsored enterprises devoted to commercialize the technologies developed in those institutions. But represented by Legend, most of these enterprises turned out to be trade-centered companies later, as a response to the market and institutional conditions in the 80s. As the founder of Legend Liu Chuanzhi

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put it, Chinese high tech companies born before 1990 ought to follow a path of “trade, industry and tech” in order to survive and grow. However, with the gradual open up of the IT sector to both domestic private firms and MNCs after China’s entry to WTO, the development of proprietary products or technology becomes imperative under the new market conditions. And university and research institutes sponsored enterprises are better positioned to develop technological capabilities due to their links to the vast technological resources of their parent organizations. Therefore, we propose the following:

**Hypothesis 4a**: Firms affiliated with research institutes were likely to have higher growth rate of R&D activity.

Moreover, as illustrated in the Legend story, early Chinese hi-tech firms had been constrained to develop technological capabilities within the firm due to a lack of financial resources and business knowledge. Once these constraints have been overcome, firms that are affiliated with research institutes would be more likely to devote resources to the development of R&D function and technological capabilities. Therefore, we propose the following:

**Hypothesis 4b**: Affiliation with research institutes moderates the effect of revenue on R&D growth.

**Institutional factors: Openness to global environment**

The institutional theory asserts that the institutional environment where organizations interact with other actors consisting of rules, norms, and roles provides stable institutional bases for their behavior (DiMaggio and Powell 1983; March and Olsen 1984; Meyer and Rowan 1977). As we mentioned earlier, investment in R&D and innovation capability has become a norm for hi-tech firms in developed economies. In contrast, the R&D system in China had been placed under central planning and lasted until
the early 1980s. It comprised of a large number of organizations specialized in particular
industries and in specific stages in the value chain, but with little or no horizontal linkages
and information flows between these functionally specialized actors. Innovation was
primarily initiated by central government ministries and bureaus. Therefore, firms in the
80s had no domestic example to look upon as far as R&D is concerned. Exposure to the
foreign markets and global firms through business transactions, mobility of personnel, or
investors thus provides an effective means in educating firms about R&D. Moreover,
openness and links with foreign resources may enhance firms’ capability to adapt by
subjecting them to more vigorous market forces. "One of the reasons Legend is successful
is that it has a lot of experience working with foreign companies like HP," says Daniel
Suen, manager of Hewlett-Packard’s personal systems group for China, in Beijing5.

We identify four such avenues of openness: export experience, hiring overseas
returnees, having an executive with overseas experience, and foreign ownership. With
more and more Chinese now working in Silicon Valley and other US high-tech centers
choose to return to China, the potential impact on firms’ adaptation toward more market
and technology oriented behavior is huge. To sum up, we expect the degree of openness to
foreign influence to have a positive effect on firms’ pace of adaptation in increasing the
level of innovation activity. Therefore,

Hypothesis 5a: Firms with export experience were more likely to have higher
growth rate of R&D activity.

Hypothesis 5b: Firms that hired employees with overseas experience were likely to
have higher growth rate of R&D activity.

Hypothesis 5c: Firms with executives with overseas experience were likely to have
higher growth rate of R&D activity.

**Hypothesis 5d:** Firms with foreign shareholders were likely to have higher growth rate of R&D activity.

**Managerial factors: The role of managers**

Top executive characteristics and demographic differences have been shown to influence decision making and strategic change (e.g. Finkelstein and Hambrick 1990; Jensen and Zajac, 2004). Managers may play a mediating role in accelerating or dampening firms’ adaptation process by making resource allocation decisions, depending on their cognitive framing of the situation and possibly capabilities. The strategic choices that managers make inherently reflect their backgrounds and experience. In addition, managerial routines and rigidities can be another source of firm’s inertia and rigidity (Christensen 1997, Mitchell 1989). In a nutshell, managers might exacerbate, mitigate, or moderate the effect of experience and hence exert an effect on firms’ dynamic capabilities (Tripsas and Gavetti 2000).

It’s important to note that executives in emerging markets often have to perform many functions that are otherwise played by market mechanisms in developed market economies due to institutional voids. Examples of these functions include obtaining market information, interpreting regulations, enforcing contracts, and settling payments (Zhou et al., 2003). For the 24 managers the authors interviewed during the period of 2001 to 2004, none of them relied heavily on industry marketing statistics. Indeed, reliable statistics does not exist in China, as they concluded. Managers have to rely on their intuition, judgment, and even courage to make critical decisions. As a consequence, managers in emerging markets may play an even more important role in shaping the direction and speed of firms’ adaptation.
Moreover, as Granovetter (1985) pointed out, economic activities are deeply embedded in social relationships. It is especially true for doing business in China. Managers rely heavily on their personal networks for access to information, advice, technology and even customers. In other words, personal networks constitute the pool from which managers can draw resources—financial, political or technological. In the case of Legend, the Academy of Science acts as its social backdrop with its vast pool of human resources, technological expertise and a door-opening reputation, which makes it possible for Legend to develop its own products and build its own brand.

In the current study, we look at two attributes of CEO: education level and tenure. An executive with higher level of education is more likely to recognize the importance of technology and innovation, and hence the strategic imperative for the firm to develop innovation capability timely. Furthermore, the social networks of executives with higher level of education tend to include contacts that are more knowledgeable, more visionary, and occupy higher political and social status. To the extent that ascriptive ties such as schoolmates and classmates take precedence over one’s network in the context of China (Xin and Pierce, 1994), the education level and background of CEO may have an important influence on firm outcome with respect to technological adaptation.

Meanwhile, the tenure of an executive is likely to be negatively associated with firm’s adaptation. The longer an executive is on his/her post, the more routinized and rigid his/her behavior tends to be, and hence a less likelihood for the firm to make strategic change or change in a rapid pace. Thus the following,

**Hypotheses 6a:** The higher the education of its CEO, the higher the growth rate of the firm’s R&D activity.
Hypotheses 6b: The higher the tenure of its CEO, the lower the growth rate of the firm’s R&D activity.

Data and Methods

The empirical setting for this research is the Zhongguancun High-Technology Park in Beijing, known as China’s Silicon Valley. Launched in 1988, Zhongguancun is the first and now the largest Chinese science park, hosting the headquarters of many of China’s leading IT companies, as well as over 6,000 other small- and medium-sized companies in a wide range of high-tech sectors. We test our theories using a longitudinal dataset of Firms in Zhongguancun 1995-2003. The data source is the Zhongguancun Managing Committee that has administered an annual survey to all firms in Zhongguancun since year 1995. We are confident that it’s by far the most comprehensive and accurate data available about Zhongguancun firms.

Our model specifies firms’ pace of technological adaptation as a function of revenue, marketing experience, ownership, openness, and managerial characteristics. We operationalize firms’ pace of technological adaptation as the annual growth rate of R&D personnel. There are two reasons to use R&D personnel as the measure of R&D activities. First, due to confidentiality concerns, Chinese firms are often reluctant to disclose information of R&D spending. Hence data of R&D investment is highly incomplete. Second, R&D personnel is often a more reliable measure of R&D activities in studies on China (Jefferson et al., 2001). We follow the literature (e.g., Helfat, 1997) to construct the variable of stock of marketing expenses, which is operationalized as the accumulated marketing expenses. Besides, total firm revenue in previous year is also employed to indicate the level of complementary assets. To test the effect of different organizational
form, we construct two dummy variables that indicate first, whether the state is the majority controlling shareholder and second, whether the state is the non-majority controlling shareholder. Regarding the main effect and interaction effect of research institute affiliation, we again adopt a dummy variable that specifies whether a firm is owned predominantly by a university or research institute. To capture the effect of openness, we employ four dummy variables. The first variable reflects whether a firm possesses permit to export and hence experience of doing business with foreign institutions through exporting. The second one indicates whether a firm hires employees returning from overseas. The third one is an indication of whether a CEO has overseas studying or work experience. And the last one indicates whether there is foreign ownership in a firm.

To test the effect of managerial characteristics, we employ two variables. The first one is a dummy variable specifying whether a CEO has received graduate degree and the second one measures a CEO’s tenure in the current position.

We control for firms’ current level of technological capabilities by including number of tech employees in the previous year as a control variable. We control for firm size using total sales. We control for economic differences and exogenous industry-wide innovation over time using year effects. We control for economic differences across industries using industry effects. We also control for the age of firms. Table 1 presents summary statistics of all the variables employed in the model.

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Place Table 1 about Here

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Results
The correlations among variables are presented in Table 2. We use a random effects model to account for the panel structure (Table 1). As a robustness check, we run a fixed effects model on those time varying variables and obtained similar but more conservative results. Model (1) is the base model that contains only the control variables. It shows that the rate of adaptation significantly decreases with firm age, indicating an inhibiting role of age on firm’s technological adaptation. The number of total tech employees is also negatively correlated with the rate of technological adaptation, indicating increasing difficulty for firms to further upgrade their technological capabilities rapidly with higher stock of technological capabilities. Firm size, however, has a positive sign which will be further explained later.

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Place Table 2 About Here

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Model (2) provides support to most of our hypotheses. First of all, the stock of marketing assets has a positive effect on the growth rate of technological capabilities: 1 million RMB increase in accumulated marketing assets tends to increase growth rate by 0.0002. This lends support to our hypothesis that marketing experience constitutes important complementary assets for Chinese firms’ technological adaptation characterized by the distinctive path of “trade, industry and technology.” At the same time, total sales remains to be significant in model 2: 1 million RMB increase in total sales tends to increase growth rate by 0.012. The fact that the magnitude of total sales greatly outweighs that of marketing assets implicates that some of the complementary assets such as financial

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6 A fixed effects model does not apply in this case because most of the variables of theoretical interest are time invariant.
and branding which might not be fully captured by marketing assets are picked up by revenue. Together, our results lends credence to the three-stage model of “trade, industry and technology” in showing that in China firms’ development of innovation capability is facilitated rather than hindered by their sizes and stock of marketing experience.

The results provide partial support to our hypotheses about government ownership. Compared with firms where the government is the majority controlling shareholder, firms where the government is the non-majority controlling shareholder exhibit higher growth rate of technological adaptation by 0.25, consistent with hypothesis 3a. However, contrary to hypothesis 3b, firms where the government is not the controlling shareholder do not have higher R&D growth than firms where the government is the majority controlling shareholder. A possible explanation is that non-majority controlling government ownership has enabled many Zhongguancun firms to tap into the resources of government that is crucial for the development of technological capabilities while resisting the negative effect of state ownership by resisting hands-on management from the government. Institutional affiliation with research institute is found to be insignificant in model 2. The effect of openness to global influence on firms’ technological adaptation has been shown but with mixed results. Firstly, Firms with export experience have a higher growth rate by 0.22 compared with those that do not have export permit. Secondly, firms with overseas employees exhibit a higher growth rate by 0.42—a huge number—compared with those without. But interestingly firms with CEOs that have overseas experience have a reduced R&D growth rate by 0.19. A possible explanation is that firms with overseas returning CEOs tend to have significantly high initial R&D level, which is consistent with the correlation table. Finally, foreign ownership is not significant, revealing that firms with
foreign ownership do not have higher R&D growth rate. This can be attributed to the fact that a great number of foreign firms in China focus on the exploitation of low-cost local resources rather than the development of technological and innovation capabilities. Overall, institutional factors have been found to play a major role in Chinese hi-tech firms’ pace of technological adaptation.

Finally, consistent with our hypotheses on managerial factors, CEO of higher education increases R&D growth rate by 0.08 whereas CEO tenure has a negative effect on firms’ R&D growth. One year CEO tenure reduces growth rate by 0.008. Note that when we put age and CEO tenure together, both of them lost significance. That indicates problem of multi-collinearity – 55%. As a result, we dropped CEO age from the model.

In model 3, we added the interaction effect of total sale and firm’s affiliation with research institutes. While the main effect of research institute affiliation remains insignificant, the interaction effect turns out to be significant. This means that for firms affiliated with research institutes, revenue has an even higher effect on the pace of technological adaptation. In other words, once financial and other constraints are overcome, firms affiliated with research institutes are more likely to engage in exploratory behavior of increasing their R&D investment and developing their innovation capabilities.

Discussion and Conclusion
This study seeks to contribute to the strategy literature by identifying mechanisms that both advance and hinder the process of organizational adaptation in midst of environmental change that is large-scale, gradual and enduring. The empirical context for this longitudinal study is China’s transition economy. We focus on a set of institutional, organizational and managerial traits as contingency factors upon which hi-tech firms’ pace of adaptation depend and find support for most of our hypotheses. First, complementary assets in the form of accumulated marketing experience and total sale facilitate firms’ adaptation toward higher technology orientation. Second, firms’ openness to global influence greatly accelerates the pace of strategic adaptation. Finally, managers play an important role in the technology adaptation of firms, where longer tenure confers more rigidities albeit higher education level of CEO positively affect firms’ rate of adaptation.

It is important to note that firms as organizations are subject to inertia to change. From an evolutionary perspective, organizations are viewed as ‘packages of routinized competences.’ While firms attempt to adapt to changing environmental contexts in order to ensure performance and survival, they often adhere to current sets of routines as a consequence of structural inertia (Hannan and Freeman, 1984; Nelson and Winter, 1982). The literature on organizational learning further argues that past learning contributes to organizational inertia and hence inhibits adaptation through the mechanism of a competency trap – which may be interpreted as resulting from having adapted too well to the prior environment (Cyert and March, 1992; Levinthal and March, 1993). Moreover, experience with existing customers and products may cause imprinting that prevents firms from diverting to and effectively exploring the new technological opportunity (Christensen, 1997). While our results have shown that marketing assets and trading experiences of
Chinese hi-tech firms have contributed to their adaptation toward development of technological capabilities when the environment is changing, it is likely that under some circumstances past success in the field of trading or manufacturing may become an obstacle rather than a promoter of Chinese hi-tech firms’ technological adaptation. There may be a point in a firm’s evolution where further accumulation of certain assets may induce the firm to continue to exploit these assets and avoid risk associated with technological exploration, and hence constraining them from conducting more innovative activities. Therefore, it is important to closely follow the evolution of these Chinese hi-tech firms and study how the dynamics of strategic and technological adaptation may be altered or reversed down the road.

Another important finding of this study concerns the two-prong effect of state ownership. As our result shows, enterprises owned by institutions rather than government agencies that are relatively distant from direct state control yet often backed up by the institutions financially and operationally are more likely to be engaged in more exploration type of behavior to develop technological capabilities, whereas private firms that are subject to more selection and survival pressure may be more conservative and hence engaged in more exploitation type of behavior. Moreover, spin-offs from research institutes or universities, including Legend, a spin-off from the Academy of Science, have access to the pool of knowledge and technology possessed by their parent organizations and hence embody higher level of absorptive capacity that may promote development of technological development through technology transfer and collaboration (Cohen and Levinthal, 1990). That said, it is important for future research to further explore the nature of relationship between the firms and their parent institutions to shed light on the processes
and dynamics of firm evolution. Future studies should also seek to acquire more fine-grained information so as to further unravel the mechanisms of adaptation at the firm level.

To reiterate, our research has yielded three broad conclusions: first, complementary assets in the form of marketing experience and revenue contribute to Chinese hi-tech firms’ later adaptation toward higher technology orientation. Second, Chinese hi-tech firms’ openness to global influence helps overcome rigidities and accelerate the pace of strategic adaptation. Finally, managers play an important role in the technology adaptation of firms, where longer tenure confers more rigidities albeit higher education level of CEO positively affect firms’ rate of adaptation. As a practical implication, Chinese hi-tech firms should perhaps establish more links with the global markets by doing business with foreign firms, hiring employees with experience in the overseas hi-tech markets, appointing a CEO with higher education and shortening the tenure of CEO so as to overcome rigidities and adapt faster to environmental change.

On the whole, this study extends the existing strategy literature on adaptation, complementary assets, institutions and the role of managers to the context of a transition economy. As the extant literature attests (Boisot & Child, 1996; Peng, 2000), studying firms in transition economies will broaden the scope and enhance the relevance of managerial theory in a global economy, and this study represents a significant step forward in that direction. Despite the presence of idiosyncratic factors, China, Eastern Europe, and the former Soviet Union all feature the existence of “institutional voids” because of a lack of market supporting institutions (Khanna & Palepu, 1997). All transition societies bear the institutional imprints of a long-lasting experience with state socialism, and they evolve into mixed economies characterized by hybrid organizational and property forms. Path
dependence from central planning system is likely to result in structural similarities across transition societies (Nee & Stark, 1989; Walder, 1995). Therefore, the results and findings of this study can be extended to other transitional economies, with the local conditions being taken into consideration.
Reference:


*Administrative Science Quarterly* 35(3): 484-503.


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* p<0.05
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Table 3: Results. (Dependent Variable: The annual growth rate of R&D personnel)
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Absolute value of z statistics in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%

We use random effect GLS