Journal of International Business Studies (2010) 41, 539–556

www.jibs.net

Institutional constraints and ecological processes: Evolution of foreign-invested enterprises in the Chinese construction industry, 1993–2006

Chaohong Zhou[1] and Arjen van Witteloostuijn[1,2]

[1]Utrecht School of Economics, Utrecht University, Utrecht, The Netherlands; [2]University of Antwerpen, Antwerpen, Belgium

Correspondence:
A van Witteloostuijn, University of Antwerpen, Department of Management, Antwerpen Centre of Evolutionary Demography ([A]CED), Prinsstraat 13, 2000 Antwerpen, Belgium.
Tel: +32 32775055;
Fax: +32 32775084;
E-mail: arjen.vanwitteloostuijn@ua.ac.be

Abstract
In the current study, expansion of foreign investment in transition economies such as China is analyzed as an organizational selection process in a community ecology setting. Insights from organizational ecology are used to explain how institutional forces constrain ecological processes, together driving the evolution of the population size of foreign-invested enterprises (FIEs), privately held domestic firms, and state-owned domestic organizations. We argue that the variation in the relative forces of ecological processes and institutional constraints across FIEs and their domestic rivals accounts for the expansion of FIEs in China. On the one hand, in many transition economies, institutional constraints are imposed on foreign enterprises by regulation that limits FDI opportunities. On the other hand, after entry, foreign enterprises can benefit from their competitive advantages in their ecological struggle against domestic rivals. This logic produces different sets of hypotheses as to foreign enterprises' density and sales growth, in interaction with domestic organizations. Using a data set of the Chinese construction industry in 29 provinces over the 1993–2006 period, estimation of a partial adjustment growth model produces support for our theoretical claim.
Journal of International Business Studies (2010) **41,** 539–556. doi:10.1057/jibs.2009.61

Keywords: competitive structure; institutional environment; organizational ecology; China; foreign direct investment

INTRODUCTION

Research on foreign direct investment (FDI) inflow in China mostly concerns relations between FDI activities and regional characteristics (e.g., Broadman & Sun, 1997; Chen, 1996; Fung, Lizaka, & Parker, 2002; Head & Ries, 1996; Leung, 1990). The expansion of FDI in China is basically explained with reference to agglomeration economies in association with regional advantages (Broadman & Sun, 1997; Fujita & Thisse, 2002; Fung et al., 2002), and local and national policy incentives (Broadman & Sun, 1997; Zhang, 2005). However, FDI inflow in China has not yet, to the best of our knowledge, been analyzed as an organizational selection process, in which the creation and expansion of formal organizations

Received: 21 December 2006
Revised: 14 April 2009
Accepted: 19 April 2009
Online publication date: 8 October 2009

depend both on the socio-economic conditions and on the mobilization of resources (Nielsen & Hannan, 1977). That is, in the extant literature, expansion of foreign investment has not been studied through the lens of FDI as the outcome of ecological processes of competition for scarce resources.

This ecological lens is widely employed in the study of organizational populations in Western socio-economic systems in the tradition of what is now known as organizational or population ecology (e.g., Baum & Kom, 1994; Brittain & Wholey, 1988; Carroll, 1981; Carroll & Hannan, 2000; Nielsen & Hannan, 1977). This organizational ecology perspective has proven to be very fruitful in studying the organization–environment interaction in the context of long-run evolutionary processes, with a rigorous theoretical foundation in the form of a series of fine-grained model fragments, such as density dependence, niche width, and resource partitioning (see Hannan & Freeman, 1977, 1989; Hannan, Pólos, & Carroll, 2007). In an attempt to add new insights to the FDI literature, this paper applies this ecological theory lens to the context of the Chinese transition economy generally, and the Chinese construction industry in particular. We argue that the expansion of foreign-invested enterprises (FIEs) in China is the outcome of an ecological process, resulting from limited availability of environmental resources in interaction with competition among different organizational forms. This argument comes in two key steps: first, environmental resources affect the carrying capacity (i.e., the ceiling of a population's size) of foreign enterprises as an organizational population; second, their responsiveness to changes in carrying capacity and inter-organizational competition determines their proliferation within China. This implies that the current study takes a community ecology perspective.

The Chinese context is particularly interesting because of the transition from closeness to openness, and from a centrally planned to a free market economy. In such a transition setting we emphasize the impact of ecological processes and institutional constraints on the viability of foreign-invested ventures in interaction with two types of domestic rivals – state-owned and privately held enterprises. We argue that foreign-invested, state-owned and privately owned enterprises differ in terms of the competitive (dis)advantages they can benefit from and the institutional constraints they are facing. In a transition economy such as China the institutional constraints vary substantially across these types of enterprises, as the Chinese open-door policies and regulation reforms are associated with incremental institutional changes that affect different enterprises in different industries differently across space and time. Similarly, the variation in competitive (dis)advantages is associated with different ownership arrangements. We subsequently argue that this variation in the relative nature of competitive (dis)advantages and institutional constraints accounts for the population-level dynamic trajectory of FIEs.

This is, basically, the current paper's contribution: apart from the traditional regional characteristics, we include both institutional features and ecological dynamics as determinants of FDI inflow and post-entry foreign-invested growth, particularly through their impact on the aggregate size of the population of foreign-invested ventures as a whole. In so doing, we respond to the recent plea to integrate institutional theory into international business (Henisz, 2004; Henisz & Delios, 2002) and to pay attention to the "reverse" spillover or competitive effect from local to foreign firms (Chang & Xu, 2008). Moreover, we adopt a community ecology perspective that is new in international business. We do so in the context of the Chinese construction industry by estimating so-called partial adjustment growth models. This industry features institutional regulation tailored at FIEs in all Chinese provinces in the 1993–2006 transition period.

AN ECOLOGICAL PERSPECTIVE ON ORGANIZATIONAL GROWTH

Our steppingstone is community ecology, emphasizing the interaction within and across three populations of organizational ownership forms: state-owned domestic organizations, privately held domestic firms, and foreign-invested ventures. Community ecology examines the structure and evolution of the interaction among different but linked organizational populations engaged in diverse activities that are bound together in a broader community (Baum, 1996). From this perspective, the population growth process is determined by four fundamental ecological drivers:

(1) the carrying capacity, which is the capacity of the environment to support the organizational population;

(2) the intrinsic rate at which the population grows (or declines) in response to environmental changes;
(3) the intra-population competition effect among the members in the same population; and
(4) the competitive or symbiotic impact of the viability of one organizational form on the viability of another form.

First, organizational ecology assumes that an organizational population's expansion is finitely constrained by the available environmental resources. Hence, for any given level of environmental resources, an organizational population's size faces a ceiling, referred to as the population's *carrying capacity*, as in bio-ecology (Carroll, 1981). Second, the intrinsic growth rate, the so-called *natural rate of increase* of the population in bio-ecology, reflects the structural ability of a population to fill the gap between the current and a target level of this population's size (Tuma & Hannan, 1984). Formally, this is captured by the population's adjustment speed, which reflects the population's growth speed in the absence of resource constraints. The higher this speed, the faster the population's response to changes in resource availability. Third, the *intra-population competition effect* captures the self-dampening impact that results from the interaction among the focal population's members. Usually, this effect is negative, because members in the same population compete for the same scarce resources. An increase in the focal population's size will reduce resource availability, resulting in a negative effect on this population's own growth. Hence this reflects the strength of competition among members in the same population. Fourth, the competitive or symbiotic effect of one organizational population or form on the other is measured by so-called *interaction coefficients*. We refer to this as *cross-form* or *cross-population interaction*. The interaction between population x (of, say, state-owned domestic enterprises (SDEs)) and y (of, say, foreign-invested ventures) may be competitive (negative) or symbiotic (positive). If the relationship is primarily competitive, population x's density or growth is negatively correlated with population y's density or growth; if the relation is predominantly symbiotic, population x's density or growth is positively associated with population y's density or growth.

Formally, the above ecological processes are modeled in the so-called *partial adjustment growth model*. The most commonly used specification of this model is the Lotka–Volterra differential equation, as explained in Hannan and Freeman (1977):

$$\frac{dN_i}{dt} = r_i N_i \left(\frac{K_i - N_i + \sum_{j \neq i} \alpha_{ij} N_j}{K_i} \right) \qquad (1)$$

where N_i and N_j are the population size or density (number) of organizations of population i and j, respectively; K_i is the carrying capacity of population i; r_i is the intrinsic growth rate of population i; and α_{ij} is the interaction coefficient that captures the effect of population j on population i. Eq. (1) reflects how the growth rate of a focal organizational population i is influenced by the four ecological parameters explained above: carrying capacity (K_i), adjustment speed (r_i), intra-population competition effect (α_{ij}), and cross-form interaction (α_{ij}, here with population j).

In the Chinese context our argument is that the nature of ecological processes implied by Eq. (1) is affected by the institutional constraints and the competitive nature of the organizational forms that "define" the context within which the ecological processes play out. That is, institutional constraints set by the regulatory environment and the competitive nature of the three organizational forms together have a differential effect on the ecological parameters. For one, institutional constraints affect carrying capacity directly, and adjustment speed, intra-population competition and cross-form interaction indirectly. Moreover, the competitiveness of organizational forms directly impacts on adjustment speed, intra-population competition, and cross-form interaction. Below, we explain this in greater detail.

First, selection processes may be constrained or amplified by the institutional setting, as institutional constraints can affect the population's and form-specific carrying capacities in a number of ways, which may dampen or promote the force of ecological processes (e.g., Pennings, Lee, & van Witteloostuijn, 1998) by impacting on barriers to entry and resource availability, and by monitoring, certifying, authorizing, and endorsing the nature of competition (see Baum, 1996, for a review). For instance, the form-specific payoff from direct and indirect competition can be changed by regulation if this affects organizational forms' competitiveness differently, favoring one organizational form over another. In turn, the constrained or amplified carrying capacity affects adjustment

speed, intra-population competition and cross-form interaction. For example, with lower carrying capacity, the population's resource space will be more crowded. Then, expansion of one organization will limit the room for others to grow: that is, each organization grows at the expense of others. Hence lower carrying capacity induces lower adjustment speed, and tougher intra-population and cross-form competition. This logic is in line with the argument that stricter resource constraints intensify competition (Carroll, 1981; Nielsen & Hannan, 1977), and hence trigger more aggressive competitive behavior.

Second, differences in form-specific competitiveness impact on the ecological parameters more directly. In our Chinese context the competitiveness of a certain ownership-defined form refers to the average ability and performance of enterprises sharing this specific ownership arrangement to sell products and services. Such competitive abilities are a fundamental property of the organizational form, reflecting the effect of the strengths and weaknesses associated with a specific ownership arrangement on the competitiveness of the form's population of enterprises as a whole. For reasons elucidated below, competitiveness varies across the three organizational forms we focus on here: foreign-invested, domestic state-owned, and domestic privately held enterprises. For an organizational form with higher competitiveness the time needed to mobilize, allocate, and assemble resources in response to changing carrying capacity will be shorter, on average: hence this form exhibits higher adjustment speed. Moreover, a highly competitive organizational form imposes stronger competition on similar and other forms, given the degree of resource availability: hence this form generates tougher intra-population and cross-form competition.

OWNERSHIP-DEFINED ORGANIZATIONAL FORMS

Basically, there are four types of ownership-defined organizational forms in China: state-owned domestic enterprises, collectively owned domestic enterprises (CDEs), privately owned domestic enterprises (PDEs), and FIEs. By definition,[1] SDEs' assets all belong to the state. CDEs' means of production and property are owned by local authorities – that is, by local governments such as the city, county, township, village committee, and any other rural community. PDEs include solely private investment enterprises and private partnership ventures. FIEs are solely foreign-owned enterprises and joint ventures of Chinese and foreign investors. Figure 1 shows the yearly densities of the four major organizational forms – SDEs, CDEs, PDEs, and FIEs – in the Chinese construction industry in the period from 1994 to 2006.

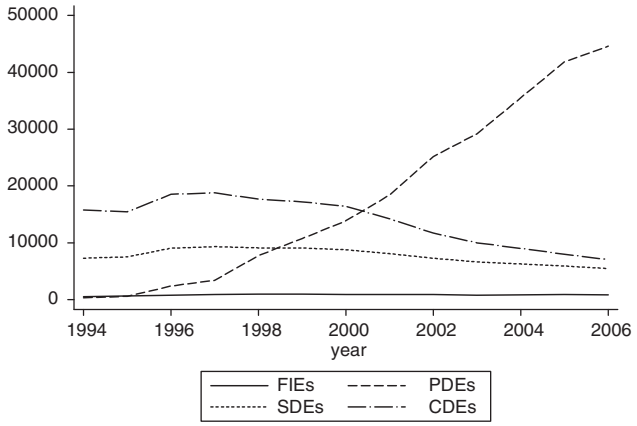

Figure 1 Densities of four ownership forms in China, 1994–2006.

Two fundamental (de)regulatory programs, the open-door and privatization reform policies, implemented by the Chinese government since 1979, are essential to understand the recent dynamics of the entry of FIEs and the expansion of domestic firms in the Chinese construction industry. In 1979 China launched the policy to liberalize industries and markets to establish a friendly regulatory framework for foreign investment. This was done by, for instance, relaxing rules regarding foreign ownership, mode of entry, and operational freedom. As a consequence, the overall institutional environment for foreign investment has gradually improved with the promulgation and implementation of a series of policies and laws regarding FDI (Zhang, 2005).

Nevertheless, despite the clear movement toward international openness, China still restricts foreign investment in many industries. For example, after three subsequent revisions (in 1997, 1999 and 2002, respectively), the *Regulations Guiding the Direction of Foreign Investment* and the *Catalogue Guiding Foreign Investment in Industry* still explicitly state that foreign investment is restricted substantially in 75 industry categories, and is prohibited altogether in 31 industry categories. For the restricted industries a foreign-invested project with an investment sum under $30 million, between $30 and $100 million, or of more than $100 million is required to be

approved by the central government, the national ministry, or the local provincial government, respectively. For the prohibited industries approval of foreign investment will simply not be granted (Lauffs & Tan, 2002).

The Chinese construction industry is such a restricted industry, to date only partially opened to foreign investment. Although the Chinese government has implemented a series of FDI laws and regulations in order to improve China's investment environment, and to provide incentives to foreign investors, ever since 1979, generally, China has introduced strict rules as to the involvement of overseas contractors in the construction industry, particularly (Chen, 1997; Gale & Luo, 2004). Foreign firms, including enterprises from Hong Kong, Macao, and Taiwan, are allowed to enter into the Chinese construction markets in most cases only by setting up joint ventures with domestic partners (Chen, 1997; Luo, Gale, & He, 2001). Solely foreign-funded firms are permitted to work only on certain types of projects, implying that they account for just 9–15% of FIEs in the Chinese construction industry. Examples are fully foreign-invested construction works, foreign aid projects, and domestic construction jobs in which the local contractors are incapable of implementing what is needed owing to technology constraints.

Moreover, setting up a construction joint venture in China is strictly regulated. First, the approval process for a Sino-foreign construction joint venture is very complex. The process consists of four stages, and at each stage a different ministry (or its local branch) is involved in the examination of the joint venture's application. Second, the capital and technological requirements for setting up a construction joint venture are high. For instance, according to a regulation from the Ministry of Construction and The Commission of Foreign Economic Relations and Trade in 1995, a construction joint venture will be approved only if: (1) the Chinese partner has US$ 5 million, minimally, of formal registration capital; and (b) the foreign partner brings advanced technology, up-to-date management skills and a high reputation to the joint venture (Luo, Gale, & He, 2001).

Moreover, since 1979, China has embarked upon ambitious privatization reform programs, centered on the transfer of ownership from the government to the private sector. Particularly after 1992, when the then leader Deng Xiaoping made a famous speech in South China calling for the continuation of market-oriented economic reforms, the transformation processes have accelerated dramatically. Consequently, reform has brought about a diversity of domestic ownership forms, spanning from stated-owned domestic organizations to privately held domestic firms, intermediated by the hybrid form of collectively owned domestic enterprises. The proliferation of a diverse set of new organizational forms came at the expense of outdated state-owned enterprises, which can be seen clearly in Figure 1, revealing the contraction of the state-owned enterprises' population size over time. Although property right arrangements are crucial elements in any economic system, the importance of changes in property rights or ownership structures are really essential in transition countries such as China, which is politically still a regime of communism. In particular, the ownership arrangement comes with a set of regulations that constrain organizational behavior, and so the capacity to reduce uncertainty (Freeman & Lomi, 1994; Nee, 1992; Peng, Tan, & Tong, 2004). For the sake of clarity, we focus our analysis on two domestic ownership forms, next to foreign-invested ventures: state-owned and privately held domestic enterprises.

Strictly speaking, the collectively owned domestic organization is a separate form. However, since a collectively owned domestic enterprise is owned, at least nominally and albeit indirectly, by the state (Peng et al., 2004), we treat collectively owned domestic enterprises as state-owned domestic organizations. This is also justified by evidence from Figure 1, which shows a similar trend in the evolution of the densities of state-owned and collectively owned enterprises. This comes as no surprise, as both forms are associated with similar principal–agent problems, inherent in non-private ownership. Both organizational forms are publicly owned. SDEs are owned by the central state, while CDEs are owned by local government, community, township, or village. In both cases the (chief) executives are appointed by the governmental owner-authorities. Although CDEs tend to be less restricted by top-down control and/or less empowered by top-down favored treatment, the two organizational forms share many characteristics (see Garnaut & Song, 2003; Garnaut, Song, Yao, & Wang, 2001; Taubmann, Heberer, & Jie, 2003). Note that we reran all models with four rather than three organizational forms (available upon request). This produced a pattern of results very similar to what is reported below.

Being controlled by the state, SDEs are characterized by substantial organizational inefficiencies and high agency costs as a result of:

- the lack of management autonomy;
- the requirement to serve the government and the Communist party, next to engaging in pure business activities;
- the bureaucratic mentality and culture of dependency (Wilkinson, Eberhardt, & Millington, 2006); and
- the soft budget constraint (Kornai, 1986).

In contrast, foreign-invested and PDEs tend to feature higher organizational efficiencies and lower agency costs, which can be attributed to the, relatively speaking, non-bureaucratic cultures and structures, smooth decision-making capabilities, absence of social and political obligations (Wilkinson et al., 2006), and attitude of market orientation (Peng et al., 2004). Thus foreign-invested and privately held domestic enterprises outperform state-owned domestic organizations economically, by and large. Indeed, empirical evidence indicates that organizational performance in terms of factor productivity or profitability is negatively associated with government control, and positively with privatization (Ai & Wen, 2005; Chen & Zhu, 2005; Lane, Broadman, & Singh, 1998; Li, 2004).

THREE SETS OF HYPOTHESES

We develop three sets of hypotheses related to the ecological partial adjustment model of growth by introducing institutional and ecological arguments specific to the context of modern China, generally, and the Chinese construction industry, specifically. This implies that we focus on two forces, and their impact on a population's size. The first force relates to differences across the three organizational forms as to the institutional constraints imposed by the (changing) regulatory regime and deregulation initiatives in China. The second force involves the competitive nature of the three organizational forms inherent in different consequences of the type of ownership arrangement. Both forces are argued to affect a population's size. Population size can be measured in terms of density or mass. Density is the total sum of the number of a population's organizations, and mass is a size-weighted density measure. As we will explain below, we measure mass as a population's aggregate sales. We argue that the imposed institutional constraints raise a *barrier to entry* to FIEs, affecting density negatively, whereas the unleashed ecological processes open a *gateway to growth* for FIEs, implying a positive impact on mass.

On the one hand, entry into the Chinese construction industry was and still is a highly regulated event, restricting foreign entry to specific activities, and forcing foreign enterprises to enter through forming alliances with domestic companies. Both institutional constraints imply barriers to entry, as (1) limited access to pre-specified niches of the Chinese construction industry sets boundaries to the FIEs' carrying capacity, and (2) mandatory joint venture entry reduces gateways to entry by forcing foreign enterprises to align with a restricted set of domestic partners. On the other hand, after entry, the FIE can engage in head-on competition with domestic rivals in the pre-specified niches, no longer being constrained by any pre-entry institutional restriction. By bringing in the capabilities and competencies of the foreign partner, the FIE is very likely to be associated with competitive advantages *vis-à-vis* local rivals, generating ecological fitness. So, after taking the hurdle of the barrier to entry, the FIE enters into a gateway to growth. This overall logic can nicely be linked to the three building blocks of the ecological partial adjustment growth model. That is, we investigate the interdependent relationship of FIEs with both types of domestic enterprises in the Chinese construction industry through the lens of the three instrumental ecological parameters:

(1) adjustment speed;
(2) intra-population competition; and
(3) inter-form interaction.

A barrier to entry affects density, and a gateway to growth does impact on mass. As we will argue below, given this institutional context, FIEs' entry and growth are likely to affect the FIE population's adjustment speed in terms of density *vis-à-vis* mass differently, but not so for the intra-population and inter-population effects, which are expected to be similar for density and mass.

Adjustment Speed

The foreign-invested venture form's adjustment speed must be evaluated *vis-à-vis* the adjustment speed of rival organizational forms – that is, state-owned and privately held domestic enterprises (Nielsen & Hannan, 1977). The first argument in this three-way comparison is that the very aim of the Chinese liberalization and open-door policies is to promote PDEs' and foreign-invested ventures' participation in economic activities at the expense

of state-owned domestic organizations. Indeed, the entry and exit of SDEs are determined by the planning mechanism, through which governments, nationally and regionally, plan and approve the founding of new and the demolishment or transformation of old state-owned enterprises. Hence the growth or decline of state-owned enterprises is driven largely by governmental policy preferences. Since 1993 the government has ambitiously embarked on policies of privatization and reform of SDEs. Particularly relevant are the "corporatization" program to transform state-owned organizations into "modern corporate enterprises" – that is, to introduce modern shareholding and private enterprises, with commercial objectives and clearly defined rights and obligations (Wang, Hadavi, & Krizek, 2006).

Against this background, the founding of state-owned enterprises has turned from a frequent into a rare event, whereas the incidence of the policy-induced exit of SDEs or their transformation into state-private mixed shareholding ventures or privately held enterprises increased over time. Thus the intrinsic growth rate of the population of state-owned enterprises can be expected to be lower than that of privately held and FIEs. Basically, state-owned enterprises are an outdated organizational form by now, fitting well into the environment in the old regime of a centrally regulated communist planning system, but totally inadequate to perform well in modern market economies, given their highly bureaucratic, costly and inert blueprints. In contrast, PDEs and FIEs are the organizational forms designed to operate vitally in the modern, liberalized market economy of China. Hence the growth potential of the populations of PDEs and FIEs, leveraged by their competitiveness, is hypothesized to exceed by far that of their state-owned domestic counterparts, as is their adjustment speed.

The next question is how the adjustment speed of FIEs can be expected to compare with that of privately owned domestic organizations. Indeed, the PDE/FIE comparison is more subtle, given the complicated mechanisms of institutional constraints and organizational form's competiveness. On the one hand, institutional constraints in the semi-opened Chinese construction market imply a powerful entry barrier to FIEs. The complexity of approval procedures, requirement for advanced technology and considerable capital, and mandatory joint venture all imply a higher entry barrier. So FIEs are likely to reveal a lower intrinsic density growth rate implied by lower carrying capacity than PDEs. On the other hand, after entry, foreign-invested ventures can benefit from their competitive advantages, as a result of their advanced technology, good project and information management skills, higher labor productivity, and capability to access the local market by allying with domestic partners. Hence, in terms of the post-entry mass growth potential, foreign-invested ventures outdo privately held domestic enterprises, enjoying a gateway to growth effect. This logic suggests:

Hypothesis 1a: In terms of density, (a) the adjustment speed of privately held domestic enterprises is higher than that of foreign-invested enterprises, and (b) that of foreign-invested enterprises is higher than that of state-owned domestic enterprises.

Hypothesis 1b: In terms of mass, (a) the adjustment speed of foreign-invested enterprises is higher than that of privately owned domestic enterprises, and (b) that of privately owned domestic enterprises is higher than that of state-owned domestic enterprises.

Intra-population Competition

We need two sets of arguments to derive a hypothesized form-specific ranking of the strength of the intra-population competition effect. First, as discussed above, FIEs are constrained by entry regulation, implying a lower carrying capacity for foreign-invested ventures than for privately held domestic enterprises. Regulation artificially increases resource scarcity for the population of foreign-invested ventures. As neither domestic ownership form faces institutionally restricted entry, we hypothesize that this induces a strongest self-dampening effect within the population of foreign-invested ventures. Second, inherent in the consequences of different ownership arrangements, the state-owned organizations' competitiveness is considerably weaker than that of the other two organizational ownership forms. So the intra-competition effect in the state-owned form's population is expected to be the smallest. Thus we propose:

Hypothesis 2: (a) The intra-competition effect in the population of foreign-invested ventures is larger than in the population of privately owned domestic enterprises, and (b) the intra-competition effect in the population of privately owned

domestic enterprises is larger than that in the population of state-owned organizations.

Cross-population Interaction

Whether cross-form interaction exhibits a competitive or a symbiotic effect is related to the nature of form heterogeneity in the population's microstructure. For example, the so-called size-localized competition argument holds that competition between large and small organizations is less intensive than that among large or small organizations (Baum & Menzias, 1992; Hannan, Ranger-Moore, & Banazak-Holl, 1990). In terms of spatial heterogeneity, Hannan, Carroll, Dundon, and Torres (1995) and Lomi (2000) argue that competition is more intense among spatially proximate organizations, whereas legitimation (implying symbiotic interaction) operates more broadly across space. In terms of the heterogeneity in the targeted resource base (i.e., the organizational niche), Baum and Singh (1994a, b) demonstrate that the competition intensity among organizations is proportional to the overlap of their niches. In terms of heterogeneity in competitiveness, Barnett and Hansen (1996) show that banks facing competitors with more recent experience are more likely to fail than those facing competitors with less recent competitive experience. Following this logic, we argue that heterogeneity in terms of ownership arrangement is highly relevant for the nature of cross-form ecological interaction, particularly in a highly regulated transition economy environment such as China's.

Specifically, we need to differentiate the effect associated with ecological cross-form interactions in three parts. The first part involves cross-form interaction of foreign-invested ventures with PDEs. Privately owned domestic firms and FIEs have to compete head on with similarly equipped and positioned organizational forms. After all, since both forms are market-oriented, they are designed to do precisely this: compete viably in market environments. Hence their strategic positioning and competitive behavior are likely to be quite similar. For example, both forms are likely to target the construction projects launched in the private sector, resulting in niche overlap, and both forms' project procurement policies are strongly reliant on competitive bidding, leading to escalation of price-cutting rivalry and shortening of construction time (Wang et al., 2006). To be able to do so, both forms are likely to compete for similar resources, such as skilled labor, and access to construction and market information through market channels. As a result, growth in one free market form triggers tough competition that does spill over to the rival market-oriented organizational form, hence reducing the growth of the latter's population. This logic induces:

> **Hypothesis 3a**: The population size of foreign-invested ventures negatively affects that of privately owned domestic enterprises, and the population size of privately held domestic organizations negatively affects that of foreign-invested enterprises.

Similarly, given the competitive nature of foreign-invested and PDEs, we expect a similar negative effect of both forms on state-owned organizations. Constrained by their organizational inefficiency and high agency cost, the outdated stated-owned enterprises are less likely to outcompete both other, more efficient, organizational forms. For example, state-owned organizations are hard hit by the technology/management-based quality competition from foreign-invested ventures or the aggressive price-cutting rivalry from privately held domestic enterprises (Shen, Zhao, & Drew, 2006; Xu, Tiong, Chew, & Smith, 2005). Hale and Long (2006) show that the labor market is an important channel through which foreign-invested ventures and PDEs negatively affect state-owned organizations. The expansion of foreign-invested and privately held domestic enterprises increases demand for skilled labor that triggers mobility of SDEs' skilled labor of higher quality to foreign-invested and PDEs, as the former face wage constraints as a result of their rigid remuneration system. By way of compensation, FIEs could generate a technological spillover effect from which local firms might benefit (Buckley, Clegg, & Wang, 2002; Chang & Xu, 2008). However, this spillover effect cannot outweigh the impact of competition in the labor and product market, particularly not for state-owned enterprises that are headed by a rigid management reacting slowly to environmental and technological change. Overall, we predict:

> **Hypothesis 3b**: The population size of foreign-invested and privately owned-owned domestic enterprises negatively affects that of state-owned organizations.

Strictly speaking, a large population size of state-owned enterprises may signal two opposing forces.

On the one hand, as state-owned enterprises are the least competitive organizational form, they pose little competitive threat to both other organizational forms. Hence the cross-population competition effect generated by the SDE population is not proportional to the size of that population. Moreover, since state-owned enterprises are installed by the state, agglomeration of state-owned organizations might signal ample market demand in specific regions, as stimulated by public investment preferences and programs, such as infrastructure construction and large-scale urban real state development. Then, a large size of the population of state-owned enterprises would signal favorable business opportunities in the region, which is likely to open a gateway to entry for foreign-invested and privately held domestic enterprises. On the other hand, the dominance of state-owned domestic organizations may imply an environment in which state-run operations receive a favorable treatment from the authorities, protecting the *status quo* and raising barriers to entry and introducing growth restrictions for newcomers from the populations of the other two organizational forms. Given that our theory is silent about the dominance of either force, we propose:

Hypothesis 3c: The population size of state-owned domestic organizations positively affects that of foreign-invested ventures and privately owned domestic enterprises.

Hypothesis 3c-alt: The population size of state-owned domestic organizations negatively affects that of foreign-invested ventures and privately owned domestic enterprises.

Note that we believe that, in the context of the Chinese transition economy, the aggregate cross-population effect from the population of state-owned organizations is likely to be positive, given the ongoing privatization and reform policy programs, particularly since 1992, stimulating the participation of non-public ownership in the economic sphere in combination with the open-door policies involving the post-WTO obligation to fully liberalize the Chinese economy. Moreover, as indicated above, the mobility of skilled labor from state-owned organizations to foreign-invested and privately held domestic enterprises implies a prominent positive spillover effect (Hale & Long, 2006) from SDEs on FIEs and PDEs.

METHOD AND DATA

Method

We apply the partial adjustment model (Carroll, 1981; Tuma & Hannan, 1984) to estimate population *x*'s adjustment speed to environmental change and intra-population competition, as well as the ecological interaction with both other populations *y* and *z*. We illustrate the technique following Carroll (1981). The specification of the Lotka–Volterra Eq. (1) implies

$$\frac{\mathrm{d}N_i(t)}{\mathrm{d}t} = r_i N_i \left[1 - \frac{N_i(t)}{K_i} + \sum_{j \neq i} \alpha_{ij} N_j(t) \right] \qquad (2)$$

which can be succinctly rewritten as

$$\frac{1}{N_i} \frac{\mathrm{d}N_i(t)}{\mathrm{d}t} = b_{i0} + b_{ii} N_i + \sum_{j \neq i} b_{ij} N_j(t) \qquad (3)$$

where b_{i0} is the adjustment speed parameter of population *i*; b_{ii} is the feedback or growth-dampening parameter of population *i*, which also captures the intra-population competition effect; and b_{ij} is the population interaction parameter indicating the competitive or symbiotic effect of population *j* on population *i*. As there is no known explicit solution to the Lotka–Volterra model, the approach uses the exact discrete approximation. The exact discrete approximation gives

$$N_i(t+h) = \frac{\lambda_i^h K_i N_i(t)}{K_i + (\lambda_i^h - 1) \left[N_i(t) - K_i \sum_{j \neq i} \alpha_{ij} N_j(t) \right]} \qquad (4)$$

where h is the time interval, and $\lambda_i = \mathrm{e}^{r_i}$. To put Eq. (4) into a form that can be estimated readily, we invert it into

$$\frac{1}{N_i(t+h)} = \frac{1}{\lambda_i^h} \frac{1}{N_i(t)} + \frac{\lambda_i^h - 1}{\lambda_i^h} \left[\frac{1}{K_i} - \sum_{j \neq i} \alpha_{ij} \frac{N_j(t)}{N_i(t)} \right] \qquad (5)$$

As environmental resources set a ceiling on population size, environmental variables must be introduced into the model. Following Carroll (1981), we specify a non-linear relationship between an organizational population's carrying capacity and environmental resource variables in the form of

$$\frac{1}{K_i} = c_{i0} + \sum_m c_{im} \frac{1}{X_{im}} \qquad (6)$$

where c_m is the coefficient of environmental variable X_m. After substituting the K_i term into Eq. (5), we have

$$\frac{1}{N_i(t+h)} = \frac{1}{\lambda_i^h}\frac{1}{N_i(t)} + \frac{\lambda_i^h - 1}{\lambda_i^h} \times \left[c_{i0} + \sum_m c_{im}\frac{1}{X_{im}} - \sum_{j\neq i}\alpha_{ij}\frac{N_j(t)}{N_i(t)}\right] \quad (7)$$

More succinctly, Eq. (7) can be rewritten as

$$\frac{1}{N_i(t+h)} = \beta_{i0} + \beta_{ii}\frac{1}{N_i(t)} + \sum_{j\neq i}\beta_{ij}\frac{N_j(t)}{N_i(t)} + \sum_m \beta_{im}\frac{1}{X_m} \quad (8)$$

The set of β coefficients in Eq. (8) can be nicely estimated with standard regression methodology. Regression estimates from Eq. (8) can be transformed into the set of parameters that appear in Eqs. (3) and (6) by the following formulae:

$$b_{i0} = -\frac{\ln \beta_{ii}}{h} \quad (9a)$$

$$b_{ij} = \frac{\beta_{ij}\ln \beta_{ii}}{h(1-\beta_{ii})} \quad (9b)$$

$$b_{ii} = -\frac{\beta_{ii}}{K_i} \quad (9c)$$

$$c_{i0} = \frac{\beta_{i0}}{1-\beta_{ii}} \quad (9d)$$

$$c_{im} = \frac{\beta_{im}}{1-\beta_{ii}} \quad (9e)$$

With this model specification (Eqs. (8) and (9a–9e)) in place, we can test Hypotheses 1–3. Note that, as calculation of the parameters (9a)–(9e) involves complex functions, a significant test (i.e., standard errors for estimates of these parameters) cannot be provided with this special procedure (see Carroll, 1981).

Data

Sources. The major data sources used here are subsequent volumes of the *China Statistical Yearbook*, an official publication of the National Bureau of Statistics of China (NBS), from the period 1993 to 2006, the *China Compendium of Statistics 1949–1999* (NBS, 2000) and the *China Compendium of Statistics 1949–2004* (NBS, 2005). For quite a few data missing in the above sources, we supplement them from the available Statistical Yearbook of some provinces. This 1993–2006 period is chosen for three reasons:

- foreign investment activities in the construction industry started to emerge in the early 1990s;
- this period is characterized by important changes in FDI-related policies; and
- data for foreign-invested construction enterprises are available only for this 14-year period.

Dependent variables. The dependent variables are the size of the organizational population of our three organizational forms: foreign-invested ventures, state-owned domestic organizations, and privately held domestic enterprises. We measure population size with two variables, in line with our hypotheses: the total number (density) and aggregated sales (mass) of foreign-invested, state-owned and privately held domestic enterprises. The number of organizations is widely used as a measure of an organizational population's density. Aggregate sales are a robust measure of population mass, as this captures the comparative size of a population (Brittain & Wholey, 1988). The number, *Density*, and inflation-corrected sales, *Mass*, of foreign-invested construction ventures, including those from Hong Kong, Macao and Taiwan, are aggregated at the province-year level. Similarly, SDE and PDE population size are measured at the province-year level. Hence the data used have a cross-sectional (i.e., across 29 major provinces, excluding Chongqing and Tibet) and longitudinal (i.e., for 1994–2005 period for *Density*, and for 1993–2005 for *Mass*) structure.

In line with regulation directed at foreign-invested construction enterprises, solely foreign-funded enterprises are allowed to independently contract only construction work that involves investment by foreign countries or international organizations. Thus the solely foreign-funded construction enterprises account for a very small proportion of all construction firms with foreign capital participation. Hence the majority of the FIEs are joint ventures with local partners,[2] in which the foreign partner is required to contribute a minimum of 25% of the joint venture's capital, according to the Chinese Joint Venture Law (Luo, 2001). The population size, in density and mass, of

state-owned organizations and PDEs includes only organizations without any alliance relation with foreign enterprises. This is not associated with double counting, as the official statistics never mix FIEs with domestic firm types. That is, once a domestic firm of whatever form has set up a joint venture with a foreign firm, the original firm is classified in the new category of joint ventures, and this joint venture is uniquely identified as a foreign-invested venture in the data.

Independent variables. The independent variables that are hypothesized to have an impact on our dependent variables are simply the lagged values of all population size measures. Hence we include the lagged population size measures of state-owned domestic, privately held domestic, and FIEs. As discussed above, we add collectively owned domestic organizations to the SDE category. The lagged own-form population size variable captures the potentially self-dampening effect on own-population growth. Cross-interaction effects are reflected in the other-form population size measures. Corresponding to the two measures of the dependent variable, we aggregated all lagged density and lagged mass measures at the province-year level. As we will discuss later, we lag this set of independent variables for 1 year.

Control variables. Earlier studies suggest that economic conditions such as economic wealth, market size, and investment policies are among the major factors affecting FDI inflow in China (Broadman & Sun, 1997; Chen, 1996; Fung et al., 2002). These environmental resource variables are prominent drivers of the carrying capacity of the population of organizational forms. We include four measures to capture these factors' effects on carrying capacity: real GNP per capita (*GNP per capita*); human population size (the number of inhabitants in each province, or *Population size*); real fixed capital investment (*Fixed investment*); and *GNP per capita squared*.[3] In fact, GNP per capita and human population size, being proxies for economic wealth and market size, respectively, have been widely used in empirical organizational ecology studies as surrogate measures of carrying capacity (e.g., Carroll, 1981; Nielsen & Hannan, 1977). Fixed capital investment is a measure of aggregate investment in both the public and private sector in each province, offering a proxy for aggregate demand in the construction market at the province level. All the three environmental resource variables are measured at the province level.

Estimation procedure. Cross-sectional time series data are often associated with heteroskedasticity. In fact, a preliminary analysis of our data using the Breusch–Pagan test indeed indicates that the error distribution features heteroskedasticity, conditional on the set of contemporaneous independent variables (available upon request). Another potential complication is autocorrelation. The disturbance terms may well be correlated over time and with the lagged dependent variable included in the estimation form of Eq. (8). We deal with both issues by applying the feasible generalized least squares (FGLS) estimator, which controls for both heteroskedasticity and autocorrelation.[4] Since the World Bank (2008: 11) notes that it takes an average of 41 days (ranging from 28 to 55 days in 31 cities) to open a business in China, we adopt a 1-year lag structure.

Table 1 reports descriptive statistics. This table provides these statistics only for the original data. As indicated above, the raw data have been transformed into complex terms, such as lagged,

Table 1 Descriptive statistics

Variable	*Obs.*	*Mean*	*Std dev.*	*Minimum*	*Maximum*
Density FIE	371	29.73585	38.14822	2	193
Density SDE	377	742.6897	501.3016	32	2684
Density PDE	373	627.2252	857.3038	1	5369
Mass FIE	397	18,320.08	40,828.28	20.15197	321,708.2
Mass SDE	406	716,929.4	549,640.4	24,104.18	2,747,183
Mass DPE	399	642,084.5	1,337,096	53.9104	11,000,000
GNP per capita	406	2820.277	2406.493	517.4846	16,601.69
Population size	406	4171.904	2552.175	466.7	9717
Fixed investment	406	374.6679	426.6787	13.7386	3435.048

Note: FIE=foreign-invested enterprises; SDE=state-owned domestic enterprises; PDE=privately owned domestic enterprises.

inversed and multiplicative terms, in the right-hand of Eq. (8) for regression estimation. This is why we decided not to include a correlation matrix, for the sake of brevity (available upon request).

Note that, given the special regression model implied by Eq. (8), multicollinearity cannot be avoided, because the $1/N_{it}$ and N_{jt}/N_{it} terms are correlated by their very construction. Empirically, indeed, our data suffer from multicollinearity, though not too much. The most severe multicollinearity occurs in two mass models of FIE and PDE, in which the correlations of $1/N_{it}$ and N_{jt}/N_{it} are 0.89 and 0.92, respectively. However, the correlation coefficients for most the relevant pairs of variables in the six density and mass models are all below 0.69. Theoretically, multicollinearity is not a real issue, as our theory needs such a special model. Indeed, in by far the majority of the empirical studies in the organizational ecology tradition, multicollinearity issues have to give way to what is required by theory. For example, to test the famous density-dependence theory, density *and* density squared have to be entered in the same model. The near-perfect multicollinearity in the type of model that emerges, as an inevitable result, does not undermine these models' value-added. Similarly, in many community ecology studies, multicollinearity follows "naturally" from including densities of different organizational populations in the same model. These densities are often highly correlated, because different organizational forms reveal similar evolutionary patterns over time.

EMPIRICAL EVIDENCE

Table 2 reports the FGLS regression estimates for the pooled data set over the 1994–2006 period for the FIEs, SDEs and privately held domestic enterprises' population size in terms of *Density*, and over the 1993–2006 period for the three population sizes in terms of *Mass*. The form-related parameters in this table have no direct interpretation, though, but are needed to calculate the carrying capacity, adjustment speed, intra-population competition and cross-population interaction coefficients by transforming the regression coefficients in Table 2 according to Eqs. (9a–9e). The transformed coefficients are reported in Table 3.

The estimates of the effects of the three environmental variables measuring carrying capacity – that is, *GNP per capita*, *Population size* and *Fixed investment* – are shown in the top panel of Table 3. Basically, the three proxies for the three populations' carrying capacity exhibit positive signs, with a few exceptions. These exceptional negative signs may arise from the non-linear specification of carrying capacity (Carroll, 1981). The findings suggest that economic conditions such as economic wealth, market size and buyer demand are all positively associated with the carrying capacity of FIEs, which is in line with the evidence in the FDI literature (Broadman & Sun, 1997; Chen, 1996; Fung et al., 2002).

In order to facilitate an intuitive interpretation, we calculated the carrying capacity of the three organizational forms' populations from the estimates in Table 2 for the mean values of *GNP per capita*, *Population size* and *Growth in fixed investment* and *GNP per capita squared* in 1994, 1999 and 2004, each year representing the early, mid and late historical stages of the recent evolution of the Chinese construction industry. The result is reported in the second panel of Table 3. These estimated carrying capacities exhibit a systematic pattern: each organizational form's carrying capacity increases over time. This implies, as could be expected, that improved economic wealth, market size and buyer demand over time promote any form's carrying capacity. Moreover, we observe that PDEs enjoy the largest carrying capacity, state-owned domestic organizations the second largest, and FIEs the smallest. This pattern is in line with the actual evolutionary trajectories of the three types of ventures, as reflected in the time series in Figure 1.

The third panel in Table 3 reports the results for estimates of the adjustment speed coefficients, relating to Hypothesis 1. By and large, the speed of adjustment is systematically patterned in line with the predictions of Hypothesis 1. The speed of *Density* adjustment of privately owned enterprises is substantially higher than that of foreign-invested ventures and state-owned organizations, and the speed of density adjustment of state-owned companies is always the lowest. Hypothesis 1a is fully confirmed, supporting our logic that, because of regulatory entry barriers, the foreign-invested ventures' population size in terms of density expands slowly in response to environmental change in comparison with privately held domestic enterprises, but quicker than SDEs, as the latter's growth is constrained by the privatization and open-door policies, and by their inherently weaker competitiveness.

Interestingly, as expected, the substantially higher speed of *Mass* adjustment of FIEs *vis-à-vis* both

Table 2 FGLS estimates of coefficients in Eq. (8)

Independent variable	*Dependent variable*					
	N=Density			*N=Mass*		
	$N_{FIE}^{-1}(t+1)$	$N_{SDE}^{-1}(t+1)$	$N_{PDE}^{-1}(t+1)$	$N_{FIE}^{-1}(t+1)$	$N_{SDE}^{-1}(t+1)$	$N_{PDE}^{-1}(t+1)$
$N_{FIE}^{-1}(t)$	0.9001			0.20114290		
	(0.04534)			(0.0564681)		
$N_{SDE}^{-1}(t)$		0.9811			0.74760510	
		(0.02691)			(0.02755810)	
$N_{PDE}^{-1}(t)$			0.40090			0.6478457
			(0.03976)			(0.0422649)
$N_{SDE}(t)\,N_{FIE}^{-1}(t)$	−0.0001			−0.00000002		
	(0.00005)			(0.0000002)		
$N_{DPE}(t)\,N_{FIE}^{-1}(t)$	0.0002			0.00000023		
	(0.00006)			(0.0000002)		
$N_{FIE}(t)\,N_{SDE}^{-1}(t)$		−0.0015			−0.00000071	
		(0.00048)			(0.00000090)	
$N_{PDE}(t)\,N_{SDE}^{-1}(t)$		0.0001			0.00000002	
		(0.00003)			(0.00000001)	
$N_{FIE}(t)\,N_{PDE}^{-1}(t)$			−0.00015			0.0000048
			(0.00161)			(0.0000119)
$N_{SDE}(t)\,N_{PDE}^{-1}(t)$			0.00001			−0.0000007
			(0.00006)			(0.0000001)
$GNP^{-1}(t+h)$	7.7361	0.3172	−10.83560	0.33027300	−0.00049170	0.2720691
	(19.36231)	(0.20966)	(11.0165)	(0.9116355)	(0.00020130)	(0.1242609)
$POP^{-1}(t+h)$	9.8330	0.5247	1.68209	0.81315720	0.00010840	0.0485765
	(11.80995)	(0.12672)	(4.75701)	(0.4935982)	(0.00017140)	(0.0410977)
$INVEST^{-1}(t+h)$	0.6798	−0.0271	0.33451	0.07180420	0.00007410	−0.0017628
	(0.85747)	(0.00727)	(0.26638)	(0.0328664)	(0.00001420)	(0.0030680)
$GNP^{-2}(t+h)$	12387.0	−28.943	14568.5	552.53920	0.14490910	−145.89250
	(14923.1)	(109.966)	(9138.76)	(616.8736)	(0.12068560)	(96.141080)
Constant	−0.0047	−0.0001	0.00129	−0.00038860	0.00000016	−0.0000730
	(0.00630)	(0.00008)	(0.00301)	(0.0003263)	(0.00000008)	(0.0000367)
Log likelihood	783.3876	2,360.035	1,047.081	2,232.981	4,993.444	2,880.356
Number of observations	342	342	342	368	368	368

Note: FIE=foreign-invested enterprises; SDE=state-owned domestic enterprises; PDE=privately owned domestic enterprises; GNP=GNP per capita; POP=human population size; INVEST=fixed capital investment. Standard errors are shown in parentheses.

domestic ownership forms indicates that the foreign-invested ventures' sales growth pattern is radically different from the density growth pattern, which is in line with the prediction of Hypothesis 1b. After the institutional hurdle of the barrier to entry is taken, foreign-invested ventures benefit from a gateway to growth by outcompeting both domestic ownership forms in the marketplace. Moreover, privately owned domestic companies reveal a higher mass adjustment speed than their state-owned counterparts in all three models, as predicted. So Hypothesis 1b receives clear support.

To test Hypothesis 2, the bottom panel of Table 3 shows the estimates of the growth-dampening parameters for foreign-invested ventures, state-owned domestic organizations and privately held domestic enterprises in 1994, 1999, and 2004. Overall, the absolute values of the intra-competition coefficients in both *Density* and *Mass* models decrease over time for all three organizational forms, suggesting a decreasing intra-competition effect over time. This result indicates that the increase of carrying capacity over time dampens the strength of intra-population competition. For the *Density* models the strength of intra-population competition decreases from foreign-invested ventures to state-owned organizations to privately held companies. The absolute value of the foreign-invested ventures' intra-population competition coefficient in all 3 years is substantially higher than that of both domestic ownership forms. The much lower carrying capacity of foreign-invested ventures

Table 3 Estimates of carrying capacity, adjustment speed and intra-population competition effect of different ownership forms

	N=Density			*N=Mass*		
	dN_{FIE}/dt	dN_{SDE}/dt	dN_{PDE}/dt	dN_{FIE}/dt	dN_{SDE}/dt	dN_{PDE}/dt
Effect of environmental variable on carrying capacity K^{-1}						
GNP^{-1}	77.44014	16.78392	−18.0863	0.413432	−0.00195	0.772585
POP^{-1}	98.43105	27.76393	2.807673	1.017901	0.000429	0.137941
$INVEST^{-1}$	6.805048	−1.4358	0.55835	0.089884	0.000294	−0.00501
GNP^{-2}	123,997.4	−1,531.5	24,317.18	691.6621	0.574136	−414.286
Carrying capacity						
1994	9.179405	330.7942	542.23	1,241	704,176.7	5,578.388
1999	19.10996	445.7676	2,716.493	2,671.208	896,101.7	11,831.97
2004	99.14057	444.5891	3,741.771	53,508.38	132,7763	136,854.1
Adjustment speed	0.105	0.019	0.914	1.604	0.291	0.434
Intra-population competition						
1994	−0.09806	−0.00297	−0.00074	−0.00016	-1.1×10^{-6}	−0.00012
1999	−0.0471	−0.0022	−0.00015	-7.5×10^{-5}	-8.3×10^{-7}	-5.5×10^{-5}
2004	−0.00908	−0.00221	−0.00011	-3.8×10^{-6}	-5.6×10^{-7}	-4.7×10^{-6}

Note: FIE=foreign-invested enterprises; SDE=state-owned domestic enterprises; PDE=privately owned domestic enterprises; GNP=GNP per capita; POP=human population size; INVEST=fixed capital investment.

vis-à-vis the carrying capacities of both domestic ownership forms may account for this. This interpretation is in line with the argument that an increase in the foreign-invested ventures' density generates a larger depression effect on this population's own future density growth because of institutional constraints and their own competitive strength. The larger intra-form competition effect of state-owned organizations' population density compared with that of privately held enterprises, which goes against Hypothesis 2, may suggest that the institutional constraints imposed on state-owned enterprises implied by the privatization and reform programs are so significant that an increase in their density results in a larger self-dampening effect, relative to privately owned enterprises.

For the *Mass* models, in the earlier 2 years 1994 and 1999, the strength of the force of intra-competition increases from state-owned domestic organizations to privately held domestic enterprises to foreign-invested ventures. In the later year 2004, though, this force increases from state-owned to foreign-invested to privately held enterprises. In sum, Hypothesis 2 is largely confirmed for both *Density* and *Mass* models. Yet the differences in the parameters' values for foreign-invested ventures *vis-à-vis* PDEs are not as drastic for the *Mass* as for the *Density* models. This suggests that the competitive intensity within the populations of foreign-invested and privately held enterprises is converging over time, with the latter's intensity even exceeding the former's in recent history. Spillover effects may account for this convergence. Moreover, the absolute values of the intra-population competition coefficient for all three organizational forms are substantially lower in the *Mass* than in the *Density* models. The larger self-dampening effect in terms of density, relative to mass, might reflect the prominent role of institutions in constraining organizational growth in China.

To test Hypothesis 3, Table 4 reports the cross-population effects across the three organizational ownership forms. The parameter estimates in Table 4 were calculated by transforming the underlying regression coefficients with the formulae given in Eqs. (9a)–(9e). The estimated cross-population interaction effects for foreign-invested and PDEs are systematically patterned. Impacting on foreign-invested ventures, privately held domestic enterprises always give negative coefficients, in both the *Density* and *Mass* models. Impacting on privately owned enterprises, foreign-invested ventures are associated with a positive coefficient (+0.000226) in the *Density* model and a negative coefficient (−0.000006) in the *Mass* model.[5] This set of estimates largely supports Hypothesis 3a, which predicts a two-way competitive effect between these two organizational forms. This is largely in agreement with the argument that the two free market organizational

Table 4 Estimates of coefficients of cross-population interaction

	N=Density			*N=Mass*		
	FIE	*SDE*	*PDE*	*FIE*	*SDE*	*PDE*
FIE		0.001551	0.000226		0.0000008	−0.000006
SDE	0.000118		−0.000022	0.00000004		0.0000009
PDE	−0.00016	−0.00014		−0.00000005	−0.00000002	

Note: FIE=foreign-invested enterprises; SDE=state-owned domestic enterprises; PDE=privately owned domestic enterprises.

forms engage in head-on competition, fighting for similar resources.

The effect of the two free market-oriented organizational forms on the central planning-designed form, state-owned enterprises, is patterned differently. Foreign-invested ventures are associated with a positive coefficient in both *Density* and *Mass* models, which goes against our hypothesis, while privately held domestic enterprises reveal a negative coefficient in both *Density* and *Mass* models, which is in agreement with our hypothesis. Hence Hypothesis 3b is supported for PDEs, but not for foreign-invested ventures. We return to this issue below. Finally, consider the cross-form effect of state-owned enterprises on both other organizational forms. The state-owned organizations' cross-effect coefficients exhibit positive signs in all but the DPE *Density* model, suggesting a symbiotic effect in all other cases. This result is largely in line with Hypothesis 3c. The negative impact of state-owned organizations' density on privately held enterprises' density offers partial support for Hypothesis 3c-alt. This may suggest that when the environment is dominated by state-owned enterprises, this signals that the economy is still largely ruled by the institutional forces of the planning system. Then the state-imposed social legitimation, as reflected in preferential policies, favors state-owned domestic organizations at the expense of privately held domestic enterprises.

In general, the estimated cross-effect of FIEs on the two domestic forms goes against our hypotheses, too. For example, we observe a positive effect in the SDE *Density* and *Mass* models, as well as in the PDE *Density* model. These unexpected symbiotic rather competitive cross-form linkages may suggest that the spillover effect from FIEs to domestic forms outweighs the competitive damage from direct rivalry. Moreover, note that the absolute values of the cross-form effect coefficients in the *Mass* models are substantially lower than their counterparts in the *Density* models. The larger cross-population competitive or symbiotic effects in terms of density, again, suggest the prominent role of institutions in constraining organizational growth in China.

DISCUSSION

The drivers of the success – or failure, for that matter – of foreign enterprises are determined by the characteristics of the host country's environment. This insight, as such, is anything but new in international business. However, in this paper we added two novel twists to this general logic. The first twist is that we sought to integrate complementary insights from institutional theory and organizational ecology into international business. Henisz and Delios (2002) and Henisz (2004) have already argued that this is, as yet, largely unexplored territory. In international business the combination of both perspectives is essential, since ecological processes evolve within the constraints set by the institutional context, which differs wildly from one country to the other. Particularly in transition economies, a straightforward application of organizational ecology makes no sense, as the "free" forces of selection cannot operate in such environments. This is the second twist central in the current study. Together, both twists to the general international business logic as to the local drivers of foreign enterprises' performance imply two main contributions to the extant literature.

Theoretically, we develop an institutional ecology of foreign enterprises' performance in transition economies, explicitly hypothesizing about cross-form interaction. The institutional pillar of this logic relates to the barrier to entry argument, and the ecological pillar to the gateway to growth reasoning. On the one hand, in many transition economies, institutional constraints are imposed on foreign enterprises by regulation that limits FDI opportunities. On the other hand, after entry,

foreign enterprises can benefit from their competitive advantages in their ecological struggle against domestic rivals. This logic produces different sets of hypotheses as to foreign enterprises' density and sales growth, in interaction with domestic organizations. Empirically, we introduce the so-called partial adjustment model in international business. The partial adjustment model was developed in bio-ecology to study the growth of species *x* in interaction with species other-than-*x*. The model estimates the effect of carrying capacity, adjustment speed, intra-population competition and cross-species interaction. In our setting, this logic was translated to apply to different organizational forms – that is, different ownership arrangements. In so doing, we could estimate the institutionally constrained ecological interaction between foreign-invested ventures, privately held domestic enterprises, and state-owned domestic organizations in a community ecology framework.

The empirical evidence largely supports Hypotheses 1a, 1b, 2, 3a and 3c, and partly supports Hypotheses 3b and 3c-alt. All this together provides evidence for our twofold institutional barrier to entry and ecological gateway to growth argument. By and large, however, the positive effect of FIEs on domestic rivals goes against our hypotheses (though their effect on privately held enterprises' mass growth is negative). These unexpected symbiotic rather competitive effects may suggest that the positive managerial and technological spillovers from foreign enterprises to domestic firms outweigh the downside of direct competitive rivalry. This interpretation is in line with the technology spillover argument that foreign entrants can increase the speed of technology transfer from foreign entrants to local firms by demonstrating their technological superiority (Caves, 1974; Chang & Xu, 2008).

This remark relates to an important caveat: by far the majority of our foreign enterprises are, forced by Chinese regulation, engaged in alliances with domestic firms. So the spillover effect from foreign to domestic enterprises might be channeled through the former's local alliance partners, which subsequently operate as knowledge transfer nodes in the network of domestic organizations. Moreover, our results for foreign-invested ventures apply mainly to allied foreign enterprises. If some domestic firms have ties to many foreign firms in the market, they may not be competing with FIEs as much as they would if there were no ties. This is, of course, a serious limitation implied by our data set. We cannot be sure whether our findings also apply in contexts where alliances with domestic firms are less common. This is something we would like to explore in future work. We do believe, in this respect, that our theoretical logic and empirical methodology offer a promising steppingstone for this kind of work in international business.

Our study contributes to our understanding of the intricate impact of ecological processes and institutional constraints on the evolution of foreign investment in the Chinese transition economy. Of course, further development of our novel institutional theory – organizational ecology perspective requires much more work. For one, replication in different settings is a must. Does our theory apply to other countries, industries and periods? As is clear from the organizational ecology tradition, the evolutionary clock needs sufficient time to tick. In this context, transition economies imply clear pros and cons. On the one hand, transition speeds up the evolutionary process by "resetting the clock" through the implementation of reform programs. It offers a unique "natural laboratory" for studying the impact of shifting institutional features on evolutionary processes in the organizational world. In the current paper we developed a first attempt to do so. On the other hand, the transition is so recent that the evolutionary processes are still far from mature. This offers ample opportunities for future work, also in the domains of international business and economics.

ACKNOWLEDGEMENTS

Arjen van Witteloostuijn gratefully acknowledges the financial support of the Odysseus program of the Flemish Science Foundation (FWO). We thank three reviewers and Anand Swaminathan for their constructive comments. Of course, the usual disclaimer applies.

NOTES

[1]This definition is in line with the following legal documents: Law of the People's Republic of China on State-owned Industrial Enterprises (1988); Interim Regulation of the People's Republic of China on Rural Collectively Owned Enterprises (1990); Interim Regulation of the People's Republic of China on Urban Collectively Owned Enterprises (1991); Interim Regulation of the People's Republic of China on Privately Owned Enterprises (1988); Law of the People's Republic of China on Foreign Invested Enterprises (1986).

[2]Anand Swaminathan suggested distinguishing with-alliance from without-alliance sub-forms. However, regrettably, we cannot do so, owing to data unavailability. This type of information is, generally, non-existent for the Chinese construction industry, with some exceptions for some years. For example, only in 4 years (1999, 2000, 2001, and 2003) have the official data made such a distinction; for the remaining years the official data simply do not report the figures of without-alliance sub-forms separately. Note that we checked for the fraction of without-alliance sub-forms in the total population of FIEs for the available 4 years. The without-alliance FIEs account for 2.8–5.6% (in term of sales, or mass) and 7.8–11.1% (in terms of density) of the total FIEs' population size. These shares are, in all likelihood, even much smaller for the pre-1999 period, given the nature of regulation. So, basically, our results relate to with-alliance FIEs.

[3]The introduction of this quadratic term closely follows Carroll (1981) in the assumption that resource abundance increases carrying capacity at a decreasing rate. Removing the quadratic term, as in Brittain and Wholey (1988) and an earlier version of this paper, revealed no differences.

[4]Autocorrelation is controlled by specifying a panel (province) specific AR(1) process.

[5]Given the complexity of such a community structure matrix and the possible feedback processes embedded (Baum & Kom, 1994; Baum & Singh, 1994b), cross-form interaction effects are not always systematically patterned (e.g., Brittain & Wholey, 1988; Carroll, 1981). This implies a need for careful interpretation, relating to the empirical context at hand.

REFERENCES

Ai, C., & Wen, M. 2005. Ownership and sector performance in current China: A regional study. *Annals of Economics and Finance*, *6*(2): 303–317.

Barnett, W. P., & Hansen, M. T. 1996. The red queen in organizational evolution. *Strategic Management Journal*, 17(SI): 139–158.

Baum, J. A. C. 1996. Organization ecology. In S. Clegg, C. Hardy & W. R. Nord (Eds), *Handbook of organizational studies*, 76–114. London: Sage Publications.

Baum, J. A. C., & Kom, H. J. 1994. The community ecology of large Canadian companies, 1984–1991. *Canadian Journal of Administrative Sciences (Revue canadienne des sciences de l'administration*, 11(4): 277–294.

Baum, J. A. C., & Menzias, S. J. 1992. Localized competition and organizational failure in the Manhattan hotel industry, 1898–1990. *Administrative Science Quarterly*, 37(4): 580–604.

Baum, J. A. C., & Singh, J. V. 1994a. Organizational niches and the dynamics of organizational founding. *Organization Science*, 5(4): 483–501.

Baum, J. A. C., & Singh, J. V. 1994b. Organizational niches and the dynamics of organizational mortality. *American Journal of Sociology*, 100(2): 346–384.

Brittain, J. W., & Wholey, D. R. 1988. Competition and coexistence in organizational communities: Population dynamics in electronic components manufacturing. In G. R. Carroll (Ed.), *Ecological models of organizations*, 195–222. Cambridge, MA: Ballinger Publishing Company.

Broadman, H. G., & Sun, X. 1997. The distribution of foreign direct investment in China. *World Economy*, 20(3): 339–361.

Buckley, P. J., Clegg, J., & Wang, C. Q. 2002. The impact of inward FDI on the performance of Chinese manufacturing firms. *Journal of International Business Studies*, 33(4): 637–635.

Carroll, G. R. 1981. Dynamics of organizational expansion in national systems of education. *American Sociological Review*, 46(5): 585–599.

Carroll, G. R., & Hannan, M. T. 2000. *The demography of corporations and industries*. Princeton, NJ: Princeton University Press.

Caves, R. E. 1974. Multinational firms, competition and productivity in host-country markets. *Econometrica*, 41(162): 176–193.

Chang, S. J., & Xu, D. 2008. Spillovers and competition among foreign and local firms in China. *Strategic Management Journal*, *29*(5): 495–518.

Chen, C. 1996. Regional determinants of foreign direct investment in mainland China. *Journal of Economic Studies*, *23*(2): 18–30.

Chen, J. J. 1997. China's construction industry and foreign investment. *Building Research and Information*, 25(1): 5–10.

Chen, X., & Zhu, X. 2005. Government controlling and firm performance: An empirical study on China's listed companies. *Chinese Business Review*, 4(*7*): 54–58.

Freeman, J., & Lomi, L. 1994. Resource partitioning and foundings of banking cooperatives in Italy. In J. A. C. Baum & J. V. Singh (Eds), *Organizational evolution: New directions*, 269–293. Newbury Park, CA: Sage.

Fujita, M., & Thisse, J. F. 2002. *Economics of agglomeration: Cities, industrial location and regional growth*. Cambridge: Cambridge University Press.

Fung, K. C., Lizaka, H., & Parker, S. 2002. Determinants of US and Japanese direct investment in China. *Journal of Comparative Economics*, 30(3): 567–568.

Gale, A., & Luo, J. 2004. Factors affecting construction joint ventures in China. *International Journal of Project Management*, *22*(1): 33–42.

Garnaut, R., & Song, L. 2003. *China's third economic transformation: The rise of the private economy*. London: Routledge Curzon.

Garnaut, R., Song, L., Yao, Y., & Wang, X. 2001. *Private enterprises in China*. Canberra: Asia Pacific Press at the Australian National University.

Hale, G., & Long, C. 2006. FDI spillover and firm ownership in China: Labor market and backward linkages. Working Paper 2006–25, Federal Reserve Bank of San Francisco.

Hannan, M. T., Carroll, G. R., Dundon, E. A., & Torres, J. C. 1995. Organization evolution in a multinational context: Entries of automobile manufacturers in Belgium, Britain, France, Germany and Italy. *American Sociological Review*, 60(4): 509–528.

Hannan, M. T., & Freeman, J. 1977. The population ecology of organizations. *American Journal of Sociology*, 82(5): 929–964.

Hannan, M. T., & Freeman, J. 1989. *Organizational ecology*. Cambridge, MA: Harvard University Press.
Hannan, M. T., Pólos, L., & Carroll, G. R. 2007. *Logics of organization theory: Audiences, codes and ecologies*. Princeton, NJ: Princeton University Press.
Hannan, M. T., Ranger-Moore, J., & Banazak-Holl, J. 1990. Competition and the evolution of organizational size distributions. In J. A. C. Baum & J. V. Singh (Eds), *Organizational evolution: New directions*, 246–268. Newbury Park, CA: Sage.
Head, K., & Ries, J. 1996. Inter-city competition for foreign investment: Static and dynamic effects of China's incentive areas. *Journal of Urban Economics*, 40(1): 38–60.
Henisz, W. J. 2004. The institutional environment for international business. In P. J. Buckley (Ed.), *What is international business?*. New York: Palgrave.
Henisz, W. J., & Delios, A. 2002. Learning about the institutional environment. In P. Ingram & B. Silverman (Eds), *The new institutionalism in strategic management*, Vol. 19: 339–372. New York: JAI Press.
Kornai, J. 1986. The soft budget constraint. *Kyklos*, 39(1): 3–30.
Lane, J., Broadman, H. G., & Singh, I. 1998. Labor flexibility, ownership and firm performance in China. *Review of Industrial Organization*, 13(6): 621–635.
Lauffs, A., & Tan, A. 2002. A new foreign investment regime. *China Business Review*, 29(4): 22–25.
Leung, C. K. 1990. Locational characteristics of foreign equity joint venture investment in China, 1979–1985. *Professional Geographer*, 42(4): 403–421.
Li, S. 2004. The puzzle of firm performance in China: An institutional explanation. *Economics of Planning*, 37(1): 47–68.
Lomi, A. 2000. Density dependence and spatial duality in organizational founding rates: Danish commercial banks, 1846–1989. *Organization Studies*, 21(2): 433–461.
Luo, J. 2001. Assessing management and performance of Sino-foreign construction joint ventures. *Construction Management and Economics*, 19(1): 109–117.
Luo, J., Gale, A., & He, X. 2001. Investing in the Chinese construction industry via joint ventures. *Building Research and Information*, 29(4): 277–285.
Nee, V. 1992. Organizational dynamics of market transaction: Hybrid forms, property rights and mixed economy in China. *Administrative Science Quarterly*, 31(1): 1–27.
Nielsen, F., & Hannan, M. T. 1977. The expansion of national educational systems: Tests of a population ecology model. *American Sociological Review*, 42(3): 479–490.
Peng, M. W., Tan, J., & Tong, T. W. 2004. Ownership types and strategic groups in an emerging economy. *Journal of Management Studies*, 41(7): 1105–1129.
Pennings, J. M., Lee, K., & van Witteloostuijn, A. 1998. Human capital, social capital, and firm dissolution. *Academy of Management Journal*, 41(4): 425–440.
Shen, L. Y., Zhao, Z. Y., & Drew, D. S. 2006. Strengths, weaknesses, opportunities, and threats for foreign-invested construction enterprises: A China study. *Journal of Construction Engineering and Management*, 132(9): 966–975.
Taubmann, W., Heberer, T., & Jie, F. 2003. Economic structures and changes in rural enterprises in China at the end of the twentieth century: The privatization of enterprises. *Chinese Economy*, 36(6): 5–88.
Tuma, N. B., & Hannan, M. T. 1984. *Social dynamics: Models and methods*.. San Francisco, CA: Academic Press.
Wang, D., Hadavi, A., & Krizek, R. J. 2006. Chinese construction firms in reform. *Construction Management and Economics*, 24(5): 509–519.
Wilkinson, B., Eberhardt, M., & Millington, A. 2006. On the performance of Chinese state-owned and private enterprises: The view from foreign-invested enterprises. *Journal of General Management*, 32(1): 65–80.
World Bank. 2008. Doing business in China 2008. http://www.doingbusiness.org/subnational/exploreeconomies/China.aspx. Accessed 30 September 2008.
Xu, T., Tiong, R. L. K., Chew, D. A. S., & Smith, N. J. 2005. Development model for competitive construction industry in the People's Republic of China. *Journal of Construction Engineering and Management*, 131(7): 844–853.
Zhang, J. 2005. *A fifty-year journey of China towards the world economy: An empirical study on the determinants of China's bilateral trade relations*, PhD thesis, University of Groningen, Groningen.

ABOUT THE AUTHORS

Chaohong Zhou is a postdoctoral researcher at Utrecht University's School of Economics, The Netherlands. He holds a PhD in Economics (2009) from the University of Groningen, The Netherlands. His research focuses on organizational ecology and FDI, applied to China. He is a Chinese citizen. E-mail address: c.zhou@uu.nl.

Arjen van Witteloostuijn is a research professor in Economics and Management at the University of Antwerpen, Belgium, and a professor of Institutional Economics at Utrecht University, the Netherlands. He holds a PhD degree in Economics from the University of Maastricht, the Netherlands. His research is at the interface of business, economics, psychology, public administration, and sociology. He is an area editor of *JIBS*. He is a Dutch citizen. E-mail address: arjen.vanwitteloostuijn@ua.ac.be.

Accepted by Anand Swaminathan, Area Editor, 19 April 2009. This paper has been with the authors for three revisions.