

## INSTITUTIONAL BARRIERS AND INDUSTRY DYNAMICS

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*This study demonstrates that new entrants exhibit higher productivity but also higher exit hazard than incumbents in post-liberalization China. We argue this seemingly paradoxical relationship is attributable to institutional barriers, defined as the hindrance in the institutional environment that prevents market selection forces to function. New entrants require higher productivity to compensate for those institutional barriers, which in turn implies a higher exit hazard after controlling for productivity. Our empirical findings support this argument and further show that the differences in productivity and exit hazard between new entrants and incumbents become smaller where and when institutional barriers recede. By integrating economic and institutional perspectives, we highlight the importance of institutional factors in shaping industry evolution. Copyright © 2013 John Wiley & Sons, Ltd.*

### INTRODUCTION

Beginning with Schumpeter's seminal work (Schumpeter, 1934), a central question for business scholars is how the competitive interaction between new entrants and incumbents shapes the process of industry evolution (Agarwal, Sarkar, and Echambadi, 2002; Geroski, 1995; Stinchcombe, 1965). To account for this process, the economics literature develops models in which market entry and exit are determined by economic efficiency (Hopenhayn, 1992; Jovanovic, 1982; Melitz, 2003). Originally developed in free-market economies, these models often assume away the institutional environment, predicting a one-to-one correspondence between productivity and survival (Baldwin, 1995; Syverson, 2011). We extend

this literature to a setting where the impact of economic forces on industry evolution is moderated by institutional factors. In the context of post-liberalization China, we find that new entrants have higher productivity than incumbents, but despite their higher productivity, they are also more likely to fail, creating a divergence between productivity and survival.

We argue this seemingly paradoxical relationship can be attributed to institutional barriers, defined as the hindrance in the institutional environment that prevents market selection forces to function (Li and Atuahene-Gima, 2001; Luo and Junkunc, 2008; Tybout, 2000). These institutional barriers create persistent survival advantages for incumbent firms independent of their productivity, which increase the fixed costs of doing business for new entrants. As a consequence, only new entrants with higher productivity are able to enter and operate in the industry. Thus, institutional barriers truncate the productivity distribution of potential entrants, raising the average productivity of actual entrants. Meanwhile, new entrants are more likely

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to exit after controlling for productivity, reflecting their survival disadvantages stemming from institutional barriers.

This study employs two empirical strategies to support these arguments. First, we jointly examine productivity and exit hazards. A divergence between these two variables according to entry timing suggests the existence of institutional barriers. Second, we explore whether such a divergence would vary according to the changes in institutional environments. To test this idea, we exploit institutional variations generated by the gradual reform process in China and adopt the difference-in-difference approach (Rajan and Zingales, 1998; Samaniego, 2009). If we find the divergence between productivity and exit hazard varies systematically with the magnitude of institutional barriers, we can offer stronger evidence for the role of institutional factors in shaping industry evolution. We find empirical support for these intuitions using census data from the Chinese National Bureau of Statistics (NBS) from 1998 to 2007.

This study seeks to improve our understanding of industry evolution by introducing insights from institutional theory into the established economics models that assumed away institutional environments. By examining the divergence between efficiency and survival, we offer an institution-based perspective to understand the long-standing debate whether new entrants are productive enough to replace incumbents (Schumpeter, 1934, 1942). This perspective may be particularly relevant in settings where institutional barriers are significant. We also aim to contribute to institutional theory by identifying a novel theoretical mechanism through which institutional factors affect economic outcomes. As the term 'liability' implies, the liability of newness literature has primarily focused on how institutional barriers lead to negative survival outcomes for new entrants (Stinchcombe, 1965). Adding to this literature, we identify circumstances in which institutional barriers lead to positive productivity outcomes for new entrants. In doing so, we respond to a call from the recent institutional theory literature that emphasizes the need to isolate the specific mechanisms by which 'identical' institutional forces can result in... *divergent* outcomes (Scott, 2008: 177; italics added by authors). This research further extends the literature that examines the impact of environmental changes on the relative advantage of new entrants vis-à-vis incumbents (Agarwal *et al.*, 2002; Sarkar

*et al.*, 2006). We explicitly consider the interplay between entry/exit dynamics and institutional variations, shedding new light on industry evolution in the context of institutional changes.

## THEORY AND HYPOTHESES

We define institutions as the basic rules of the game, such as legal regimes and the way they are enforced, widely held norms that constrain behavior, and organizing principles of economic activity (North, 1990). Institutional barriers are the hindrance in the institutional environment that prevent the market selection mechanism from functioning properly. Institutional barriers can result from inadequate institutional infrastructure, such as poorly specified property rights and contract laws (Li and Atuahene-Gima, 2001; Nee, 1992), institutional voids, such as underdeveloped labor and capital markets (Khanna and Palepu, 1997), or institutional susceptibility (or institutional obstacles), such as excessive regulatory requirements and requests for bribery (Luo and Junkunc, 2008; Tybout, 2000). We use the term institutional barriers following the spirit of 'barriers to survival', introduced by Geroski (1995: 424) to denote the stylized fact that 'the survival rate of most entrants is low'. This concept allows us to examine how institutional transitions moderate industry evolution, a process similar to the effect the structural shift of technological regimes has on the productivity and the survival likelihood of new entrants (Agarwal *et al.*, 2002; Sarkar *et al.*, 2006). Specifically, we investigate how institutional barriers create a wedge, leading to the divergence between productivity and survival according to entry timing. We draw on two streams of literature: industry dynamics and institutional buffering, and develop a theoretical framework by integrating them.

### Industry dynamics and institutional buffering

Understanding industry dynamics is important for researchers in economics and strategy. The economic literature has focused on the impact of efficiency on firm survival. According to Jovanovic's (1982) model, firms possess different levels of efficiency, as determined by a random draw upon entry, which remains fixed over time. Firms know only the distribution of this draw, not their exact efficiency level; they must update efficiency expectations based on past performance.

More efficient firms choose to stay in business and expand, while less efficient firms contract and exit. Hopenhayn (1992) extends Jovanovic's model by assuming that, after firms draw their initial productivity level from the same distribution, they are subject to firm-specific productivity shocks following a Markov process. Firms exit when their expected profits based on realized productivity cannot cover fixed costs. New firms continue to enter until the expected profits of entry are equal to the cost of entry. This process leads to a stationary equilibrium with simultaneous entry and exit, as well as heterogeneous size and growth rates. These models have been enriched in various theoretical settings (Asplund and Nocke, 2006; Ericson and Pakes, 1995; Melitz, 2003), evolving into a platform for empirical research to understand the relationship between economic efficiency and industry turnover (cf., Bartelsman and Doms, 2000; Bartelsman, Haltiwanger, and Scarpetta, 2009).

While the industry evolution models outlined above provide a basis to study economic efficiency, they often assume away institutional factors, resulting in a one-to-one correspondence between productivity and survival. In reality, however, industry evolution can be interrupted by government regulation and distorted by institutional barriers. For example, firms in transitional economies, such as China, are subject to both market forces and institutional legacies from the planned economy. Thus, it is important for economic theory to be informed by institutional theory when examining the process of industry evolution in the face of institutional changes.

Organization researchers have long argued that institutional forces may buffer incumbents from selection pressures regardless of their economic efficiency, a mechanism in the literature known as institutional buffering (Aldrich, 1979, 1999). Institutional theorists propose that legitimacy, social support, and approval from external constituents in the institutional environment improve the likelihood of an organization's survival (DiMaggio and Powell, 1983; Meyer and Scott, 1983; Oliver, 1991). Organizations can gain approval and endorsement by building strong connections with established social actors in the institutional environment, through sources including political parties, government relations, charitable organizations, or 'guanxi' (Baum and Oliver, 1991; Li and Zhang, 2007; Miner, Amburgey, and Stearns, 1990; Park and Luo, 2001). Thus, organizations

choose 'legitimation-based strategies' to increase their chances for survival (Suchman, 1995; Zimmerman and Zeitz, 2002).

In social and institutional interactions, in general, it is harder to trust a newcomer, so new organizations face challenges in developing long-lasting relationships with other players in the institutional environment (Singh, Tucker, and House, 1986; Stinchcombe, 1965). As a consequence, older incumbent organizations tend to be viewed as more reliable and accountable than new outfits. Incumbent firms, even less productive ones, can survive without exit. DiMaggio and Powell (1983: 149) point out that 'a wide range of factors—institutional commitment, elite sponsorship, and government support in terms of open-end contracts, subsidy, tariff barriers and import quotas, or favorable tax law—reduce selection pressures even in a competitive organizational field'. Such institutional buffering effects, by definition independent of productivity, can take either intangible forms, such as legitimacy (Suchman, 1995; Zimmerman and Zeitz, 2002), or tangible forms, such as government contracts or direct subsidy (Nee and Opper, 2010). In practice, institutional buffering works by providing resources to firms. For example, as our field interview shows, a loss-making state-owned enterprise might secure a loan from state banks to pay its workers and suppliers to remain viable (Kornai, Maskin, and Roland, 2003).<sup>1</sup> Given the carrying capacity of a particular industry, a larger number of surviving incumbents creates higher selection pressure for new entrants. While it is possible for new entrants to gain or develop their own institutional buffering to neutralize incumbents' advantages, it is difficult to eliminate the gap completely in a short period of time because it takes significant investment and time to develop and cultivate institutional ties (Park and Luo, 2001). In effect, newer entrants may continue to be disadvantaged due to time compression diseconomies (Dierickx and Cool, 1989).

Given their relative disadvantage in institutional buffering, new entrants need to consider alternative

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<sup>1</sup> Most of the examples in this article are drawn from the field interviews we conducted in China, covering regions with different degrees of market development and government interventions, companies of different size and industries, and various industry participants including managers, consultants, and bankers. Overall, these field interviews support the validity of our theoretical constructs and resonate with our findings from the large-sample analysis.

strategies to conform with the given institutional environment. A clear alternative strategy is to enter with superior efficiency to overcome institutional barriers, which we label 'efficiency-based strategies'. There has been little research on how institutional buffering affects efficiency outcomes, since the institutional buffering literature has focused on how institutional factors buffer firms from selection forces, i.e., survival outcomes. Just as existing economic models assume away institutional factors, the institutional buffering literature does not examine the consequences of efficiency. While this assumption may be appropriate when studying nonprofit organizations (Singh *et al.*, 1986), relaxing this assumption improves our understanding of economic efficiency, another important performance criterion of industry evolution. To address this issue, we integrate the industry dynamics and institutional buffering literatures by examining how institutional buffering influences economic efficiency.

We formalize these arguments by incorporating institutional barriers into the established industry economic models. Institutional barriers increase the fixed costs of doing business for new entrants vis-à-vis incumbents (Melitz, 2003). We consider institutional buffering not as a one-time cost of entry but as fixed costs of doing business, because the impact of institutional buffering on survival may persist over time. For example, in the early stages of China's gradual reform process, the market was not fully liberalized and market selection forces did not fully function to determine entry and exit. New entrants found it difficult to compete with loss-making incumbent firms that undercut prices based on subsidies from the government. Institutional buffering truncates the productivity distribution of new entrants since only firms that can afford to pay additional fixed costs can enter and operate in the industry. Because firms with low productivity cannot afford the extra fixed costs of doing business, the average productivity of entrants in this truncated distribution will rise in proportion to the amount of the fixed costs. This argument fits well with existing models on industry dynamics. In the Melitz (2003) and Hopenhayn (1992) models, both efficient and inefficient firms can enter *ex ante* since they do not know their exact productivity but only more efficient firms can survive *ex post*. Thus, it appears that, on average and in equilibrium, later cohorts are more efficient than early cohorts.

Alternatively, if we assume that firms have some knowledge of their actual productivity level before entry, as in Klepper (1996), the existence of institutional buffering lets only more efficient firms enter in later cohorts. Thus, according to either line of models, conceptualizing institutional buffering as fixed costs suggests that new entrants will have higher productivity than incumbents.

This conceptualization, from the perspective of institutional theory, also implies that new entrants pursue efficiency-based strategies in response to institutional pressures. For example, a new entrant might have to develop more innovative designs and services of higher quality to compete with well-connected incumbent firms that undercut competition based on a government subsidy. This mechanism, in fact, resonates with a related insight by Stinchcombe (1965: 148): 'If an alternative requires new organization, it has to be much more beneficial than the old before the flow of benefits compensates for the relative weakness of the newer social structure'. Stinchcombe's original insight, however, has not been leveraged in the subsequent literature on 'liability of newness', which tends to focus on survival outcomes. We return to this important, yet under-studied, aspect of Stinchcombe's original arguments, using it as a lens to integrate insights from both the economics theory and the institutional theory literature. New entrants could resort to efficiency rather than conforming to the institutional environment in order to survive. Such a balanced view allows us to contribute a novel theoretical explanation to the divergent outcomes or organizational heterogeneity existing in the same general environment (Scott, 2008).

Based on these arguments, we expect that new entrants should exhibit higher productivity to compensate for the liability of newness arising from institutional buffering. Correspondingly, if we examine firms' survival rates after controlling for their productivity, we expect that new entrants are more likely to exit than incumbent firms. Such a difference in the exit rate between incumbents and new entrants, when productivity is controlled for, reflects the incumbent's survival advantage granted by institutional buffering. In effect, institutional barriers play a dual role in leading to the divergent prediction on the productivity and survival of new entrants vis-à-vis incumbent firms: on one hand, they require a higher productivity for new entrants to compensate for their survival disadvantage; on the other hand,

they allow incumbents a higher survival rate than new entrants at the same level of productivity. Therefore, we expect a divergence between productivity and survival to exist where and when there are institutional barriers. In order to test this hypothesis, we need to examine jointly both productivity and exit hazard of firms according to their entry timing. Thus, we hypothesize that

*Hypothesis 1: A divergence exists between productivity and survival according to entry timing where and when there are institutional barriers: (a) new entrants are more productive than incumbent firms; (b) new entrants are also more likely to exit, controlling for their productivity.*

### **Institutional variations**

Stinchcombe (1965) notes that the institutional environment can change to alleviate the liability of newness. For example, if a society provides stronger infrastructure to offer new entrants access to financial resources and intermediary services, then the liability of newness will be lower, because new entrants' lack of social and political connections can be mitigated by market-based institutions. Extending this logic, we argue that reducing institutional barriers will narrow the divergence between productivity and survival.

Institutional barriers vary greatly from region to region and from time to time. For example, China consists of heterogeneous provinces with different degrees of market development and openness to competition due to its gradual reform policy (Nee, 1992; Walder, 1995). In 2007, it took 29 days to register a commercial property in Shanghai, but it took 78 days in Lanzhou, the capital city of an inland province. Similarly, the time Chinese firms spent interacting with government bureaucracies ranged from 36 days/year at the top 10th percentile of cities to 87 days/year at the bottom 10th percentile of cities (World Bank, 2006, 2008). When excessive regulatory compliance occupies valuable firm resources of managerial time and attention, it acts as an institutional barrier or fixed cost. Therefore, it is important to understand how institutional variations affect industry dynamics. China's gradual reform process creates a quasi-experimental setting to examine the impact of variation in institutional environments

across regions, while controlling for country-level unobserved heterogeneity.

It is also important to consider the temporal dimension of industry evolution because institutional barriers also change over time, especially in transitional economies. China has evolved from a reforming economy fraught with political uncertainty to one more favorable to entrepreneurial activities (Li and Atuahene-Gima, 2001; Luo, 2003; Tan and Tan, 2005). The general environment has changed from one where institutional dimensions are important to one where technical dimensions are becoming more important. For example, as our field interviews confirm, a rapidly growing venture capital industry allows new entrants to raise capital to compete with established incumbent firms (Ahlstrom, Bruton, and Yeh, 2007), although the incumbent firms may have preferential access to bank loans based on social relations. Similarly, new entrants can rely on market-based intermediaries for legal, accounting, and information services, even if they lack social connections (Zhang and Li, 2010). In these cases, new entrants are less disadvantaged compared with incumbent firms due to improved institutional infrastructure and market institutions (Li and Atuahene-Gima, 2001; Nee, 1992). Furthermore, while China's overall liberalization process is gradual, its 2001 entry into the World Trade Organization (WTO) was a major event with a fundamental impact on further liberalization. Various reforms geared toward domestic firms—e.g., the legalization of private firms and relaxation of bankruptcy procedures for state-owned enterprises (SOEs)—preceded the WTO entry to prepare for full-scale competition with foreign firms.

Following from these discussions, we expect the divergence between productivity and survival to narrow when institutional barriers decrease. When institutional buffering is reduced by the removal of institutional barriers, the fixed costs of doing business are reduced. Thus, the decrease in institutional barriers is associated with a lower threshold that truncates the productivity distribution for entrants. With a decrease in the threshold, the observed average productivity of the truncated distribution for new entrants will become lower. Therefore, the productivity difference between new entrants and incumbents, i.e., new entrants' superior productivity requirement to compensate for the institutional buffering effect, is reduced when

institutional barriers are lowered. Correspondingly, when we examine firms' survival rates after controlling for productivity, the survival disadvantage of new entrants is lower when institutional barriers are lower. To test this hypothesis, we need to examine jointly both productivity and exit hazard of firms according to their entry timing when institutional barriers change. We thus have the following hypothesis.

*Hypothesis 2: The divergence between productivity and survival according to entry timing decreases when institutional barriers are reduced: a) the productivity gap between new entrants and incumbent firm, as observed in hypothesis 1a, is reduced when institutional barriers are lower; b) the survival rate difference between new entrants and incumbent firm, as observed in hypothesis 1b, is reduced when institutional barriers are lower.*

## RESEARCH METHODS

### Empirical setting

China's recent liberalization process provides an ideal empirical setting to test our hypotheses on how various degrees of institutional barriers affect the industry dynamics between new entrants and incumbent firms. Prior to 1978, China was a planned economy dominated by state-owned enterprises (SOEs). SOEs had little control over their operations and no incentive to improve cost efficiency or product quality. As a result, industry in China was characterized by inefficiency and stagnation (Rawski, 1980). Beginning in 1978, China sought to address these issues with the adoption of a 'reform and open-door policy', which catalyzed the transition from a planned economy to a market economy. This liberalization process can be divided into three major phases: the gradual reform phase (1978–1992), the liberalization phase (1993–1998), and the post-liberalization phase (1998–present).

During the first phase of the reform, China opted to undergo a gradual transition rather than the 'big bang' approach taken by former Soviet Bloc nations, where SOEs were immediately privatized en masse. Through a gradual approach, the Chinese government sought to increase the efficiency of SOEs by providing them with increased

autonomy and incentives. At the same time, the Chinese government sought to address demands unmet by SOEs by allowing non-SOEs—private firms, collective firms, and foreign firms (mainly in joint ventures)—to enter the market. The entry of non-SOEs was facilitated by introducing a dual-track pricing system whereby market supply and demand determined the price of inputs and outputs above and beyond the predetermined quota. Despite these capitalist elements, the primary purpose of the first phase of the reform was to enhance the efficiency of SOEs while avoiding their collapse from competitive market forces (Lau, Qian, and Roland, 2000). As such, non-SOEs were treated as a supplement to, rather than a replacement for, SOEs.

China's decentralized economic structure facilitated this gradual reform approach to economic liberalization. Each region in China historically operated as a self-contained market in which a variety of industries operate under the control of regional governments, analogous to the M-form organization structure (Chandler, 1962). This decentralized structure helped economic liberalization by promoting the entry and expansion of non-SOEs for two reasons: regional governments had incentives to promote non-SOEs as an important source of regional economic growth; and the central government could experiment with liberalization by introducing non-SOEs at the regional level and, if successful, diffuse the practices across the nation (Qian, Roland, and Xu, 1999, 2006).

Although the first phase of the reform in China generated encouraging results, two lingering issues prevented further economic growth. First, SOEs experienced limited gains in efficiency, primarily due to vague property rights. Second, the decentralized market structure of China implies the objective of each region is to maximize local economic growth, but not necessarily national economic efficiency. This decentralized structure often leads to regional protectionism, duplicative investments, and misallocation of resources (Young, 2000). This second issue is exacerbated because the political careers of regional leaders are closely tied to the economic performance of their own regions vis-à-vis other regions (Li and Zhou, 2005).

In response to these problems, the Chinese government shifted reform policy to facilitate ownership restructuring and promote market competition during the second phase of reform (1993–1998)

(Jefferson *et al.*, 1999; Wu, 2005). This phase was initiated in November, 1993 by the National Congress of the Communist Party of China (NCCPC), which proclaimed the establishment of a 'socialist market economy' and a modern corporate system as its primary goals. In December 1993, the NCCPC passed the Corporate Law, which facilitated the privatization and corporatization of former SOEs and collective firms. In September 1997, the NCCPC officially recognized the political legitimacy of non-SOEs as integral to the socialist market economy. Also in 1997, the Chinese government issued policies to facilitate the bankruptcy of insolvent SOEs. In addition, private ownership was explicitly legalized in a 1998 constitutional amendment. The domestic policy reform coincided with the relaxation of restrictions on foreign direct investment (FDI). Beginning with the establishment of four special economic zones in 1980, China has pursued an open-door policy to attract FDI, mainly through joint ventures. With China's accession to the WTO in 2001, foreign firms could maintain full ownership and acquire local firms in most nonstrategic industries. As a consequence, FDI inflow increased dramatically.

Through ownership restructuring reforms and an evolving open-door policy, including WTO membership, during the third phase of reform (1998–2007) China came to share important features with other nations characterized by free market economies. Firms with different ownership types were allowed to compete with each other, and, as a result, many local and foreign firms exited. These three phases in China's gradual reform policy generated institutional variations along the dimensions of region and time. Competition and market selection also vary along these dimensions. These variations present a context that allows us to examine the institutional buffering mechanism behind productivity and exit hazard differences between new entrants and incumbents.

## Data

We use annual industrial survey data from the Chinese National Bureau of Statistics (NBS) to test our hypotheses. This database includes financial information for industrial firms with annual sales of at least 5 million Chinese yuan (RMB) (roughly U.S. \$680,000, according to the official 2007

exchange rate) from 1998 to 2007. The annual number of observations ranged from 162,033 to 336,768 belonging to a total of 557,554 firms. (By law, all firms in China are required to participate in the NBS survey.) Several recent studies use the annual industrial firms database (Brandt, Van Biesebroeck, and Zhang, 2011; Chang and Xu, 2008; Hsieh and Klenow, 2009; Park, Li, and Tse, 2006; Zhang *et al.*, 2010). While this database has an advantage in creating a panel with its unique firm identifier, it has a limitation in that it contains only firms with 5 million RMB or more in sales. To overcome this firm size restriction, we also test our hypotheses using the NBS economy-wide census in 2004, in which all 1.19 million industrial firms participated, regardless of annual sales. We perform further robustness checks using this full census and additional subsample analyses (discussed later). If firms undergo restructuring sufficiently significant to require an identifier change, we consider them different firms. Alternatively, we consider them the same by matching them based on demographic information, and redefine entry and exit accordingly. Our results do not vary with this alternative approach. Figure 1 shows the composition of firms in our sample. Figure 1(a) presents a general trend, showing that the proportion of SOEs and collectives among firms in the annual industrial survey declines over time, while that of private, incorporated, and foreign firms increases. Figure 1(b) shows the number of firms by entry year. While some firms trace their establishment year as far back as 1817, many more firms were established after 1978, when China began to pursue economic reform. Figure 1(b) also shows the number of exits during the 1999–2004 time period, when we observe exits.

## Measurements

We measure *entry year* as the calendar year in which a firm was established, as recorded in the NBS database. *Exit* is a dichotomous variable that records the exit event when a given firm identifier at time  $t$  does not reappear in the database at time  $t + 1$ . However, there is a possibility that a firm may have been removed from the annual industrial survey database because sales dipped below 5 million RMB. To address this problem, we record *exit* only when the disappearing firm does not reappear in the 2004 economy-wide census. For example, if a firm exists in the 2001

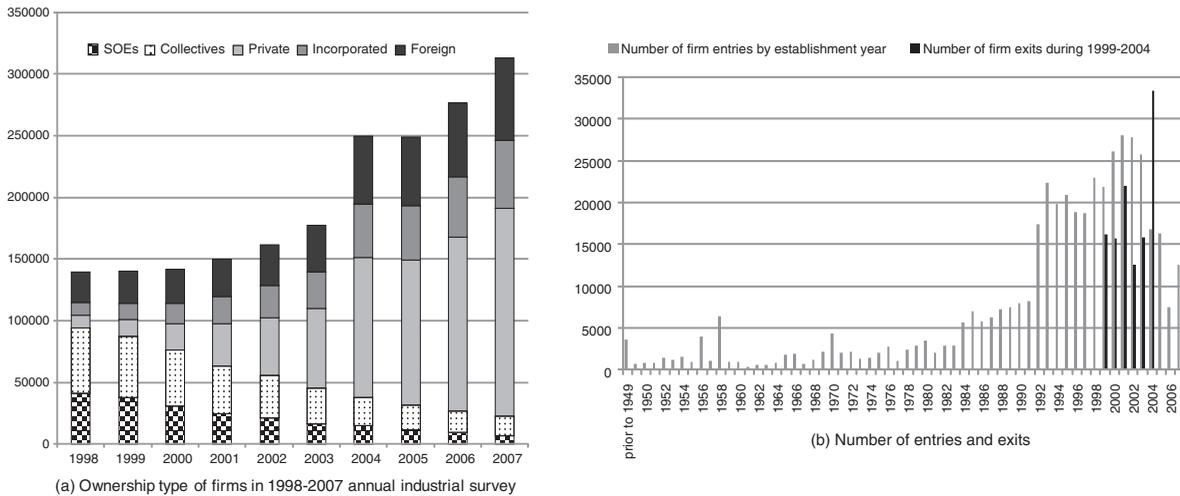


Figure 1. Sample composition

annual industrial survey database but disappears in the 2002 version, we code it as an exit in 2002 only if the same firm does not appear in the 2004 economy-wide census. Using this approach, we exclude cases of false exit when a firm's sales dips below the 5 M RMB threshold. Roughly 1.3 percent of firms that disappear from the annual industrial survey still exist in the 2004 economy-wide census, implying that their sales dipped below the 5 million RMB threshold. Given the need to cross-check exits from the annual surveys with the 2004 economy-wide census, we are able to define exit only during the 1998–2004 period.

We measure institutional barriers with the marketization index, constructed annually from 1998 to 2007 by the National Economic Research Institute (NERI). The marketization index contains five major fields capturing the progress of marketization along different dimensions in each of the 31 provinces in each year. Its major categories include: (1) the relation between the government and the market, (2) the development of the non-state sector, (3) the development of the product market, (4) the development of the factor market, and (5) the development of market intermediaries and the legal environment. Each major category contains several subindices, totaling 23 subindices. The subindices are constructed based on data from the National Bureau of Statistics of China and surveys conducted by NERI. The NERI marketization index forms a panel, showing the relative progress of marketization across different regions over time

in China (see Appendix for more information). This index is a suitable measure since a higher degree of marketization reflects fewer institutional barriers. Incumbents are favored because they have developed strong connections with the governments while it is costly for new entrants to catch up quickly due to time-compression diseconomies. Such connections offer incumbents survival advantages when the market is not fully developed. For example, reflected in category (1) of the NERI index, if the state still dominates resource allocation through state-owned banks, loss-making incumbents can remain viable by getting easier access to credit. Our field research, discussed in the theory section, supports this operationalization. We perform robustness tests with alternative measures for institutional barriers.

In terms of ownership structure, we classify firms into five categories: *foreign firms*, two types of modern local firms (*private firms* and *incorporated firms*), and two types of conventional local firms (*SOEs* and *collectives*). These five firm types represent different levels of technological competency and incentive schemes. For this set of firm-type variables, we take SOEs as the reference category. *Firm size* is measured as a firm's output in billion RMB at time  $t$ . In addition, we control for industry, region, and year fixed effects. We employ the 3-digit SIC as our definition of industry.

We measure firm productivity using a multilateral index developed by Caves, Christensen, and Diewert (1982) and later modified by Aw, Chung,

and Roberts (2003).

$$\begin{aligned}
 \text{Productivity}_{it} &= \left( \ln Y_{it} - \overline{\ln Y_t} \right) \\
 &+ \sum_{\tau=2}^t \left( \overline{\ln Y_\tau} - \overline{\ln Y_{\tau-1}} \right) - \left[ \sum_{j=1}^m \frac{1}{2} (S_{ijt} + \overline{S_{jt}}) \right. \\
 &\left. (\ln X_{ijt} - \overline{\ln X_{jt}}) + \sum_{\tau=2}^t \sum_{j=1}^m \frac{1}{2} (S_{j\tau} + \overline{S_{j\tau-1}}) \right. \\
 &\left. (\overline{\ln X_{j\tau}} - \overline{\ln X_{j\tau-1}}) \right] \tag{1}
 \end{aligned}$$

where  $i$  denotes firm,  $t$  year, and  $j$  type of input ( $j = 1, \dots, m$ ).  $Y_{it}$  denotes output, and  $X_{ijt}$  denotes inputs including labor input, material input, and capital stock.  $S_{ijt}$  denotes input shares, defined as the ratio of labor costs to output for labor input, the ratio of material costs to output for material input, and one minus labor share and material share for capital input. The first term in Equation (1) captures the deviation of a firm’s output in year  $t$  from the industry average output in that year. The second term reflects the cumulative change in industry average output between year  $t$  and the initial year. The third and fourth terms repeat the same for each input  $j$ , which are summed using input share for each firm ( $S_{ijt}$ ) and the average input share for each 3-digit industry ( $\overline{S_{jt}}$  in the third term and  $\overline{S_{j\tau-1}}$  in the fourth term) in each year as weights. The productivity index measures the proportional difference between the productivity of firm  $i$  in year  $t$  relative to the hypothetical firm in the base year. (See File S1 on how we calculate inputs and outputs to measure productivity appropriately.)

This productivity index has several advantages over conventional parametric measures, e.g., the residuals from the Cobb-Douglas production function and its variants. This index is straightforward in computation and flexible in allowing heterogeneous production technology. Given that firms with varying degrees of technological sophistication compete with each other in China, this flexibility makes it particularly relevant to our setting. According to Van Biesebroeck (2007: 529), who examines the robustness of various productivity measures, ‘...when measurement error is small (or outliers are properly controlled *ex post* [parenthesis is ours]), index numbers are among the best for estimating productivity growth and

are among the best for estimating productivity levels’. Another advantage of the productivity index is that it allows for a consistent comparison of firm-level productivity across years. To compare any two firm-year observations that are transitive, this indicator expresses a firm’s output and inputs as deviations from a single reference point. The reference point is a hypothetical firm that operates for each 3-digit SIC industry in the base time period, i.e., 1998, the first year of the annual database, using the industry average for input shares, inputs, and output. We perform robustness tests with alternative ways of measuring productivity.

**Models**

To exploit the panel data, we include the lagged dependent variable to estimate the productivity to capture unobserved firm heterogeneity. We confirm our findings with alternative panel analysis techniques such as the fixed effects or random effects models. Our key variable of interest, entry year, however, drops in the fixed effects model as it is time-invariant. Since we include firms with two consecutive years of data to include the lagged dependent variable, there are 1,357,777 unique firm-year observations in the productivity model. To avoid biasing productivity regressions with outliers, we winsorize both tails of the productivity index by 0.1 percent to remove the most extreme values. The results do not change with or without winsorization. We enter both the marketization index variable and its interaction with entry year. We include industry, year, and region fixed effects to the model. Our empirical model for firm productivity can be summarized as follows:

$$\begin{aligned}
 \text{Productivity}_{it} &= f(\alpha_1 \times \text{entry year}_i, \\
 &\alpha_2 \times \text{entry year}_i \times \text{marketization index}_{it}, \\
 &\alpha_3 \times \text{productivity}_{it-1}, \alpha_4 \times \text{firm size}_{it}, \\
 &\alpha_5 \times \text{ownership}_{it}, \alpha_6 \times \text{marketization index}_{it}, \\
 &\text{industry fixed effects}_i, \text{year fixed effects}_t, \\
 &\text{region fixed effects}_i). \tag{2}
 \end{aligned}$$

As noted earlier, we examine exit only during the 1998–2004 period, because we must rely on the 2004 economy-wide census to verify exit. With one observation for each firm-year pair, there are 851,287 unique firm-year observations in the

exit models. We use the random effects logit specification to estimate the model and control for unobserved firm heterogeneity by including firm random effects. Our empirical model for firm exit can be summarized as follows:

$$\begin{aligned} \text{Probability of exit}_{it+1} = & f(\beta_1 \times \text{entry year}_i, \\ & \beta_2 \times \text{entry year}_i \times \text{marketization}_{it}, \\ & \beta_3 \times \text{productivity}_{it}, \beta_4 \times \text{firm size}_{it}, \\ & \beta_5 \times \text{ownership}_{it}, \beta_6 \times \text{marketization index}_{it}, \\ & \text{industry fixed effects}_i, \text{year fixed effects}_t, \\ & \text{region fixed effects}_i). \end{aligned} \quad (3)$$

Hypothesis 1 expects a divergence between productivity and survival according to entry timing where and when there are institutional barriers. To test this hypothesis, we need to show new entrants are more productive than incumbent firms ( $\alpha_1 > 0$ ) and they are also more likely to exit than incumbent firms, controlling for their productivity ( $\beta_1 > 0$ ). Similarly, Hypothesis 2 expects that the divergence between productivity and survival according to entry timing decreases when institutional barriers are reduced. To test this hypothesis, we need to show that new entrants' productivity requirement ( $\alpha_2 < 0$ ) and their higher exit hazards become lower with fewer institutional barriers ( $\beta_2 < 0$ ). If we find the divergence between productivity and exit hazard narrows when institutional barriers decrease, following the spirit of the difference-in-difference approach (Rajan and Zingales, 1998; Samaniego, 2009), we can offer stronger evidence for the role of institutional barriers in affecting firm entry and exit.

## RESULTS

### Productivity of new entrants

Table 1 shows the descriptive statistics and Table 2 displays the estimated productivity models. In models (1)–(7) of Table 2, we test our hypotheses with entry year and its interactions with the marketization index for the whole sample and for subsamples of each ownership type. In model (1), the coefficient for entry year is significantly positive, supporting Hypothesis 1a, which suggests that the productivity level of more recent entrants is, on average, higher than earlier

entrants. Specifically, the coefficient of entry year in model (1) suggests that newer entrants generate 1.03 ( $= 1 + 0.003 \times 10$ ) times more output than incumbents 10 years older when using the same amount of inputs. Among the control variables, firm size is positively associated with productivity. For ownership type, private firms and collectives have the highest level of productivity, followed by incorporated firms and foreign firms and SOEs that serve as a reference group.<sup>2</sup> Model (2) in Table 2 adds the interaction term between entry year and the marketization index variable in order to test Hypothesis 2a. The interaction term is significantly negative, suggesting that the productivity difference between new entrants and incumbents is smaller when there are fewer institutional barriers, reflected in the marketization index, thereby supporting Hypothesis 2a. The main effect of the marketization index, which is negatively associated with productivity in model (1), turns positive once its interaction effect with entry year is added in model (2), suggesting its effect on productivity is, in fact, conditional on entry year. As institutional barriers decrease, less efficient new entrants can enter the market while overall productivity of all firms improves. For example, when the marketization index is 3 (at a low level), the productivity of a hypothetical firm entering in 1988, evaluating the mean values of all other covariates, is 0.208, while the productivity of the same hypothetical firm entering in 1998 is 0.242, suggesting that a firm entering 10 years later has productivity 3.4 percent higher than the earlier entrant, after controlling for year, industry, and region fixed effects. When the marketization index is 9 (at a high level), the productivity of a hypothetical firm entering in 1988 is 0.153, while the productivity of the same hypothetical firm entering in 1998 is 0.175, showing that the later entrant has productivity 2.2 percent higher than the earlier entrant. Thus, the productivity gap between entrants and incumbents is reduced by 1.2 percentage points (i.e.,  $3.4 - 2.2\% = 1.2\%$ ) when institutional barriers are lowered.

In models (3)–(7), we examine productivity differences in each of the five ownership types.

<sup>2</sup> The coefficients of year fixed effects (not shown in Table 2) show a pattern in which the average productivity of all firms increases over time, suggesting the lower bound of efficiency among surviving firms rises over time due to the gale of creative destruction.

Table 1. Descriptive statistics

	Mean	S.D.	Min	Max	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<b>(a) Productivity model</b>													
(1) Productivity	0.167	0.383	-2.258	2.609	1								
(2) Entry year	1992.818	12.801	1817	2007	0.291	1							
(3) Output	0.075	0.657	0	186	0.024	-0.026	1						
(4) Private	0.362	0.481	0	1	0.204	0.321	-0.041	1					
(5) Incorporated	0.153	0.36	0	1	0.011	0.016	0.044	-0.320	1				
(6) Collectives	0.162	0.368	0	1	-0.022	-0.176	-0.025	-0.331	-0.187	1			
(7) Foreign	0.206	0.404	0	1	-0.044	0.156	0.038	-0.383	-0.216	-0.224	1		
(8) Marketization	7.44	2.251	0	11.71	0.198	0.377	0.023	0.275	-0.034	-0.231	0.182	1	
(9) Lagged productivity	0.148	0.371	-2.258	2.609	0.659	0.284	0.018	0.194	0.007	-0.008	-0.035	0.189	1
N = 1,357,773													
<b>(b) Exit model</b>													
(1) Exit	0.152	0.359	0	1	1								
(2) Entry year	1992.818	12.801	1817	2007	0	1							
(3) Output	0.075	0.657	0	186	-0.025	-0.026	1						
(4) Productivity	0.167	0.383	-2.258	2.609	-0.011	0.291	0.024	1					
(5) Private	0.362	0.481	0	1	0.026	0.321	-0.041	-0.204	1				
(6) Incorporated	0.153	0.36	0	1	-0.025	0.016	0.044	0.011	-0.320	1			
(7) Collectives	0.162	0.368	0	1	0.037	-0.176	-0.025	-0.022	-0.331	-0.187	1		
(8) Foreign	0.206	0.404	0	1	-0.088	0.156	0.038	-0.044	-0.383	-0.216	-0.224	1	
(9) Marketization	7.44	2.251	0	11.71	-0.069	0.377	0.023	0.198	0.275	-0.034	-0.231	0.182	1
N = 851,287													

Table 2. The regression modeling of productivity

Variables	Whole sample		SOEs	Collectives	Privates	Incorporated	Foreign
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Entry year	0.003*** (0.267 × 10 <sup>-4</sup> )	0.004*** (0.775 × 10 <sup>-4</sup> )	0.003*** (0.180 × 10 <sup>-3</sup> )	0.003*** (0.174 × 10 <sup>-3</sup> )	0.003*** (0.207 × 10 <sup>-3</sup> )	0.003*** (0.152 × 10 <sup>-3</sup> )	0.004 *** (0.420 × 10 <sup>-3</sup> )
Output	0.009*** (0.001)	0.009*** (0.001)	0.012*** (0.001)	0.033*** (0.002)	0.098*** (0.002)	0.004*** (0.001)	0.008*** (0.426 × 10 <sup>-3</sup> )
Private	0.107*** (0.001)	0.104*** (0.001)					
Incorporated	0.070*** (0.001)	0.067*** (0.001)					
Collectives	0.097*** (0.001)	0.093*** (0.001)					
Foreign	0.067*** (0.001)	0.064*** (0.001)					
Marketization	-0.012*** (0.001)	0.430*** (0.020)	0.106* (0.057)	0.226*** (0.052)	0.101** (0.050)	0.219*** (0.042)	-0.018 (0.096)
Entry year × marketization /1000		-0.221*** (0.010)	-0.052* (0.029)	-0.116*** (0.026)	-0.053** (0.025)	-0.113*** (0.021)	0.004 (0.048)
Lagged productivity	0.569*** (0.002)	0.568*** (0.002)	0.604*** (0.002)	0.596*** (0.002)	0.535*** (0.001)	0.588*** (0.002)	0.514*** (0.001)
Observations	1,357,773	1,357,773	134,955	208,213	487,851	219,816	306,938
R-squared	0.478	0.478	0.433	0.448	0.424	0.454	0.405

\*\*\*p < 0.001, \*\*p < 0.01, \*p < 0.05.

Robust standard errors in parentheses. 3-digit industry, 2-digit region, and year effects are not shown.

The coefficients for the entry year variable are significantly positive in all five ownership types, supporting Hypothesis 1a that new entrants are more productive than incumbents. The coefficients for the interaction term between entry year and the marketization index are significantly negative, except for foreign firms, suggesting that the productivity difference between new entrants and incumbents becomes smaller for private, incorporated, collective, and SOE firms when there are fewer institutional barriers, supporting Hypothesis 2a. While it is generally true that conventional firms, i.e., SOEs and collectives, lost ground in recent years, SOE and collective entries continue to occur. These newly entered SOEs and collectives, called 'Neo-SOEs', are often created by combining the assets of several SOEs with new governance and management structures. These newly entered SOEs need to be more productive than incumbent SOEs in order to survive. Otherwise, they can be privatized or incorporated later. The productivity gap between new foreign entrants and foreign incumbents is insignificant. Perhaps, more recent foreign entrants were able to enter via wholly owned subsidiaries, bringing more

sophisticated technology, as the Chinese government relaxed the joint venture requirements with its accession to WTO.

### Exit hazards

Table 3 shows firms' exit hazards from 1998 to 2004 using the annual industrial survey data. In model (1), new entrants have a higher exit hazard rate than incumbents, after controlling for productivity, supporting Hypothesis 1b. Jointly with the finding from the productivity regression in model (1) of Table 2, this finding confirms Hypothesis 1, which predicts that institutional barriers will lead to higher productivity but also higher exit hazards for new entrants than incumbents, after controlling for productivity. The exit hazard rate also appears to be conditioned by institutional variation. In model (2) of Table 3, we add the interaction between the marketization index variable and entry year. This interaction term is significantly negative, suggesting that the liability of newness is lower where there are fewer institutional barriers, supporting Hypothesis 2b. The interaction terms in the logit model require

Table 3. The random effects logit model of exit decisions

	Whole sample		SOEs	Collectives	Privates	Incorporated	Foreign
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Entry year	0.007*** (0.293 × 10 <sup>-3</sup> )	0.028*** (0.001)	0.023*** (0.002)	0.029*** (0.002)	0.010** (0.004)	0.010*** (0.003)	0.014† (0.008)
Output	-1.053*** (0.043)	-1.067*** (0.043)	-1.259*** (0.113)	-1.221*** (0.112)	-2.688*** (0.185)	-0.231*** (0.039)	-3.158*** (0.155)
Productivity	-0.173*** (0.009)	-0.178*** (0.009)	-0.322*** (0.018)	-0.139*** (0.018)	0.015 (0.022)	-0.479*** (0.031)	-0.256*** (0.031)
Private	0.013 (0.012)	0.013 (0.012)					
Incorporated	-0.310*** (0.013)	-0.328*** (0.013)					
Collectives	0.111*** (0.011)	0.091*** (0.011)					
Foreign	-0.735*** (0.014)	-0.736*** (0.014)					
Marketization	-0.259*** (0.007)	7.579*** (0.323)	3.703*** (0.679)	6.781*** (0.771)	4.164*** (1.086)	1.929* (0.902)	14.762*** (2.583)
Entry year × marketization /1000		-0.132*** (0.003)	-0.048*** (0.008)	-0.143*** (0.006)	-0.144*** (0.009)	-0.110*** (0.012)	-0.081*** (0.011)
Observations	851,287	851,287	154,329	230,417	183,511	109,336	173,688
Wald chi-squared (d.f.)	27,454.87 (214)***	28,016.09 (215)***	3,144.31 (211)***	5,815.63 (211)***	6,357.10 (208)***	2,040.10 (210)***	2,390.42 (209)***

\*\*\*p < 0.001, \*\*p < 0.01, \*p < 0.05, † < 0.10.  
Robust standard errors in parentheses. 3-digit industry, 2-digit region, and year effects are not shown.

special attention in interpretation, as this model is nonlinear and the marginal effect of the individual coefficient depends on the value of other covariates (Hoetker, 2007). We took a graphic approach to plot these true interaction effects and examine their z-statistics. The interaction terms are mostly in the negative area and z-statistics are also distributed in the negative area.

Again, jointly with the finding from the productivity regression in model (2) of Table 2, this finding confirms Hypothesis 2, which predicts that the divergence between productivity and survival according to entry timing decreases when institutional barriers are reduced. The main effect of the marketization index, which is negatively associated with exit hazard in model (1), turns positive once its interaction effect with entry year is added in model (2), suggesting that its effect on productivity is conditional on entry year. For example, when the marketization index is 3 (at a low level), the predicted probability of exit of a hypothetical firm that entered in 1988 is 22.2 percent, while the probability of exit of the same hypothetical firm that entered in 1998 is 25.4 percent, suggesting that a firm that entered 10 years later has 3.2 percentage points higher probability of exit than the earlier entrant. When the

marketization index is 9 (at a high level), the probability of exit of a hypothetical firm entering in 1988 is 6.8 percent, while the probability of exit of the same hypothetical firm entering in 1998 is 6.4 percent, showing almost the similar level of exit probability.

Our control variables, firm size and firm productivity, are negatively associated with exit likelihood. We also include the four firm types as controls, using SOEs as the reference category, in models (1) and (2) for the whole sample. The coefficient for foreign firms is the most significantly negative, suggesting that foreign firms have the lowest exit hazard compared to SOEs, followed by incorporated firms. Private firms exhibit no significantly different exit hazard than SOEs. Strangely, collectives exhibit higher productivity and a higher hazard rate than SOEs, although both are conventional types. This seemingly contradictory result requires some elaboration. Many collectives in the pre-liberalization period were efficient, privately-owned enterprises disguised as collectives (also known as Red Hat companies) in order to avoid expropriation by the state. These companies were dissolved and recreated as private firms when private firms were legalized. The transition from Red Hat to private firms possibly results in the

observation that collectives are more likely to exit than SOEs, despite their higher efficiency levels.

In models (3)–(7) of Table 3, we examine exit hazards in each of the five ownership types. There are some variations. Entry year is significantly positive for all types of firm ownership, supporting Hypothesis 1b that the liability of newness exists regardless of ownership type, while the magnitudes of coefficients and significance levels vary by ownership type. Newly entered foreign firms are the least likely to exit compared to other ownership types, reflecting that they enter with new technology, innovative ideas, or deep pockets and that they are determined to succeed. The interaction terms between entry year and the marketization index are significantly negative in all five ownership types, suggesting that the liability of newness diminishes when there are fewer institutional barriers, regardless of their ownership types, thus supporting Hypothesis 2b. Yet, the coefficients are greater for private and collective types, which are often smaller than other ownership types and therefore more sensitive to the removal of institutional barriers.

### Robustness tests

We perform various robustness tests with alternative measures and samples to reconfirm our findings. First, we use alternative measures of institutional barriers. In Tables S1 and S2, we include a categorical variable, *coastal versus inland*, which takes the value of one for the 12 coastal regions and zero for the 19 inland ones, to capture the fact that coastal regions in China are more open and liberalized than inland ones. We also capture the inter-temporal variation with a dichotomous variable, *period*, that distinguishes the pre-WTO period (1998–2001) and the post-WTO period (2002–2007). Both variables turn significantly negative, consistent with results in the main model using the marketization index, a continuous variable. We also test two other alternative variables that capture institutional barriers: *SOEs market share*, defined as the proportion of sales of SOEs to total industry shipment in each region, and *government size*, defined as the proportion of state employees to total population in each region. We collect both variables from the *Chinese Annual Statistics Yearbook*. Results show that all hypotheses are consistent with these alternative measures of institutional barriers.

Second, we conduct robustness tests with alternative methods to calculate productivity. Olley and Pakes (1996) and Levinsohn and Petrin (2003) propose an econometric technique in which an observed variable is used to proxy the unobservable productivity shock. They assume that input usage, investment in the former and material usage in the latter, is a proxy for unobserved productivity shock. In the Olley-Pakes method, we tend to lose more than one-third of observations that record no investment. Tables S1 and S2 shows that these two alternative measures for productivity generate results consistent with those using the productive index, reported in Tables 2 and 3.

Third, our annual industrial survey data have a firm size threshold. In order to test firm size bias, we reconfirm our hypotheses with all firms in the 2004 economy-wide census data, which list all 1.19 million industrial firms as of 2004. Table S1 shows that the results are consistent with those of the annual industrial survey, although we cannot consider exit and thus cannot test our exit hypotheses with this one year, cross-sectional data. As another robustness check, we perform additional exit analyses for each 2-digit SIC industry (results are available upon request). Our hypotheses are consistently supported in industries where minimum efficient scales (MES) are large (so the 5 million RMB threshold does not matter) and in industries where MES are small.

Fourth, we examine whether industry evolution depends on the life cycle stage. Following the typology of Maksimovic and Phillips (2008), we take median points in the real value (inflation-adjusted) 3-digit industry shipment growth over 1998–2007 and in the change in the number of firms during the same time period and classify industries into four types—growth (high growth of industry shipment and high growth of the number of firms), consolidating (high growth of industry shipment and low growth of the number of firms), technological change (low growth of industry shipment and high growth of the number of firms), and declining (low growth of industry shipment and low growth of the number of firms). Table S3 in the online supplement shows the productivity regressions for each of the four categories of the industry life cycle, generating results consistent with the full sample, except the technological change subsample. By definition, entry and exit in industries with technological changes are more conditioned by technological changes than

institutional changes. Similarly, Table S4 in the online supplement shows the exit analysis for each type of industry life cycle, which generates results consistent with the full sample.

Last, we consider the possibility that some new entrants may not be *de novo* but *de alio* entrants, diversifying from other markets (Agarwal *et al.*, 2002; Mitchell, 1994; Sarkar *et al.*, 2006). *De alio* entrants may not be subject to the same level of the liability of newness as *de novo* entrants, because they have incumbency advantages, albeit in different markets. Given that possibility, we regard our research design—not distinguishing *de novo* vs. *de alio* entrants—a conservative test, because the average productivity of *de alio* entrants would be lower and their exit hazard, controlling for productivity, would also be lower than *de novo* entrants, making it harder to provide support for our hypotheses. In addition, we try to identify whether a new entrant is *de novo* or *de alio* in census-level data such as ours. We take a 3 percent random sample (17,390 firms) and manually search for and drop *de alio* entrants. Models using only *de novo* entrants generate consistent results (available upon request).

## DISCUSSION AND CONCLUSION

Using Chinese census data from 1998 to 2007, a period when China experienced substantial institutional changes, we demonstrate a divergence between productivity and survival when institutional barriers are present, a phenomenon new to the literature, and further demonstrate that the divergence decreases when the degree of marketization deepens and institutional barriers decrease. By offering a theoretical account for this phenomenon, we highlight the important role institutional forces play in shaping the process of industry evolution.

We contribute to the economics literature by developing a theoretical framework in which firms differ not only in physical technology, but also in social technology (Nelson, 2002; Nelson and Sampat, 2001). Our study shows that firm heterogeneity along such multiple dimensions leads to industry dynamics that differ from those based solely on economic efficiency. The combined emphasis on economic and institutional perspectives is useful to investigate industry evolution in settings where institutional factors matter

(Li and Hitt, 2006; Luo, 2003; Luo and Junkunc, 2008; Tan and Tan, 2005; Tybout, 2000). By integrating these two theoretical perspectives, we push forward an important agenda to ‘bring institution into evolutionary growth theory’ (Nelson, 2002), because development of the institutional environment can significantly hinder or facilitate economic growth (North, 1990).

This study contributes to institutional theory by exploring a novel mechanism through which new entrants may respond to institutional constraints. Whereas institutional environments pressure entrants to adopt legitimation-based strategies to adhere to social norms (Suchman, 1995; Zimmerman and Zeitz, 2002), we show that they also adopt efficiency-based strategies, previously unexplored in the literature. We argue that new entrants rely on technical efficiency to compensate for their institutional deficiency, while incumbents rely more on their institutional connections to survive. This argument offers a new resolution to an important theoretical tension: while some scholars emphasize organizational homogeneity arising from conformity pressures of institutional environments (DiMaggio and Powell, 1983), others recognize the persistence of significant firm heterogeneity in many organizational fields (Scott, 2008; Scott and Meyer, 1991). We propose that organizational heterogeneity persists despite conformity pressure because the presence of multiple environmental dimensions (both institutional and technical) provides incumbents and entrants with alternative paths to differentiate and co-exist in equilibrium.

This study also improves our understanding of the environmental change in conjunction with the technology literature. Environmental changes redefine the basis of competition and affect the relative advantage of new entrants vis-à-vis incumbents. Extending prior work on economic, technological, and ecological factors (Agarwal *et al.*, 2002; Sarkar *et al.*, 2006), we examine the impact of institutional changes. In contrast to technological change that may destroy incumbent firms’ competence (Tushman and Anderson, 1986), we find that institutional changes, in the context of post-liberalization China, are more gradual in nature, because the market does not develop overnight. Unlike technological changes, institutional changes do not directly affect incumbent firms’ productivity, they reduce institutional buffering and expose inefficient incumbent firms

to the selection environments. Incumbent firms are gradually replaced by market forces as more efficient firms enter and competition becomes fiercer.

We make an important empirical contribution by controlling for productivity when examining firm survival, lending strong, direct empirical support to the institutional buffering argument. Our study offers systematic documentation of entry and exit and productivity patterns and their interactions with institutional variations using Chinese census data, similar to contributions by Dunne *et al.* (1988, 1989) based on US census data. This contributes to the recent call in the strategy field for more empirical regularities and stylized facts, which can be used to inform theory development and spur follow-up empirical studies (Helfat, 2007).

Furthermore, this research sheds some light on comparative studies across different countries. Institutional barriers are not China-specific but common across different countries. For example, it took 11 days to register a commercial property in Korea, but it took 33 days in the Philippines (World Bank, 2008). Senior managers in East Asian developing countries spent as much as 15 percent of their time working with government officials to interpret and comply with regulations, while firms in OECD countries spent about 5 percent of their time doing so (Batra, Kaufmann, and Stone, 2003). Recent work has begun to employ comparative studies to understand the impact of institutional environments but recognizes that unobserved country-level heterogeneity and incomparable data make cross-country comparisons difficult (Bartelsman *et al.*, 2009; Brown and Earle, 2008). Our study overcomes this issue, because China's heterogeneous, autonomously run regions represent different institutional environments while country-level heterogeneity is controlled for; data across these regions are comparable because the same method is used to collect data in all regions. Future studies could attempt to replicate the present analysis in different countries characterized by different institutional settings. Although we exploit some institutional features particular to the gradual reform process in China, we believe that the logic and empirical methods utilized here can be applied to other countries that experienced institutional transitions like deregulation and regime change.

Since our primary theoretical objective is to demonstrate a divergence between productivity

and survival, this study does not attempt to disentangle several alternative mechanisms that may imply higher incumbent productivity. For example, incumbent firms may be more productive than new entrants because they invest for longer periods to improve their core technologies (Argote, Beckman, and Epple, 1990; Balasubramanian and Lieberman, 2010; Lieberman, 1989). Incumbents might develop complementary assets like downstream resources (Mitchell, 1989; Tripsas, 1997), market-specific knowledge (Sosa, 2009), complementary technologies (Helfat, 1997), and commercialization capabilities (Lee, 2009). Also, less productive incumbent firms have already been selected out of the industry (Hopenhayn, 1992; Jovanovic, 1982), and it may appear the incumbent firms' average productivity is higher than more recent entrants in a given cross section. In addition to these learning and selection arguments, some forms of institutional barriers may grant incumbent firms exclusive access to productive resources that may increase their productivity, a mechanism termed 'resource buffering' by the prior literature (Aldrich, 1979; Miner *et al.*, 1990).

In the presence of these multiple alternative arguments, we focus only on the divergence between productivity and survival, a phenomenon new to the literature, and propose institutional barriers as a possible explanation for divergence. With respect to this objective, our hypotheses constitute a conservative test because the countering forces make it harder to detect the institutional buffering effect that suggests higher entrant productivity. To tease apart our central mechanisms, we rely on the interactions between entry timing and institutional barriers, a set of relationships that these alternative perspectives do not imply. Further, the survival analysis is not subject to these alternative explanations since they affect only productivity and, once productivity is controlled for, they do not influence exit hazards. Overall, findings from productivity and survival corroborate each other to provide consistent evidence for the role of institutional buffering.

The present research has a number of limitations that may offer opportunities for further research. We rely on a revenue-based productivity measure, which may be contaminated by market power in output and input markets. Future studies should employ physical output-based productivity measures to avoid this potential bias. Nonetheless, we

believe that the revenue-based productivity measure is a conservative test for our hypothesis that new entrants will exhibit higher productivity than incumbents, as incumbents' market power (and new entrants' lack thereof) makes their revenue-based productivity overstated (understated) compared to their physical output-based productivity (Foster, Haltiwanger, and Syverson, 2008).

Further, this study employs an economy-wide, population-level dataset to identify environment-level institutional factors that moderate firm productivity and market exit. Future research could employ a smaller sample and a more in-depth survey design to examine individual firms' employment of political strategies to respond to institutional changes (Jia and Mayer, 2010; Li and Zhang, 2007; Luo and Junkunc, 2008). An examination of firm-level political strategies and the current study's focus on institutional barriers are two sides of the same coin, embedded in the same institutional environment, and could offer complementary insights.

Last, institutional change parallels a shift in technological regimes that create or destroy competitive advantage (Agarwal *et al.*, 2002; Sarkar *et al.*, 2006; Tushman and Anderson, 1986). Productivity differences may also reflect technological advances embodied in capital investments, framed as the 'vintage capital' theory in the economic literature (Caballero & Hammour, 1994; Foster *et al.*, 2008). Since this study utilizes institutional variations to isolate our core mechanism, we do not focus on technological change. Future research could explore industry-specific factors in selected industries to understand better how industrial and technological characteristics help determine the evolutionary process.

There are several practical implications of this study. Our results may lead policy makers to consider how to remove institutional barriers to achieve smoother, faster economic growth. The empirical observation of higher productivity of new entrants does not mean necessarily that the Chinese economy is filled with new entrants with sophisticated technology. It may merely reflect new entrants' need to possess better technology than incumbents' to overcome institutional barriers. The high level of liability of newness and the efficiency required to compensate for institutional barriers is likely to prevent many other firms from entering. Because more new entrants can intensify competition, thereby improving

long-term efficiency, policy makers should strive to remove institutional barriers to promote more Schumpeterian competition. In addition, managers should heed institutional barriers when devising an entry strategy, strategically determining when and where to enter. The overall trend of our results indicates that, as China continues to liberalize, competition will intensify as more efficient new entrants challenge incumbent firms that have relied on institutional buffering. Both incumbents and new entrants should pay attention to the speed and extent of further liberalization, which will determine their relative competitive advantages and strategies over time.

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## REFERENCES

- Agarwal R, Sarkar MB, Echambadi R. 2002. The conditioning effect of time on firm survival: an industry life cycle approach. *Academy of Management Journal* **45**(5): 971–994.

- Ahlstrom D, Bruton G, Yeh K. 2007. Venture capital in China: past, present, and future. *Asia Pacific Journal of Management* **24**(3): 247–268.
- Aldrich HE. 1979. *Organizations and Environments*. Prentice-Hall: Englewood Cliffs, NJ.
- Aldrich HE. 1999. *Organizations Evolving*. Sage Publications: London, UK.
- Argote L, Beckman SL, Epple D. 1990. The persistence and transfer of learning in industrial settings. *Management Science* **36**(2): 140–154.
- Asplund M, Nocke V. 2006. Firm turnover in imperfectly competitive markets. *Review of Economic Studies* **73**(2): 295–327.
- Aw BY, Chung S, Roberts MJ. 2003. Productivity, output, and failure: a comparison of Taiwanese and Korean manufacturers. *Economic Journal* **113**: 485–510.
- Balasubramanian N, Lieberman MB. 2010. Industry learning environments and the heterogeneity of firm performance. *Strategic Management Journal* **31**(4): 390–412.
- Baldwin JR. 1995. *The Dynamics of Industrial Competition: A North American Perspective*. Cambridge University Press: Cambridge, MA.
- Bartelsman EJ, Doms M. 2000. Understanding productivity: lessons from longitudinal microdata. *Journal of Economic Literature* **38**(3): 569–594.
- Bartelsman E, Haltiwanger J, Scarpetta S. 2009. Measuring and analyzing cross-country differences in firm dynamics. In T Dunne, JB Jensen, MJ Roberts (eds), *Producer Dynamics: New Evidence from Micro Data*. The University of Chicago Press: Chicago, IL.
- Batra G, Kaufmann D, Stone AHW. 2003. *Investment Climate around the World: Voices of the Firms from the World Business Environment Survey*. World Bank: Washington, DC.
- Baum JAC, Oliver C. 1991. Institutional linkages and organizational mortality. *Administrative Science Quarterly* **36**(2): 187–218.
- Brandt L, Van Biesebroeck J, Zhang Y. 2011. Creative accounting or creative destruction? Firm-level productivity growth in Chinese manufacturing. *Journal of Development Economics* **97**(2): 339–351.
- Brown JD, Earle JS. 2008. Understanding the contributions of reallocation to productivity growth: lessons from a comparative firm-level analysis. IZA Discussion paper, Institute for the Study of Labor, Bonn, Germany.
- Caballero RJ, Hammour ML. 1994 The cleansing effect of recessions. *American Economic Review* **84**(5): 1350–1368.
- Caves DW, Christensen LR, Diewert WE. 1982. The economic theory of index numbers and the measurement of input, output, and productivity. *Econometrica* **50**(6): 1393–1414.
- Chandler ADJ. 1962. *Strategy and Structure: Chapters in the History of the American Industrial Enterprise*. MIT Press: Cambridge, MA.
- Chang SJ, Xu D. 2008. Spillovers and competition among foreign and local firms in China. *Strategic Management Journal* **29**(5): 495–518.
- Dierickx I, Cool K. 1989. Asset stock accumulation and sustainability of competitive advantage. *Management Science* **35**(12): 1504–1512.
- DiMaggio PJ, Powell WW. 1983. The iron cage revisited: institutional isomorphism and collective rationality in organizational fields. *American Sociological Review* **48**(2): 147–160.
- Dunne T, Roberts MJ, Samuelson L. 1988. Patterns of firm entry and exit in United States manufacturing industries. *Rand Journal of Economics* **19**(4): 495–515.
- Dunne T, Roberts MJ, Samuelson L. 1989. The growth and failure of U. S. manufacturing plants. *Quarterly Journal of Economics* **104**(4): 671–698.
- Ericson R, Pakes A. 1995. Markov-perfect industry dynamics: a framework for empirical work. *Review of Economic Studies* **62**(1): 53–82.
- Foster L, Haltiwanger J, Syverson C. 2008. Reallocation, firm turnover, and efficiency: selection on productivity or profitability? *American Economic Review* **98**(1): 394–425.
- Geroski PA. 1995. What do we know about entry? *International Journal of Industrial Organization* **13**(4): 421–440.
- Helfat CE. 1997. Know-how and asset complementarity and dynamic capability accumulation: the case of R&D. *Strategic Management Journal* **18**(5): 339–360.
- Helfat CE. 2007. Stylized facts, empirical research and theory development in management. *Strategic Organization* **5**(2): 185–192.
- Hoetker G. 2007. The use of logit and probit models in strategic management research: critical issues. *Strategic Management Journal* **28**(4): 331–343.
- Hopenhayn HA. 1992. Entry, exit, and firm dynamics in long run equilibrium. *Econometrica* **60**(5): 1127–1150.
- Hsieh C-T, Klenow PJ. 2009. Misallocation and manufacturing TFP in China and India. *Quarterly Journal of Economics* **124**(4): 1403–1448.
- Jefferson GH, Singh I, Xing J, Zhang S. 1999. China's industrial performance: a review of recent findings. In GH Jefferson, I Singh (eds), *Enterprise Reform in China: Ownership, Transition, and Performance*: 127–152. Oxford University Press: Oxford, UK.
- Jia N, Mayer KJ. 2010. Corporate political goals and firms' market capabilities: an integrated perspective. University of Southern California Working paper, University of Southern California, Los Angeles, CA.
- Jovanovic B. 1982. Selection and the evolution of industry. *Econometrica* **50**(3): 649–670.
- Khanna T, Palepu K. 1997. Why focused strategies may be wrong for emerging markets. *Harvard Business Review* **75**(4): 41–51.
- Klepper S. 1996. Entry, exit, growth, and innovation over the product life cycle. *American Economic Review* **86**(3): 562–583.
- Kornai J, Maskin E, Roland G. 2003. Understanding the soft budget constraint. *Journal of Economic Literature* **41**(4): 1095–1136.
- Lau L, Qian Y, Roland G. 2000. Reform without losers: an interpretation of China's dual track approach

- to transition. *Journal of Political Economy* **108**(1): 120–143.
- Lee GK. 2009. Understanding the timing of ‘fast-second’ entry and the relevance of capabilities in invention vs. commercialization. *Research Policy* **38**(1): 86–95.
- Levinsohn J, Petrin A. 2003. Estimating production functions using inputs to control for unobservables. *Review of Economic Studies* **70**(2): 317–341.
- Li H, Atuahene-Gima K. 2001. Product innovation strategy and the performance of new technology ventures in China. *Academy of Management Journal* **44**(6): 1123–1134.
- Li H, Hitt MA. 2006. Growth of new technology ventures in China: an introduction. In H Li (ed.), *Growth of New Technology Ventures in China’s Emerging Market*: 3–10. Edward Elgar Publishing Ltd.: Northampton, MA.
- Li H, Zhang Y. 2007. The role of managers’ political networking and functional experience in new venture performance: evidence from China’s transition economy. *Strategic Management Journal* **28**(8): 791–804.
- Li H, Zhou L-A. 2005. Political turnover and economic performance: the incentive role of personnel control in China. *Journal of Public Economics* **89**(9–10): 1743–1762.
- Lieberman MB. 1989. The learning-curve, technology barriers to entry, and competitive survival in the chemical-processing industries. *Strategic Management Journal* **10**(5): 431–447.
- Luo Y. 2003. Industrial dynamics and managerial networking in an emerging market: the case of China. *Strategic Management Journal* **24**(13): 1315–1327.
- Luo Y, Junkunc M. 2008. How private enterprises respond to government bureaucracy in emerging economies: the effects of entrepreneurial type and governance. *Strategic Entrepreneurship Journal* **2**(2): 133–153.
- Maksimovic V, Phillips G. 2008. The industry life cycle, acquisitions and investment: does firm organization matter? *Journal of Finance* **63**(2): 673–707.
- Melitz MJ. 2003. The impact of trade on intra-industry reallocations and aggregate industry productivity. *Econometrica* **71**(6): 1695–1725.
- Meyer JW, Scott WR. 1983. Centralization and the legitimacy problems of local government. In JW Meyer, WR Scott (eds.), *Organizational Environments: Ritual and Rationality*: 199–215. Sage: Beverly Hills, CA.
- Miner AS, Amburgey TL, Stearns TM. 1990. Interorganizational linkages and population dynamics: buffering and transformational shields. *Administrative Science Quarterly* **35**(4): 689–713.
- Mitchell W. 1989. Whether and when? Probability and timing of incumbents’ entry into emerging industrial subfields. *Administrative Science Quarterly* **34**(2): 208–230.
- Mitchell W. 1994. The dynamics of evolving markets: the effects of business sales and age on dissolutions and divestitures. *Administrative Science Quarterly* **39**(4): 575–602.
- Nee V. 1992. Organizational dynamics of market transition: hybrid forms, property rights, and mixed economy in China. *Administrative Science Quarterly* **37**(1): 1–27.
- Nee V, Opper S. 2010. Political capital in a market economy. *Social Forces* **88**(5): 2105–2132.
- Nelson RR. 2002. Bringing institutions into evolutionary growth theory. *Journal of Evolutionary Economics* **12**(1–2): 17–28.
- Nelson RR, Sampat BN. 2001. Making sense of institutions as a factor shaping economic performance. *Journal of Economic Behavior & Organization* **44**(1): 31–54.
- North DC. 1990. *Institutions, Institutional Change and Economic Performance*. Cambridge University Press: Cambridge, UK.
- Oliver C. 1991. Strategic responses to institutional processes. *Academy of Management Review* **16**(1): 145–179.
- Olley SG, Pakes A. 1996. The dynamics of productivity in the telecommunications equipment industry. *Econometrica* **64**(6): 1263–1297.
- Park SH, Li S, Tse D. 2006. Market liberalization and firm performance during China’s economic transition. *Journal of International Business Studies* **37**(1): 127–147.
- Park SH, Luo Y. 2001. Guanxi and organizational dynamics: organizational networking in Chinese firms. *Strategic Management Journal* **22**(5): 455–477.
- Qian Y, Roland G, Xu C. 1999. Why is China different from Eastern Europe? Perspectives from organization theory. *European Economic Review* **43**(4–6): 1085–1094.
- Qian Y, Roland G, Xu C. 2006. Coordination and experimentation in M-form and U-form organizations. *Journal of Political Economy* **114**(2): 366–402.
- Rajan RG, Zingales L. 1998. Financial dependence and growth. *American Economic Review* **88**(3): 559–586.
- Rawski TG. 1980. *China’s Transition to Industrialism: Producer Goods and Economic Development in the Twentieth Century*. University of Michigan Press: Ann Arbor, MI.
- Samaniego RM. 2009. Entry, exit, and investment-specific technical change. *American Economic Review* **100**(1): 164–192.
- Sarkar MB, Echambadi R, Agarwal R, Sen B. 2006. The effect of the innovative environment on exit of entrepreneurial firms. *Strategic Management Journal* **27**(6): 519–539.
- Schumpeter JA. 1934. *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle*. Harvard University Press: Cambridge, MA.
- Schumpeter JA. 1942. *Capitalism, Socialism and Democracy*. Harper & Brothers: New York; London, UK.
- Scott WR, Meyer JW. 1991. The organization of societal sectors: propositions and early evidence. In *The New Institutionalism in Organizational Analysis*, Dimaggio P, Powell WW (eds). University of Chicago Press: Chicago, IL; 108–140.

- Scott WR. 2008. *Institutions and Organizations: Ideas and Interests*. Sage Publications: Thousand Oaks, CA.
- Singh JV, Tucker DJ, House RJ. 1986. Organizational legitimacy and the liability of newness. *Administrative Science Quarterly* **31**(2): 171–193.
- Sosa ML. 2009. Application-specific R&D capabilities and the advantage of incumbents: evidence from the anticancer drug market. *Management Science* **55**(8): 1409–1422.
- Stinchcombe AL. 1965. Organizations and social structure. In JG March (ed.), *Handbook of Organizations*: 153–193. Rand-McNally: Chicago, IL.
- Suchman MC. 1995. Managing legitimacy—Strategic and institutional approaches. *Academy of Management Review* **20**(3): 571–610.
- Syverson C. 2011. What determines productivity? *Journal of Economic Literature* **49**(2): 326–365.
- Tan J, Tan D. 2005. Environment-strategy co-evolution and co-alignment: a staged model of Chinese SOEs under transition. *Strategic Management Journal* **26**(2): 141–157.
- Tripsas M. 1997. Unraveling the process of creative destruction: complementary assets and incumbent survival in the typesetter industry. *Strategic Management Journal*(Summer) Special Issue **18**: 119–142.
- Tushman ML, Anderson P. 1986. Technological discontinuities and organizational environments. *Administrative Science Quarterly* **31**(3): 439–465.
- Tybout JR. 2000. Manufacturing firms in developing countries: how well do they do, and why? *Journal of Economic Literature* **38**(1): 11–44.
- Van Biesebroeck J. 2007. Robustness of productivity estimates. *The Journal of Industrial Economics* **55**(3): 529–569.
- Walder AG. 1995. Local governments as industrial firms: an organizational analysis of China's transitional economy. *The American Journal of Sociology* **101**(2): 263–301.
- World Bank. 2006. *Governance, Investment Climate, and Harmonious Society*. Washington, DC: World Bank.
- World Bank. 2008. *Doing Business 2008*. Washington, DC: World Bank.
- Wu J. 2005. *China's Long March Toward a Market Economy*. Long River Press: San Francisco, CA.
- Young A. 2000. The razor's edge: distortions and incremental reform in the People's Republic of China. *Quarterly Journal of Economics* **115**(4): 1091–1135.
- Zhang Y, Li H. 2010. Innovation search of new ventures in a technology cluster: the role of ties with service intermediaries. *Strategic Management Journal* **31**(1): 88–109.
- Zhang Y, Li H, Li Y, Zhou L-A. 2010. FDI spillovers in an emerging market: the role of foreign firms' country origin diversity and domestic firms' absorptive capacity. *Strategic Management Journal* **31**(9): 969–989.
- Zimmerman MA, Zeitz GJ. 2002. Beyond survival: achieving new venture growth by building legitimacy. *Academy of Management Review* **27**(3): 414–431.

## APPENDIX. THE TOTAL COMPOSITE MARKETIZATION INDEX FOR 1998–2007 FROM NERI

Provinces	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Beijing	4.89	3.95	4.64	6.17	6.92	7.50	8.19	8.48	8.96	9.55
Tianjin	4.92	4.71	5.36	6.59	6.73	7.03	7.86	8.41	9.18	9.76
Hebei	5.21	4.66	4.81	4.93	5.29	5.59	6.05	6.61	6.93	7.11
Shanxi	3.61	3.32	3.39	3.40	3.93	4.63	5.13	5.28	5.84	6.23
Inner Mongolia	2.93	3.41	3.59	3.53	4.00	4.39	5.12	5.74	6.28	6.40
Liaoning	4.64	4.47	4.76	5.47	6.06	6.61	7.36	7.92	8.18	8.66
Jilin	3.57	3.97	3.96	4.00	4.58	4.69	5.49	6.06	6.44	6.93
Heilongjiang	3.31	3.57	3.70	3.73	4.09	4.45	5.05	5.69	5.93	6.27
Shanghai	5.04	4.70	5.75	7.62	8.34	9.35	9.81	10.25	10.79	11.71
Jiangsu	5.38	5.73	6.08	6.83	7.40	7.97	8.63	9.35	9.80	10.55
Zhejiang	6.41	5.87	6.57	7.64	8.37	9.10	9.77	10.22	10.80	11.39
Anhui	4.39	4.67	4.70	4.75	4.95	5.37	5.99	6.84	7.29	7.73
Fujian	5.70	5.79	6.53	7.39	7.63	7.97	8.33	8.94	9.17	9.45
Jiangxi	4.41	3.90	4.04	4.00	4.63	5.06	5.76	6.45	6.77	7.29
Shandong	5.19	5.15	5.30	5.66	6.23	6.81	7.52	8.44	8.42	8.81
Henan	5.09	4.05	4.24	4.14	4.30	4.89	5.64	6.73	7.07	7.42
Hubei	4.69	4.01	3.99	4.25	4.65	5.47	6.11	6.86	7.12	7.40

## Appendix Continued

Provinces	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Hunan	5.09	3.98	3.86	3.94	4.41	5.03	6.11	6.75	6.98	7.19
Guangdong	6.47	5.96	7.23	8.18	8.63	8.99	9.36	10.18	10.55	11.04
Guangxi	4.29	4.39	4.29	3.93	4.75	5.00	5.42	6.04	6.12	6.37
Hainan	4.51	4.70	4.75	5.66	5.09	5.03	5.41	5.63	6.35	6.88
Chongqing	4.39	4.57	4.59	5.20	5.71	6.47	7.20	7.35	8.09	8.10
Sichuan	4.37	4.07	4.41	5.00	5.35	5.85	6.38	7.04	7.26	7.66
Guizhou	3.20	3.29	3.31	2.95	3.04	3.67	4.17	4.80	5.22	5.57
Yunnan	2.89	3.47	4.08	3.82	3.80	4.23	4.81	5.27	5.72	6.15
Tibet			0.00	0.33	0.63	0.79	1.55	2.64	2.89	4.25
Shaanxi	3.45	2.94	3.41	3.37	3.90	4.11	4.46	4.81	5.11	5.36
Gansu	3.36	3.61	3.31	3.04	3.05	3.32	3.95	4.62	4.95	5.31
Qinghai	1.49	2.15	2.49	2.37	2.45	2.60	3.10	3.86	4.24	4.64
Ningxia	2.01	2.86	2.82	2.70	3.24	4.24	4.56	5.01	5.24	5.85
Xinjiang	2.00	1.72	2.67	3.18	3.41	4.26	4.76	5.23	5.19	5.36

Note: The NERI index contains the following 23 subindices, divided into 5 major categories. We use the general index because these subindices are highly correlated. NERI normalizes each subindex in each province to a value between 0 and 10 in the base year, 2001; a higher value indicates better institutional environments or lower institutional barriers. Subindices in the other years can go below zero or above 10, to reflect the progress of marketization over time. The total composite index is the equal weight of these 23 subindices.

## SUPPORTING INFORMATION

**Additional supporting information may be found in the online version of this article:**

File S1. Calculating the productivity index.

Table S1. Robustness test: productivity models with alternate measures and sample.

Table S2. Robustness test: exit decision models with alternate measures and sample.

Table S3. Robustness test: productivity models with industry life cycle and competition.

Table S4. Robustness test: exit models with industry life cycle and competition.