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Linking R&D Strategy, National Innovation System and FDI to Firm Performance

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Abstract

This paper investigates the role of R&D strategy, national innovation system (NIS) and foreign direct investment (FDI) in firm performance. Drawing on an institution-based view and the FDI spillover literature, we argue that firm performance is directly affected by R&D strategy, NIS and FDI spillovers. NIS also moderates FDI spillover effects on firm performance. Data analysis based on the World Bank Enterprise Survey of manufacturing firms in China in 2003 shows that the findings reinforce the hypotheses.

Keywords: R&D Strategy, NIS, FDI, firm performance, China

Linking R&D Strategy, National Innovation System and FDI to Firm Performance

1. Introduction

What determines firm performance is arguably one of the most widely researched topics in strategic management (Marano, et al., 2016). The literature in the past has mostly taken a resource-based view (RBV) (Barney, 1991) or an industrial organisation approach (IOA) (Porter, 1980). RBV considers firms as a collection of unique, valuable, rare and inimitable resources and firm performance is determined by resources that they possess, while IOA argues that firms pursue strategies in response to industrial structure which alters firms' conduct to impact their performance. In both theoretical frameworks, institutions within which the firms embed are treated as background. However, more recent studies as surveyed by Marano, et al. (2016) have clearly recognised the importance of institutions. Following from an institution-based view (IBV), it is the institutional arrangements in the form of political, social and legal rules that shape a firm's strategy and outcomes (North, 1990). Therefore, firm performance is closely linked to formal institutional environment (Peng, et al., 2008). This paper takes institutions to the centre of the analysis and adopts a multi-level approach to investigate firm performance by bringing R&D strategies (a firm-level factor), foreign direct investment (FDI) (an industry-level factor) and national innovation system (NIS) (a country-level institutional factor) in an integrated framework. Specifically, the paper aims to answer two research questions. First, what are the direct roles of R&D strategy, NIS and FDI in firm performance? Second, to what extent, NIS moderates FDI spillover effects on firm performance?

The paper aims to make both theoretical and empirical contributions to the extant literature. The theoretical contribution is related to develop hypotheses based on IBV and argues the direct role of NIS in firm performance and its moderating effects on FDI-performance relationship. NIS refers to an evolving, open and complex system which encompasses relationships within and between organizations and socio-economic structures (Lundvall, 2007). NIS as reflected by intellectual property rights (IPR) protection, access to market and technological information and R&D services can directly impact on firm performance by shaping opportunistic behaviours and uncertainties in market transactions and influencing firm's strategy, resource allocations and economic activities.

There has been long established literature, examining FDI spillover effects on firm performance (Iršová & Havránek, 2013; Meyer & Sinani, 2009). In view of mixed findings in the literature, we argue, the extent of FDI spillovers can be moderated by NIS. Within a well-functioned NIS, foreign firms are more willing to set up R&D facilities and conduct R&D locally, which enlarges the potential pool for FDI spillovers, thus NIS and FDI join forces in influencing firm performance.

From an empirical perspective, China presents a rich context for studying the link between firm performance and its R&D strategy, NIS and FDI. Firstly, despite the abundant literature on R&D-performance, the extant literature has mostly considered R&D as innovation (Garcia & Calantone, 2002). However, imitation is also a viable strategy, especially for firms in emerging

countries. Imitation helps firms achieve competitive advantages through learning from a pioneer's mistakes, lowering costs and employing less resource than innovation (Lee & Zhou, 2012). Both innovation and imitation are prevalent in Chinese manufacturing firms. Broadly speaking, there are three R&D strategies involving different levels of innovativeness: duplicate imitation, creative imitation and original innovation (Kim, 2004). With a duplicate imitation strategy, a firm clones its competitors' products or processes, thus the products and processes are new to the firm, but not new to the market. With a creative imitation strategy, a firm adds new features or improves the existing features on the basis of competitors' original products or processes. With an original innovation strategy, a firm introduces new products or processes into the market based on its own R&D. Thus from duplicate imitation to creative imitation, then to original innovation, there is a progression in the level of innovativeness. Many indigenous Chinese manufacturing firms have evolved from duplicate imitators to creative imitators, or from creative imitators to original innovators and they contribute to the overall R&D of China (Luo, et al., 2011). The first empirical contribution of the paper is to examine whether different levels of innovativeness may have different implications on firm performance.

China has experienced tremendous changes in its institutions (Golley, 2016) and NIS (Zhou, et al., 2005) since 1978 when the country adopted an opening up strategy. Chinese governmental institutions, especially the Ministry of Science and Technology (MOST), have made continuing efforts to promote R&D and have designed various plans such as the Science and Technology Development Plan 2006-2020 (STDP) to transform China into an innovative country (Zhong & Yang, 2007). On the FDI front, China has become one of the largest recipients of FDI and

the role of FDI in the country's development has been widely recognised (Wei & Wang, 2009). With foreign entry and foreign technologies and know-how, it is possible for indigenous firms to acquire and assimilate foreign technologies and take advantage of FDI spillover effects in order to improve firm performance (Zhou, 2006). However, we know little of how NIS directly affects firm performance and moderates the FDI-performance relationship. This constitutes the second empirical contribution of the paper. Below, section 2 reviews the literature. Section 3 discusses data and methodology, which is followed by the presentation of empirical results in section 4. Section 5 offers discussion and conclusion.

2. Literature Review

2.1 R&D Strategies and Firm Performance

This section first discusses different R&D strategies before evaluating the existing evidence on R&D-performance relationship. Firms may take different R&D strategies that involve different level of innovativeness, ranging from duplicate imitation, creative imitation to original innovation (Kim & Nelson, 2000). The relationships between different R&D strategies are clearly demonstrated in Figure 1. It illustrates a progression in R&D strategy from duplicate imitation to creative imitation, and then to innovation and is useful in analysing technology spillovers. The technological focus of indigenous firms with a duplicate imitation strategy is to carry out reverse engineering, technical licensing agreements and technical assistance associated with the original equipment manufacturing (OEM). These firms acquire mature

technologies from advanced economies. Lacking capabilities for R&D of original nature, they benefit from the presence of MNEs as they can observe and learn advanced technological and managerial knowledge, this is also called FDI spillover effects. Production by firms with a duplicate imitation strategy is mainly about the assembly operations of foreign inputs to produce undifferentiated and standard products. The acquisition of technologies by these indigenous firms can lead to diffusion within the industry and within the country. As competitive pressure increases, indigenous firms make efforts to assimilate more foreign technologies and produce slightly differentiated products. The assimilation of foreign technologies, the accumulation of experience and the enhancement of their knowledge base lead to progressive improvements of R&D capability.

Indigenous firms with a creative imitation strategy improve on the existing products and develop the products of more unique features. The technological focus may take the forms of creative adaptations, design copies, technological leapfrogging or adaptation to other industries (Lee & Zhou, 2012). These indigenous firms' objectives are to occupy the market or to become the first movers in a specific market segment with low risks and costs and improved performance of products (Kim & Nelson, 2000). Creative imitation strategy focuses on the market and is driven by the market. Between duplicate imitation and creative imitation strategies, duplicate imitators make no modifications or only slight modifications to the original products and reposition them without giving new features and characteristics to the products, but creative imitators improve on innovators' products by adding new features and characteristics (Kim & Nelson, 2000).

When a firm has an even stronger technological capability and broader knowledge base, it can develop new technologies and original products of its own. Original innovation with emerging technologies is the focus for the firms and it is about the generation of new knowledge rather than the acquisition and assimilation of foreign technologies. Original innovation is associated with pioneering activities, primarily embedded in a firm's internal competencies to develop and introduce new products to the current market for the first time (Kim & Nelson, 2000).

Firms with R&D strategies, regardless of the nature of their strategy being duplicate imitation, creative imitation or original innovation, are expected to perform better than those without. According to RBV, firms are bundles of resources and capabilities (Barney, 1991). The deployment of unique, valuable, rare and inimitable resources allows firms to achieve sustainable competitive advantages. R&D capability enables a firm to focus on product design/development and improve production processes. The prior literature reveals that firms with creative imitation or original innovation R&D strategies, i.e. the modification of existing products with new features (i.e. creative imitation) or producing new products which are completely new to the market (i.e. original innovation), tend to outperform those without (Brown & Eisenhardt, 1995; Clark & Wheelwright, 1992; Fiol, 1996; Li & Calantone, 1998). New product development (NPD) is associated with several benefits including improved quality, greater intellectual capital, enhanced brand value and improved performance (Glynn, 1996; Kessler & Chakrabarti, 1996). NPD allows a firm to combine its existing technologies with new ones. It represents core competence of the firm (Nobeoka & Cusumano, 1997). This

can help the firm get ahead of its competitors and allow it to respond rapidly and effectively to changes in customer requirements and technological advances, contributing to firms' performance. Moreover, new products are associated with product differentiation (Markides & Williamson, 1994). New products with superior features and enhanced functions are attractive to consumers when they believe that the benefits associated with these new features and functions outweigh the costs. This can help the firm cultivate consumer preference, tastes and loyalty (Li & Calantone, 1998). As a result, its performance can be improved. New product introduction also enables a firm to broaden the production line which makes it possible for it to meet market demand effectively through positioning each market niche and covering a broad range of market segments, again resulting in an improved firm performance in the marketplace (Nobeoka & Cusumano, 1997).

Few studies focus on the impact of a duplicate imitation strategy on firm performance. Here we argue that such a strategy may also improve firm performance. The costs of duplicate imitation are lower than those of creative imitation and original innovation (Ofek & Turut, 2008). As existing products have already provided information on product development (Schnaars, 1994), duplicate imitation can aid in shortening time for producing products that are new to the firm. Duplicate imitation also helps to avoid technological risk (i.e. the risks of failed investments in R&D) or market risk (i.e. the risk of the products not receiving a positive market response). By employing a duplicate imitation strategy, a firm may gain late follower advantages by seeing what happens to new products, studying competing products, accumulating experience and, in turn, planning carefully based on observations before

engaging in production. Therefore, a duplicate imitator may enjoy a high possibility of success in improving performance.

Though R&D strategies could all contribute positively to performance, they are not of equal impact. It is expected that innovators would outperform imitators (Carpenter & Nakamoto, 1989). With an original innovation strategy, a firm invests substantially into R&D in order to become the first one to introduce innovative products to the marketplace. An original innovation strategy can bring more benefits to a firm than an imitation strategy for several reasons. First of all, an innovator, the first in the market, can achieve certain economic benefits such as experience, tacit knowledge and scale economies, which are hard to obtain by imitators. These benefits can help the innovator achieve sustainable growth and firm performance in product development and production (Robinson & Fornell, 1985). In addition, with technology leadership, an innovator has the potential to create market, meet market demand, shape consumer preference, even influence consumer behaviour, all of which are unlikely to be met by imitators (Zhou, et al., 2005). Further, unlike an innovator who endeavours to exploit new markets and develop new products, an imitator may lose the chance to differentiate its products substantially. This is due to the fact that in heavily focusing on imitating products, an imitator may ignore or miss other market opportunities which are largely unexploited. On the other hand, through mastering such market opportunities, an innovator can achieve product differentiation, win consumers and improve firm performance. Last, an innovator can be more effective in marketing than an imitator because an innovator has a better understanding of the features of their own products than any potential imitators; consequently, this can help an

innovator achieve better performance in the marketplace than an imitator (Lee & Zhou, 2012). In a review of the extensive literature, Lieberman and Montgomery (1998) suggest that innovation has advantages and early entry is robust in practice. They indicate that an innovation strategy can contribute more to the success of a firm than an imitation strategy. Zhou (2006) compares the effects of an imitation strategy with an innovation strategy on firm performance in new products. The empirical results suggest that, compared with an imitation strategy, an innovation strategy helps to develop better new products.

A similar logic applies to compare the impact of creative imitation and duplicate imitation on firm performance. A firm employing a creative imitation strategy gains advantage by differentiating its products from competitors and/or innovating on processes that can lower product costs or improve quality over competitor's products. Creatively imitated products, with added values and features to original products, are likely to be attractive to consumers because such products can deliver extra values with reasonable prices (Zhou & Nakamoto, 2007). In contrast, a firm employing a duplicate imitation strategy does not differentiate the products and largely competes on the basis of price. Consequently, there is smaller room for improving firm performance opportunities for firms with a duplicate imitation strategy than those with a creative imitation strategy. Furthermore, compared to duplicate imitators, creative imitators may even charge premium prices derived from the added values and functions of products, as a result, higher performance. In summary, we expect a positive relationship between performance and a firm's innovativeness. Firms with the highest level of innovativeness engaging in original innovation perform better than those with a medium level of

innovativeness engaging in creative imitation who in turn perform better than those with the lowest level of innovativeness engaging in duplicate imitation.

Hypothesis 1a: Firms with a R&D strategy perform better than those without.

Hypothesis 1b: Firm performance is positively linked to the level of innovativeness in the firm's R&D strategy.

2.2 NIS and Firm Performance

NIS refers to an evolving, open and complex system which encompasses relationships within and between organizations and socio-economic structures (Lundvall, 2007). It is an institutional arrangement involving firms, research institutes and universities, with the purpose of facilitating learning, sharing information and promoting R&D. It is embedded in a wide national socio-economic setting comprising financial markets, education systems, welfare regimes and intellectual property rights (Lundvall, 2007). It determines the direction and rate of competence-building and innovation emanating from the processes of experience-based and science-based learning (Lundvall, et al., 2009). In NIS, firms communicate and link up with a knowledge infrastructure. The access to information is an important medium during the process (North, 1993). Firm's activities are promoted or constrained by NIS (Edquist, 2006). A well-functioned NIS promotes interactions between socio-economic agents and facilitates information and knowledge sharing. It protects the interests and returns from firm's R&D activities and reduces costs, risks and uncertainties associated with R&D through strong law

enforcement. With reduced costs and risks and enhanced information and knowledge, firm performance is likely to experience improvement.

Following from an IBV, institutional arrangements shape the firm's strategy and outcomes (North, 1990). NIS affects firm performance in a number of ways. NIS matters to the efficiency and effectiveness of the firm's business activities (Lu, et al., 2008). A well-functioned NIS promotes interactions between socio-economic agents and facilitates information and knowledge sharing. NIS affects interactions among economic agents within or across industries, between universities and industries, between suppliers and consumers and between foreign and indigenous firms, and it influences the development of the R&D infrastructure (Edquist, 2006). A well-functioned NIS stimulates competition, improves communication, builds networks between economic agents and forms a knowledge base (Dunning & Lundan, 2008). Such NIS directs businesses towards more economically productive activities and raises efficiency. It protects the interests and returns from a firm's R&D and reduces costs, risks and uncertainties associated with R&D through strong law enforcement. A well-functioned NIS also provides adequate and high-quality services for firms and helps them with R&D, production and the introduction of new products. Consequently, firms experience better performance in both product development and product marketing.

To the contrary, with a NIS that is not well-established, communication and interactions between organizations are likely to be poor. As a result, information, knowledge, experience and services cannot be effectively shared and delivered. Firms have to counter risks and

overcome difficulties in product development and product marketing mostly on their own, and this generates high uncertainties and costs and may negatively affect firm performance in R&D and product introduction. Such NIS prevents firms from fully appropriating their R&D; rather, poor law enforcement is normally associated with violations of intellectual property rights and counterfeits, which endanger firms' innovation and discourage R&D. Poor law enforcement is associated with high costs, risks and uncertainties for firms, which restrict the further improvement on firm performance in new product development. Also, firms may not have access to the high-quality services provided by the governments, which may further restrict firms' capability of countering risks and uncertainties, resulting in poor performance. Last but not least, a not well-established NIS constrains the effective allocation of resources towards firms' R&D and raises inefficiency in firms' business activities.

Hypothesis 2: NIS positively affects firm performance.

2.3 FDI Spillovers, NIS and Firm Performance

2.3.1 FDI Spillovers and Firm Performance

Following an early theoretical discussion of productivity spillovers or external effects from FDI by (MacDougall, 1960), a large number of studies have been produced, investigating whether the presence of FDI affects the performance of indigenous firms (see survey articles, e.g. Görg & Strobl, 2001; Iršová & Havránek, 2013; Meyer & Sinani, 2009; Wooster & Diebel, 2010). Such effects can be through reducing the bottlenecks in supply chains, introducing new

practical knowledge and skills, demonstrating advanced technologies and training employees who may later be employed by indigenous firms (Bruun & Bennett, 2002). It is possible for indigenous firms to learn some of the knowledge and skills through learning-by-watching, learning-by-doing and reverse engineering and enhance their performance as a result (Srivastava, 1986). FDI injects much-needed funds into indigenous firms for their expansion. FDI can also break down monopolies and encourage competition.

The competition pressure associated with FDI inflows may affect the performance of indigenous firms in two ways. On the one hand, FDI inflows push indigenous firms to enhance technological capacity and upgrade organizational practices in order to better compete against MNEs and other competitors. Consequently, indigenous firms' performance can be improved. On the other hand, FDI may decrease the level of profits in indigenous firms and may crowd them out in both product and resource markets. MNEs and indigenous firms compete with each other for skilled labour, capital and land, which pushes up the operating and production costs of indigenous firms and pushes down their profits and resources available for production. In addition, MNEs normally provide competitive offers to quality staff in host countries; as a result, the wages and costs of production may be pushed up and profits of indigenous firms may be pushed down. Indigenous firms may also fail when providing final goods and services because MNEs have strength in the quality of products and brand names. As a result, the competitive pressure produced by inward FDI may eventually be harmful to the performance of local firms.

Overall, the direction of FDI spillovers on firm performance is an empirical question. Existing research on the impact of FDI on firm performance largely focuses on productivity and produces mixed results (Görg & Strobl, 2001; Iršová & Havránek, 2013; Meyer & Sinani, 2009; Wooster & Diebel, 2010). Various factors have been proposed that may facilitate spillover absorption by indigenous firms including the conditions of host countries, e.g. human capital, R&D expenditure and infrastructure. However, we will argue below that FDI spillover effects can also be moderated by NIS.

2.3.2 Moderation Effects of NIS on FDI Spillovers

NIS reflects the level of protection of property rights, the level of access to market and technological information and external R&D services available to organizations. Within a well-functioning NIS, the costs and risks of taking advantage of FDI spillovers are low because firms are capable of countering risks and reducing the costs of operations through acquiring information, being protected by law and communicating with other social-economic agents (Gachino, 2006). Indigenous firm's capability and incentive to make use of FDI spillovers can be supported and enhanced. Also, foreign firms may be willing to transfer technologies and know-how to host countries within a well-functioned NIS framework and they may undertake more R&D activities locally, extending the potential pool of FDI spillovers. As a result, the extent of FDI spillover effects acquired by indigenous firms can be promoted. To the contrary, within a poorly-functioning NIS, indigenous firms may find it difficult to benefit from FDI spillovers because the channels for acquiring information, the communication between

organizations and the absorptive capacity are weak. Also, the breadth and depth of technologies transferred by foreign firms to host countries may be restricted because of the risks of being imitated and violated (Kafouros, et al., 2012) and uncertainties stemming from weak enforcement of laws and lack or shortage of reliable information and R&D services, shrinking the potential pool of FDI spillovers locally. Consequently, the extent of FDI spillover effects acquired by indigenous firms will be constrained. Thus, NIS positively moderates FDI spillover effects.

Hypothesis 3: FDI spillover effects are positively moderated by NIS.

3. Data and Methodology

3.1 Data

The primary source of data is World Bank Enterprise Survey (WBES) 2003 on Chinese firms[1,2]. We use WBES 2003 for all the variables except FDI which is measured at the industry level from China Statistics Yearbook on Science and Technology 2000-2002. WBES 2003 was carried out in collaboration with the Chinese National Bureau of Statistics and is part of a larger World Bank project aimed at studying the investment climate and business environment at the firm level in a range of countries. The Chinese dataset covers 18 cities and 6 major

[1] There are also 2002, 2005 and 2012 WBESs on Chinese enterprises. However, different questionnaires were used in these surveys which do not contain many of the variables under investigation in this paper, therefore they are not used.

[2] This 2003 dataset has been used in previous research including Brambilla, et al. (2009), Cull and Xu (2005) and Lin, et al. (2010).

manufacturing industries. The cities are Benxi, Changchun, Changsha, Chongqing, Dalian, Guiyang, Harbin, Hangzhou, Jiangmen, Kunming, Lanzhou, Nanchang, Nanning, Shenzhen, Wenzhou, Wuhan, Xian, and Zhengzhou. The industries are garments, electronics, food, vehicles and vehicle parts, metals and machinery, and chemicals and pharmaceuticals. Detailed questions were asked regarding ownership structure, input, output, production, exports, foreign involvement, institutions and innovation activities. The data span was 2000-2002 for some variables, e.g. input, output, production, exports and innovation activities. However, firms were interviewed once in 2003, so for some questions the answers cover the information for the entire 3-year period.

This dataset has the characteristics of representativeness and reliability. The World Bank Enterprise Survey normally targets small- and medium-sized enterprises, which can be reflected by the size distribution of the sample firms in the datasets used. Stratified sampling techniques were used to ensure a good representation of the population of firms in chosen locations and industries. In addition, private contractors were employed to collect data via face-to-face interviews with the accountants/personnel managers of firms and the senior managers of main production facilities to ensure data reliability.

All variables in monetary form are deflated using producer price indices (base year = 2000) from the China Statistics Yearbook. The combination of industry-level and firm-level data allows for in-depth analysis. Altogether, there are 2,400 firms in WBES 2003 and 1,609 of them are manufacturing firms including 158 foreign-invested firms. Because this paper focuses on

indigenous manufacturing firms, foreign-invested enterprises (FIEs) and non-manufacturing firms are excluded, which leaves 1,451 firms for estimation. After an extensive check for outliers[3] and missing values the final sample contains 1,022 firms, among which 513 indigenous firms have R&D strategies and 509 firms have not. Out of the 513 firms with R&D strategies, 492 firms have provided information that can help us determine the firm's level of innovativeness. Table 1 presents sample profile by industry in 2002.

<Table 1 Here>

3.2 Dependent and Key Independent Variables

For dependent variables, we use profitability to capture firm performance. Profitability is measured as the return on assets, i.e. the ratio of total profits to total assets. The FDI spillover variable is measured by the share of foreign firms' R&D expenditure in the industry's total R&D expenditure. One-year lagged FDI is used in the estimation to mitigate the endogeneity effect. To identify a firm's R&D strategy, we investigate whether a firm has a R&D strategy using the question - "Has your firm introduced new products or entered a new business line during the past three years". As we do not know whether a newly introduced product or business line is new to the world or it is new to China, this question captures firm's overall R&D strategy. A dummy variable is created accordingly, i.e. R&D Strategy.

[3] We check all the observations thoroughly and removed those data that appear to be incorrectly entered or measured.

To determine the level of innovativeness of the firms that have R&D strategies, we use questions on "patents granted in China", "total R&D expenditure" and "Has the firm introduced new process improvements, new management techniques or new quality controls in production". Patenting and R&D investments are widely recognized as an indicator of a firm's R&D (Lin & Chen, 2005). Process innovation is about a firm's status in new management techniques, new process and new quality control development (Lin, et al., 2010), therefore, it is also an integral part of a firm's R&D. There are interdependencies between the product and process innovations. The latter is essential for the generation of the former. Kraft (1990) reveals that process innovation is connected with product innovation, and firms can learn and upgrade the manufacturing process while making product innovation. Therefore we consider patenting, R&D expenditure and process innovation together to indicate the level of innovativeness. A firm's responses to the three questions are aggregated and the magnitude of the score indicates the progression of R&D strategy. The higher the aggregate score is, the more likely the firm pursues original innovation strategy and less likely duplicate imitation strategy. The variable is a proxy for a firm's level of innovativeness (Innovativeness).

We capture NIS from three aspects: contract and property rights protection, access to information and R&D services. Lundvall (2007) suggests that the core of NIS is not only firms' in-house innovation, but also the external technological information and services derived from the knowledge infrastructure. This core is embedded in a wide national socio-economic setting comprising elements particularly contract and property rights protection. Moreover, access to

an information service is an important medium during the process of communication and interactions between firms and knowledge infrastructure (North, 1993). We use three questions to operationalize these three aspects of NIS.

(1) R&D Services

To apprehend external R&D supports, we employ the questions related to the level of availability, affordability and quality of R&D services which are evaluated on a 1-4 scale. The answers to these questions are combined as a composite measure.

(2) Contract and Property Protection (Laws)

Firms were asked the likelihood that the legal system would uphold their contract and property rights in business disputes, with a higher value meaning a better legal protection.

(3) Access to Information

Firms were asked to state whether they were satisfied with the availability/accessibility of information on the supply of inputs/services, demand for product, export market and import sources, technical standards and product/technology development as well as laws and regulations on a scale of 1 to 5, with 1 suggesting “not satisfied” and 5 “greatly satisfied”. The answers to all the options are aggregated to indicate the scope of information that is accessible to a firm.

3.3 Control Variables

Five control variables, firm size as measured by the logarithm of total number of employees, exporting, competition, R&D expenses and R&D personnel, in addition to city dummies, are

included in estimation. City dummies are used to control for location-specific effects. Exporting is seen as an important factor in improving firm performance (Liu & Buck, 2007; Liu & Zou, 2008). Exporting firms operate in an international context that normally has fiercer competition than a domestic market. Through competing internationally and building networks with foreign partners, firms acquire experience, information and knowledge that can be employed to improve performance. Exporting is measured as the log transformation of values in exports.

The role of competition in affecting firm performance can be ambiguous. On the one hand, performance may be improved because firms have to improve efficiency and reduce costs under the condition of fierce competition (Brambilla, et al., 2009). On the other hand, firm performance may be weakened as competition could imply firms are facing high risks and uncertainties. Competition is measured as the number of competitors within the main business line. R&D expenses and R&D personnel are selected because they are closely related to the R&D activities of firms. R&D expenses are normalized by sales, i.e. it is measured as the ratio of R&D expenditure to sales. R&D personnel is measured as the ratio of the number of employees undertaking R&D activities to the total number of employees.

<Tables 2 & 3 Here>

4. Empirical Results

Table 2 shows summary statistics and correlation coefficients. Multicollinearity is checked by and correlation coefficients as well as variance inflation factors (VIF). Correlation coefficients are low as shown in table 2. For models where no interaction terms are included, VIF scores are all lower than the normally accepted threshold level of 10. Both sets of results indicate that multicollinearity is not a major issue. However, the correlation coefficients between the individual variables and their interaction terms are high. We deal with the issue in models with interaction terms using a mean-centring approach.

Table 3 presents the estimation results. The first two specifications are for the full sample that include firms with and without R&D strategies (R&D Strategy). The last two specifications are confined to only firms with R&D strategies and the variable - Innovativeness - is included to capture the impact of the level of innovativeness on firm performance. While the first and third specifications test the direct impact of three NIS factors on firm performance, the second and fourth specifications test the moderating impact of three NIS factors on FDI spillover effects.

The results of the first and second specifications clearly show that firms with R&D strategies perform better than those without R&D strategies. Hypothesis 1a can be supported. Further, the results of the third and fourth specifications reveal that there is a positive relationship between the level of innovativeness and firm performance, reflecting a positive relationship between the progression of the R&D strategy and firm performance. In other words, firms

taking a more original innovation strategy have better performance than those taking a more creative imitation strategy, which in turn have better performance than those taking a more duplicate imitation strategy. This is in line with Hypothesis 1b.

To test hypothesis 2, we look at three components of NIS. R&D Services have a positive sign and are statistically significant in all specifications, indicating its significant and positive role in affecting firm performance. In contrast, Laws and Access to Information appear to significantly impact on firm performance in the full sample only. For the final key variable, FDI's effects are statistically negative in the full sample, but have insignificant effects in the subsample of firms with R&D strategy. These mixed results show the different degrees of benefit and spillover effects that firms with and without R&D strategy could enjoy from different components of NIS and the presence of FDI.

To investigate hypothesis 3, we interact NIS variables with FDI. First, Laws positively moderate FDI spillovers in the full sample as the interaction term is statistically significant. Second, R&D Services positively moderate FDI spillovers in the sub sample as the interaction variable is statistically significant. Finally, Access to Information does not show a statistically significant moderating role in FDI spillovers in either the full sample or the sub sample for firms with R&D strategies.

5. Discussions, Conclusion and Limitations

R&D is important for attaining competitive advantages and improving performance. Broadly speaking, a firm's R&D strategy progresses from duplicate imitation to creative imitation, then to original innovation, depending on the level of innovativeness. The existing research focuses mainly on innovation and firm performance, and imitation tends to be treated as a uniform strategy. Moreover, on the one hand, China has established NIS to facilitate innovation and has attracted a large volume of FDI, aiming to generate more R&D. On the other hand, despite the absolute increase in R&D investments and the transfer of technologies from FDI, imitation in China is still prevalent. This paper makes a theoretical contribution to firm performance literature by taking an institution-based view to examine the role of R&D strategy and innovativeness, NIS and FDI in an integrated framework. We hypothesize the direct effects of R&D and NIS on firm performance and the moderating effects of NIS on FDI spillover effects.

The empirical results show that firms with R&D strategy are more likely to enjoy better firm performance than those without. Undertaking R&D can help firms lower cost, improve quality, generate greater intellectual capital, enhance brand value, or broaden production line. R&D can also make it possible for firms to meet and cultivate consumer's needs effectively through positioning in market niche or covering a broad range of market segments. Therefore, even though R&D requires upfront investments, the benefits for firm performance outweigh the costs.

The evidence of innovativeness on firm performance further suggests that a higher level of innovativeness in R&D strategy produces more significant and positive effects on firm performance than a lower level of innovativeness. Therefore, an original innovation strategy is more effective in improving firm performance than a duplicate imitation strategy. This finding has implications for firms in emerging economies, which tend to have a lower level of innovativeness, comparing with their counterparts in developed countries, who usually have a higher level of innovativeness. Through imitating and learning, some indigenous firms in emerging economies have emerged from being contract manufacturers or suppliers for foreign partners to being major competitors, relying on duplicate imitation or creative imitation. However, the progress of moving into original innovation has been slow. Our finding suggests that, to improve performance, it is important for Chinese firms to make the transition to become an innovator.

This study also reveals the positive effects of China's NIS on firm performance. China has made tremendous efforts on NIS. Various governmental institutions have been assigned responsibilities to facilitate R&D (Zhong & Yang, 2007) (See Appendix). China has also been making significant R&D investments and has increased R&D expenditure year by year. The efforts on NIS have clearly borne fruit and firms have benefited from the improvement of NIS. While Chinese firms transforming from duplicate imitators to creative imitators and then to original innovators, China needs further work on NIS through providing technological information and services and enhancing contract and property rights protection.

Further, performance of indigenous Chinese manufacturing firms is positively affected by R&D services. The quality, availability and affordability of R&D services can influence firm performance because R&D services are the media of knowledge and technological information which are the keys to firm operations. Moreover, formal institutional settings in the form of R&D services affect firm behaviour by providing resources and opportunities, as a result, affecting firm's capabilities (Breznitz, 2007). Additionally, contracts and property rights protection help protecting economically valuable assets for firms, which in turn benefit performance. Making information accessible is also an essential condition for firms to improve performance as this helps to minimise transaction costs.

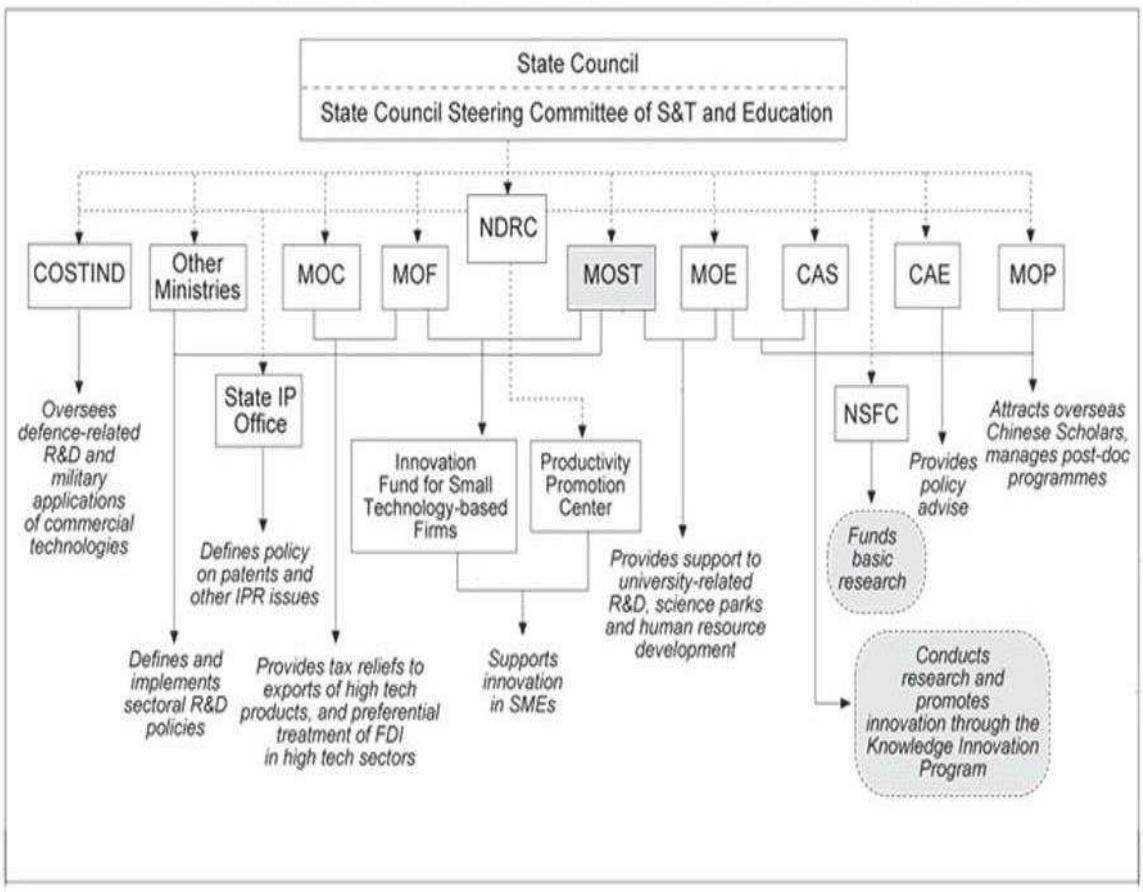
The results on FDI spillovers are mixed. FDI insignificantly affects firm performance in the sub sample but produces negative and statistically significant effect on firm performance in the full sample. This may suggest that FDI produces a 'crowding-out' effect on Chinese manufacturing firms. However, firms with a R&D strategy are more capable of countering the negative 'crowding-out' effect and absorbing the possible positive spillover effects from FDI than those without a R&D strategy. Moreover, NIS shows a generally positive moderating effect on FDI spillovers, particularly the R&D services and legal protection aspects of NIS. This shows the importance of building a well-functioning NIS which, in addition to positively stimulating firm performance as mentioned above, supports indigenous firms to benefit from FDI spillover effects.

The empirical results offer managerial and policy implications. As the results confirm that firms with R&D strategies are more likely to enjoy better firm performance than those without and firm performance is positively linked to the level of innovativeness in R&D strategy, firms should have a R&D strategy, it being duplicate imitation, creative imitation or original innovation. Given its capacity, a more original innovation strategy is more beneficial to firm performance than a more duplicate imitation strategy. Further, NIS not only directly impacts on firm performance but also moderates FDI spillover effects. Firms therefore should actively participate in a country's national innovation system, interacting with other firms, business partners, R&D institutions and universities. This could offer firms an effective way of acquiring high-quality R&D services from external sources.

In terms of policy implications, governments should provide support and encourage firms to actively engage in R&D, particularly innovative R&D, which would also contribute to the competitiveness of the country. Governments should take actions in offering high-quality and affordable R&D services to firms. The R&D services should be made more accessible to firms. In this regard, removing the funding constraints and providing a combination of international and local services on R&D are effective means to improve firm performance. Additionally, China should strengthen the enforcement of laws and regulations, take part in international cooperation on property rights protection (Qiu & Yu, 2010) and improve transparency so as to facilitate information flows. The overall improvement in NIS help indigenous firm benefit from positive FDI spillover effects and counter the negative crowding-out effects from FDI.

The study has a few limitations. First, NIS is a very sophisticated concept and it is difficult to measure. There may be other important components that could also impact on firm performance, e.g. financial markets, education systems and welfare regimes (Lundvall, 2007). However, the dataset does not allow us to investigate the impact of these variables. Second, the classification of firms that use different R&D strategies can only capture the likelihood of a firm being a duplicate imitator, a creative imitator or an original innovator. Arguably the measures used here are crude. Third, the main dataset used is based on WBES 2003. This dataset is expected to have the characteristics of representativeness and reliability (https://www.enterprisesurveys.org/methodology). However a reviewer who is familiar with the World Bank firm level database for China questions data quality. We do not have evidence whether the sample biases systematically affect the results. Due caution is needed in this regard.

Appendix: Government Institutions in China's National Innovation System



Source: Zhong and Yang (2007)

List of abbreviations:

CAE: Chinese Academy of Engineering
CAS: Chinese Academy of Sciences
COSTIND: Commission of Science, Technology and Industry for National Defence
MOC: Ministry of Commerce
MOE: Ministry of Education
MOF: Ministry of Finance
MOP: Ministry of Personnel
MOST: Ministry of Science and Technology
NDRC: National Development and Reform Commission
NSFC: National Natural Science Foundation of China
R&D: Research and Development
SME: Small and Medium-sized enterprise
S&T: Science and Technology

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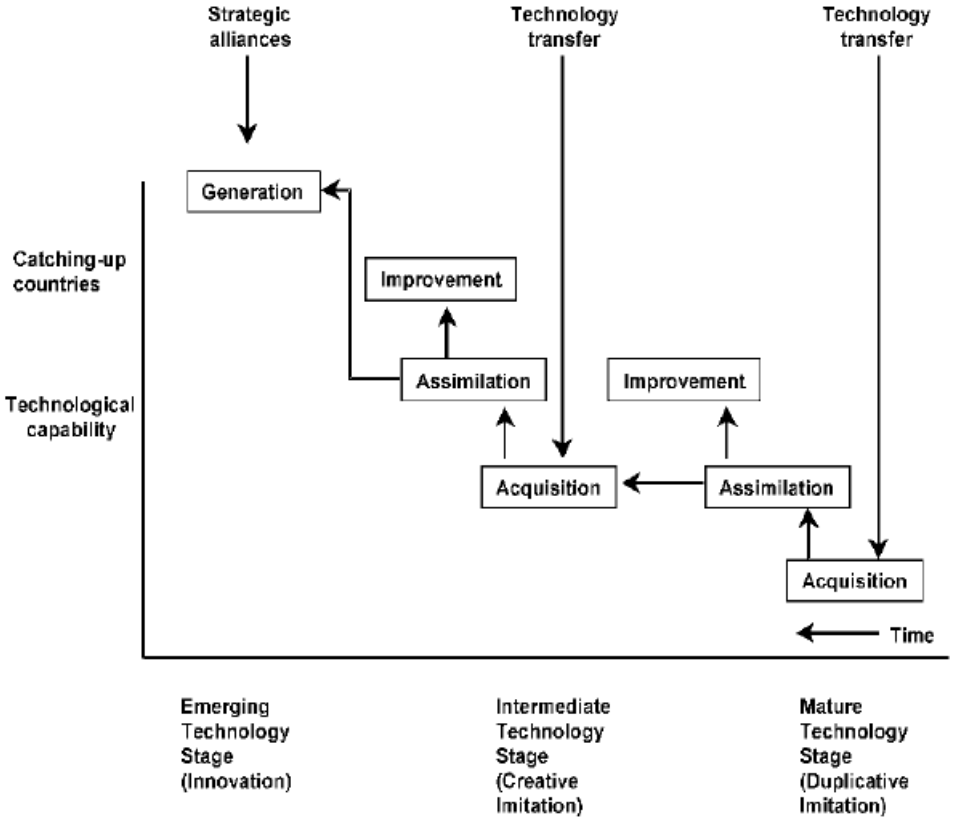
Figure 1: Technological Trajectory Framework



Source: Kim (2004)

Table 1 Sample Profile in 2002

Industry	No. of firms	Profitability	Share of R&D Expenditure by FIEs in Industry	log(Exports)	No. of R&D Personnel
1. Garments	232	0.1087	0.3153	5.9805	4.5000
2. Electronics	49	0.0921	0.1281	0.6346	6.1224
3. Food	344	0.3140	0.3827	3.9201	30.7413
4. Vehicles and vehicle parts	247	0.3210	0.2044	2.9693	73.7733
5. Metals and machinery	99	-0.0309	0.2876	0.9723	6.9596
6. Chemicals and pharmaceuticals	51	0.2101	0.1212	2.2119	8.7255

Table 2 Summary Statistics and Correlation Coefficients

Variable	Mean	s.d.	2	3	4	5	7	5	8	9	10
1. Profitability	0.234	0.789									
2. FDI	0.299	0.115									
3. R&D Strategy	0.502	0.500	0.115								
4. Innovativeness	3.074	3.049	0.031								
5. Laws	65.038	37.687	-0.001	0.120	0.052						
6. Access to information	18.239	3.762	0.015	0.051	0.009	0.046					
7. R&D Services	1.892	2.361	0.075	0.298	0.095	0.115	0.098				
8. Exporting	3.197	6.441	0.057	0.066	0.248	0.055	0.045	0.026			
9. Competition	3.742	1.305	-0.040	-0.217	-0.093	0.013	-0.068	-0.133	-0.055		
10. Log(L)	5.088	1.403	-0.026	0.257	0.270	0.126	-0.038	0.241	0.299	-0.206	
11. R&D Expenses	0.127	0.922	0.043	0.032	0.022	-0.039	0.020	0.073	-0.034	-0.070	-0.010
12. R&D Personnel	0.054	0.221	0.099	0.111	-0.020	-0.011	0.022	0.096	-0.013	-0.086	-0.086

Table 3 The Impact of R&D Strategy, NIS and FDI on Firm Performance

VARIABLES	(1)	(2)	(3)	(4)
FDI	-0.362***	-0.397***	0.0118	-0.0164
	(0.128)	(0.133)	(0.152)	(0.153)
R&D Strategy	0.208***	0.209***		
	(0.0310)	(0.0310)		
Innovativeness			0.0294***	0.0301***
			(0.00496)	(0.00505)
Laws	0.000648*	0.000629*	0.0586	0.0622
	(0.000370)	(0.000371)	(0.0492)	(0.0494)
Laws x FDI		0.00615*		0.420
		(0.00320)		(0.399)
Access to Information	0.00894**	0.00904**	0.00484	0.00565
	(0.00379)	(0.00380)	(0.00526)	(0.00532)
Access to Information x FDI		-0.000807		-0.0508
		(0.0322)		(0.0396)
R&D Services	0.0279***	0.0279***	0.0273***	0.0270***
	(0.00617)	(0.00621)	(0.00783)	(0.00794)
R&D Services x FDI		0.00875		0.145**
		(0.0482)		(0.0586)
Exporting	0.00683***	0.00693***	0.00460	0.00562
	(0.00220)	(0.00220)	(0.00432)	(0.00431)
Competition	-0.0106	-0.0105	-0.0214	-0.0164
	(0.0113)	(0.0113)	(0.0137)	(0.0138)
Log(L)	-0.00836	-0.00849	-0.00442	-0.00654
	(0.0116)	(0.0116)	(0.0145)	(0.0145)
R&D Expenses	-0.0183	-0.0172	-1.432	-1.575
	(0.0170)	(0.0174)	(1.288)	(1.329)
R&D Personnel	0.190**	0.193**	0.231**	0.228**
	(0.0743)	(0.0747)	(0.0904)	(0.0909)
Constant	-0.138	-0.138	0.232*	0.223*
	(0.100)	(0.101)	(0.131)	(0.130)
No. of observations	3,055	3,055	1,447	1,447
No. of firms	1,036	1,036	492	492
R^2	0.116	0.117	0.097	0.102

Notes: City dummies are included in the estimation. Robust standard errors are in parentheses. ***, ** and * indicate that the coefficient is significantly different from zero at the 1%, 5% and 10% level, respectively.