

# PRC Outward Investment in the USA and Europe: A Model of R&D Acquisition

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## Abstract

In this paper, I present a theoretical framework designed to explain People's Republic of China (PRC) outward foreign direct investment in the USA and Europe, in search of research and development (R&D) acquisition modeled as positive "spillover effects" in a two-country model with firms distinguished by their ability to innovate. The motivation for this paper is the growing PRC merger and acquisition activity in Europe and the USA. The fact that the PRC, despite its many successful internal reforms, cannot induce innovation activity designed to alter its external sector from one that is based on cheap labor to one that is based on innovation-rich products, has forced it to use its extensive reserve holdings to acquire the necessary R&D via merger and acquisition. These acquisitions will allow the PRC to alter their domestic and export product mix and thus avoid the middle-income trap.

## 1. Introduction to PRC Outward Investment

Maintaining international competitiveness in the current international environment requires rapid scientific and technological innovations. As the flow of foreign direct investment (FDI) and venture capital continues to expand across the world, the pressures to create quicker and more efficient ways to extract the benefits of technological innovation may lead to more creative methods for its acquisition. This is especially true for countries such as the People's Republic of China (PRC), which, on the one hand, is rich in foreign reserves and, on the other hand, short in operational research and development designed to alter its external sector from one that is based on cheap labor to one that is based on innovation and higher value added.<sup>1</sup>

Despite the fact that PRC-outward FDI (OFDI) is by world standards very small, it has significantly expanded and focused its attention on the acquisition of technology, once it adopted its "Going Global" program.<sup>2</sup> The PRC's OFDI went from US\$9.9 billion in 2005 to US\$77.2 billion in 2012 and, in the first 6 months of 2013, the PRC's OFDI was US\$42.6 billion (MOFCOM, 2013; Heritage Foundation, 2014). This impressive growth is a reflection of (a) the PRC's adoption of its National Development and Reform Commission (NDRC) and (b) the Export–Import Bank of China (EIBC) jointly issued directive to encourage overseas investment in four specific areas: "(1) Resource exploration projects to mitigate the domestic shortage of natural resources; (2) projects that promote the export of domestic technologies, products, equipment and labor; (3) overseas R&D [research and development] centers to utilize internationally advanced technologies, managerial skills and professionals; and (4) [mergers and acquisitions] that could enhance the international competitiveness of Chinese enterprises and accelerate their entry into foreign markets."<sup>3</sup>

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The driver for this OFDI is the state, not the private market. In 2012, the official PRC statistics list total PRC OFDI at US\$87.8 billion, of which the majority originated from centrally controlled state-owned enterprises (SOEs). While the role of private enterprises in OFDI is rising, it is still a minority participant in the total OFDI flows.<sup>4</sup> PRC SOE firms operating in the USA and Europe are encouraged to participate in merger and acquisitions (M&A) or to acquire 100% ownership of foreign companies, through which they can absorb state-of-the-art technologies and thus “leapfrog” several stages of development and upgrades.<sup>5</sup> While this could be viewed as intra-firm behavior, it is not. It represents PRC SOE activity and not PRC private transnational corporation (TNC) M&A activity.

Given that the official data presented by the PRC highlights the important role of its SOE in its OFDI activity, we accept their position that the majority of OFDI is done by state actors. A time series of PRC cross-border M&A activity (in millions of US dollars) is presented in Table 1. It is noteworthy that by 2012, the value of Chinese cross-border M&A was equivalent to 25% of total developed country and 15% of total world cross-border M&A investments.

The PRC’s role in OFDI is predominantly in the form of non-financial TNC M&As. Table 2 presents the top non-financial TNC, ranked by foreign assets in 2011.

*Table 1. Value of Chinese Cross-border M&As as Compared with the World and Developed Economies, 1990–2012*

<i>Year</i>	<i>China Total (PRC plus Hong Kong) (US\$million)</i>	<i>World (US\$million)</i>	<i>Developed economies (US\$million)</i>
1990	1,841	98,903	87,188
1991	947	21,094	14,624
1992	2,317	48,106	36,658
1993	1,700	43,623	34,845
1994	2,041	91,769	79,062
1995	1,436	112,527	102,004
1996	1,628	142,557	124,863
1997	5,636	180,751	163,205
1998	6,355	406,427	372,286
1999	7,235	630,807	592,794
2000	37,397	905,214	828,662
2001	1,209	429,374	388,605
2002	18,799	248,446	201,729
2003	1,380	182,874	138,180
2004	2,752	227,221	166,974
2005	11,848	462,253	359,551
2006	20,092	625,320	497,324
2007	-10,262	1,022,725	841,714
2008	36,893	706,543	568,041
2009	28,951	249,732	160,785
2010	44,384	344,029	223,726
2011	49,506	555,173	428,075
2012	45,126	308,055	175,555

*Source:* UNCTAD, *World Investment Report*, 2013.

Table 2. The top non-financial TNCs from China, ranked by foreign assets, 2011<sup>a</sup>

Foreign assets		TN <sup>b</sup>	Corporation	Home economy	Industry <sup>c</sup>	Assets		Sales		Employment		TN <sup>b</sup> (%)
						Foreign (US\$m)	Total (US\$m)	Foreign (US\$m)	Total (US\$m)	Foreign <sup>d</sup>	Total	
1	Hutchison Whampoa Limited	18	Hong Kong, China	Diversified	77,291	92,788	23,477	30,023	206,986	250,000	81.4	
2	CITIC Group	90 <sup>e</sup>	China	Diversified	71,512	514,847	9,923	51,659	30,806	140,028	18.4	
5	China Ocean Shipping (Group) Company	61	China	Transport and storage	40,435	52,230	19,454	29,579	7,355	130,000	49.6	
10	China National Offshore Oil Corp	89	China	Petroleum expl./ref./distr.	29,802	112,887	19,786	75,518	3,367	98,750	18.7	
17	Jardine Matheson Holdings Ltd	45	Hong Kong, China	Diversified	21,486	58,297	28,291	37,967	217,556	330,000	59.1	
21	Noble Group Ltd	5	Hong Kong, China	Wholesale trade	17,761	19,943	80,732	80,732	13,477	14,000	95.1	
24	China National Petroleum Corporation	100	China	Petroleum expl./ref./distr.	16,954	475,700	8,671	326,790	31,442	1,668,072	2.7	
32	CLP Holdings Ltd	60	Hong Kong, China	Utilities (Electricity, gas and water)	14,217	27,595	7,697	11,772	2,057	6,316	49.8	
34	Sinochem Group	70	China	Petroleum expl./ref./distr.	13,112	40,563	54,861	70,994	7,994	47,022	42.2	
36	First Pacific Company Ltd	2	Hong Kong, China	Electrical & electronic equipment	12,500	12,612	5,684	73,584	73,584	45,000	99.7	
37	New World Development Ltd	71	Hong Kong, China	Diversified	12,200	29,437	2,273	4,230	14,123	45,000	42.2	
40	China Resources Enterprises Ltd	14	Hong Kong, China	Petroleum expl./ref./distr.	11,606	14,635	13,020	14,153	190,000	200,000	88.8	
41	Sun Hung Kai Properties Ltd	93	Hong Kong, China	Other services	11,466	53,088	720	8,046	6,242	35,000	16.1	
46	Li & Fung Ltd	11	Hong Kong, China	Wholesale trade	10,228	10,920	18,900	20,030	25,106	29,624	90.9	
48	Shangri-La Asia Ltd	8	Hong Kong, China	Other consumer services	9,598	9,973	1,647	1,912	27,552	28,900	92.6	
51	Lenovo Group Ltd	64	China	Electrical & electronic equipment	9,103	15,861	17,179	29,574	6,238	27,000	46.2	
56	The Hong Kong and China Gas Co. Ltd	34	Hong Kong, China	Electricity, gas and water	7,738	10,957	1,606	2,881	1,369	1,938	65.7	
58	China Mobile (Hong Kong) Limited	99	China	Telecommunications	7,483	149,653	4,084	81,674	175,336	175,336	3.3	
60	Swire Pacific Ltd	69	Hong Kong, China	Business services	7,234	37,688	2,633	4,662	37,672	73,867	42.2	
66	Yue Yuen Industrial Holdings Ltd	10	Hong Kong, China	Other consumer goods	6,342	6,473	5,529	7,045	451,399	460,000	91.5	
73	Sinopec—China Petrochemical Corporation	96	China	Petroleum expl./ref./distr.	5,568	179,813	86,305	387,595	1,000	377,235	8.5	
77	Power Assets Holdings Ltd	83	Hong Kong, China	Electricity, gas and water	4,931	12,199	717	1,311	752	1,861	26.9	
79	Shenzhen International Holdings Ltd	9	Hong Kong, China	Construction	4,525	5,138	717	717	4,165	4,729	92.0	
80	Galaxy Entertainment Group Ltd	3	Hong Kong, China	Other consumer services	4,519	4,606	5,172	5,291	14,386	15,000	97.3	
81	China Minmetals Corp	94	China	Metal and metal products	4,512	36,227	8,673	54,194	7,990	146,000	11.3	
85	Guangdong Investment Ltd	6	Hong Kong, China	Diversified	4,213	4,485	884	920	4,062	4,295	94.9	
90	Road King Infrastructure Ltd	7	Hong Kong, China	Transport and storage	3,678	4,086	878	1,671	1,671	1,832	93.7	
91	Lee & Man Paper Manufacturing Ltd	1	Hong Kong, China	Wood and paper products	3,436	3,444	1,892	1,892	7,682	7,700	99.8	
92	Esprit Holdings Ltd	12	Hong Kong, China	Other consumer goods	3,381	3,473	4,268	4,344	10,857	14,100	90.9	
94	ZTE Corp	81	China	Other consumer goods	3,219	16,934	7,228	13,342	21,069	89,786	32.2	
98	China Railway Construction Corporation Ltd	98	China	Construction	3,076	66,453	2,579	68,575	23,602	241,621	6.1	
100	TPV Technology Limited	41	China	Wholesale trade	2,972	5,257	7,803	11,040	17,183	29,516	61.8	

Source: UNCTAD, World Investment Report (2013).

Notes: <sup>a</sup> All data are based on the companies' annual reports unless otherwise stated; corresponds to the financial year from 1 April 2011 to 31 March 2012. <sup>b</sup> TNI, the Transnationality Index, is calculated as the average of the following three ratios: foreign assets to total assets, foreign sales to total sales and foreign employment to total employment. <sup>c</sup> Industry classification for companies follows the US Standard Industrial Classification as used by the US Securities and Exchange Commission (SEC). <sup>d</sup> In a number of cases foreign employment data were calculated by applying the share of foreign employment in total employment of the previous year to total employment of 2011. <sup>e</sup> In lieu of 2011 figures, 2010 data have been used.

The United Nations Conference on Trade and Development (UNCTAD) ranks this data by the transnationality index (TNI), which is calculated as the average ratio of the foreign assets to total assets, foreign sales to total sales and foreign employment to total employment. The list of TNCs includes what is often referred to as the “bargain hunters”. In many cases these bargain hunters are in search of “bargains” that represent undervalued or troubled “brands”. In acquiring these companies, the PRC does not have to spend decades building up “brand” recognition. For example, Nanjing Automotive acquired British car manufacturer MG Rover’s brand in 2005. Geely Automotive, one of the PRC’s biggest automotive companies, acquired Ford Motor’s Volvo unit in 2010 in a US\$1.8 billion deal.<sup>6</sup> Furthermore, since these TNCs control virtually all intellectual property in the PRC and account for 85% of the PRC’s technology exports, the PRC’s determination to have its overseas firms undertake overseas acquisitions as a route to enhanced research and development would be a rational choice.

According to the OECD (2008), the main economic drivers of economic growth include “the absolute growth of R&D and innovation related activities”. They stress that in the 21st century one should find great competition in the scientific and technological fields; significant globalization of R&D; more performance of R&D in the services sector and a growing focus on non-technological innovation; widespread policy shifts towards fiscal incentives for R&D; and enhanced internationalization and mobility of highly skilled people, including greater participation of women in the HRST (human resources for science and technology) labor force across almost all countries. The leadership of the PRC is aware of this and is therefore on the “fast track” to encourage their overseas firms to acquire more and more foreign firms.<sup>7</sup>

In 2012, Chinese M&A deals greater than US\$1 billion consisted of 20 large SOE transactions that are listed in Table 3. The ranking represents a subset of the top 200 M&A deals listed by UNCTAD (2013, Appendix Table 17). The data represents a small subset of the total of 316 M&As completed by the PRC in 2012. The majority of these acquisitions represent far smaller sums of money. The industries represented by China’s major acquisitions range from mining industries, oil extracting industries, telecom companies, environmental sciences and technology companies to banking services and life insurance companies. The acquiring Chinese partners are large SOEs with sufficient capital to complete these transactions. These are not intra-firm transactions as one would expect in a market economy context, but rather acquisitions by China’s SOE TNCs.<sup>8</sup>

Chinese participation in greenfield projects in 2012 is at the level of 8% of total developed country greenfield investments and consists of 438 individual projects, primarily in Africa and Latin America. Most of these projects are equally large scale. A prominent example of these kinds of infrastructure projects includes a US\$1.5 billion telecom transaction between China’s ZTE and Ethiopia. The PRC managed to acquire this infrastructure project in 2006 by offering US\$1.5 billion in low-interest financing, funded by China’s state-owned banks. When faced by a World Bank complaint that Ethiopia granted ZTE monopoly rights, Ethiopia invited ZTE’s Chinese rival, Huawei to bid on a subsequent project. Under a 2013 project priced at US\$1.6 billion, funded by a low-interest loan from China’s state-owned banks, Ethiopia accepted Huawei in its telecom sector, thus creating a duopoly controlling this vital sector. Between 1995 and 2012, the Chinese state-owned Export–Import Bank and the China Development Bank provided approximately US\$50 billion in low interest financing for projects in Africa. During the same period, the US state-owned

Export–Import Bank has offered approximately US\$12 billion in low-interest financing for projects in Africa.<sup>9</sup>

If we focus strictly on Chinese state-owned TNC M&A activity, we have a very simple transaction between the state actor and the foreign firm representing the asset that is intended to be acquired. One can begin by introducing the assumption that both parties have asymmetric information on the value of the asset. Part of the asymmetry may arise from the expected positive spillover effect in the local economy after acquisition. In effect, the asset to be acquired has two value components, (1) immediate value; and (2) long-term value arising from the positive spillover. The sequence of this two party transaction can look as follows:

- (1) The state, after incurring a search cost of  $\delta$ , calculates the value of the spillover effect to be  $\Omega$ , which is greater than the expected profitability  $\pi$  of the acquired firm.<sup>10</sup> The value of the asset to the state would be:

$$V = (\pi + \Omega) - \delta \quad \text{where} \quad \Omega > \pi \tag{1}$$

- (2) The state offers the target company a purchase package  $\gamma$  which is composed of two components, the value of shares  $[v(\rho)]$  purchased, where  $0 \leq \rho \leq 1$ , and a share of the profits of the acquired firm if 100% of the shares are not sold  $\pi(1 - \rho)$ . The latter possibility will include a cost to the targeted company of operating in the PRC. This may be viewed as the cost associated with a performance clause  $\phi$  for a defined period of time or indefinitely equalling  $[\beta(\phi)]$ . Overall, the offer would be

$$\gamma = [v(\rho)] + [\pi(1 - \rho)] - \beta(\phi) \tag{2}$$

- (3) The target company observes the purchase package  $\gamma$  but not  $V$ .
- (4) If the target company rejects the offer, then its payoff is its expected profits  $\pi$  from its normal activities, while the state payoff is zero. If the target company accepts the state’s offer, its payoff will be  $\gamma = [v(\rho)] + [\pi(1 - \rho)] - \beta(\phi)$  and the government gets  $V = (\pi + \Omega) - \delta - \gamma$ .

Under the scenarios we have outlined above the PRC TNC in its M&A activity is betting on the fact that not only is  $\Omega > \pi$  but also that  $(\pi + \Omega) > (\delta + \gamma)$ . The empirical literature on the generic issue of “spillover effects” of TNC activity is mixed. We presume that there must be sufficient positive “spillover” effects to justify the large sums of OFDI by PRC state-owned TNCs in their M&A activities. The empirical literature attempting to explain PRC state-owned TNC activities is inconclusive and without much theoretical underpinnings (Todo et al., 2011; Chen and Lee, 2012; Li, 2012; Szamosszegi, 2012; Bowman et al., 2013). We attempt to fill this gap by presenting, in section 2, a reasonable theoretical explanation of PRC OFDI in search for “spillover effects” in a two-country model with firms distinguished by their ability to innovate.

## 2. Innovation via M&A or Immigration of Skilled S&E Workers?

Consider a world with two countries with two legal enforceable intellectual property rights (IPR) environments, where an entrepreneur can innovate—with a well-established common law legal structure  $C^L$  that enforces IPR rules and that of a transition economy  $C^T$  with a “work in progress” legal enforcement of IPR. The state actor  $S^T$  in the transition economy  $C^T$  is attempting to acquire “spillover” effects

Table 3. Cross-border M&amp;A deals worth over \$1 billion completed in 2012 by China

Rank	Value (US\$b)	Acquired company	Host economy <sup>a</sup>	Industry of the acquired company	Ultimate acquired company	Ultimate host economy	Industry of the ultimate acquired company
20	4.8	Petrogal Brasil Ltda	Brazil	Crude petroleum and natural gas	Galp Energia SGPS SA	Portugal	Crude petroleum and natural gas
32	3.5	Energias de Portugal SA(EDP)	Portugal	Electric services	EDP	Portugal	Electric services
46	3.0	MGN Gas Networks (UK) Ltd	UK	Natural gas transmission	MGN Gas Networks (UK) Ltd	UK	Natural gas transmission
55	2.6	AMC Entertainment Holdings Inc	USA	Motion picture theaters, except drive-in	AMC Entertainment Holdings Inc	USA	Motion picture theaters, except drive-in
57	2.5	Devon Energy Corp-Shale Oil & Gas Assets(5)	USA	Crude petroleum and natural gas	Devon Energy Corp	USA	Crude petroleum and natural gas
62	2.3	Swire Properties Ltd	Hong Kong, China	Land subdividers and developers, except cemeteries	John Swire & Sons Ltd	UK	Deep sea foreign transportation of freight
73	2.2	LME Holdings Ltd	UK	Security and commodity exchanges	LME Holdings Ltd	UK	Security and commodity exchanges
86	2.0	Unicom New Horizon Telecommunications Co Ltd	China	Radiotelephone communications	China United Network	China	Telephone communications, except radiotelephone
87	1.9	Weetabix Ltd	UK	Cereal breakfast foods	Lion Capital LLP	UK	Investors, nec
103	1.7	ING Management Holdings (Malaysia) Sdn Bhd	Malaysia	Life insurance	ING Groep NV	Netherlands	Life insurance
113	1.6	Lasalle Investment Management KK-Property Portfolio	Japan	General warehousing and storage	Jones Lang LaSalle Inc	USA	Real estate agents and managers
118	1.5	Gloucester Coal Ltd	Australia	Bituminous coal and lignite surface mining	Noble Group Ltd	Hong Kong, China	Grain and field beans
122	1.5	Talisman Energy (UK) Ltd	UK	Crude petroleum and natural gas	Talisman Energy Inc	Canada	Crude petroleum and natural gas
130	1.4	China Unicom (Hong Kong) Ltd	Hong Kong, China	Telephone communications, except radiotelephone	China Unicom (Hong Kong) Ltd	Hong Kong, China	Telephone communications, except radiotelephone
136	1.4	Tower Top Development Ltd	China	Operators of nonresidential buildings	Yuexiu Property Co Ltd	Hong Kong, China	Land subdividers and developers, except cemeteries
138	1.3	Australia Pacific LNG Pty Ltd	Australia	Crude petroleum and natural gas	Conoco-Phillips Co	USA	Crude petroleum and natural gas
147	1.3	Anvil Mining NL	Australia	Copper ores	Anvil Mining NL	Australia	Copper ores
148	1.3	Extract Resources Ltd	Australia	Uranium-radium-vanadium ores	Extract Resources Ltd	Australia	Uranium-radium-vanadium ores
179	1.1	Kyobo Life Insurance Co Ltd	Korea, Republic of	Life insurance	Kyobo Life Insurance Co Ltd	Korea, Republic of	Life insurance
194	1.0	Grande Cache Coal Corp	Canada	Bituminous coal underground mining	Grande Cache Coal Corp	Canada	Bituminous coal underground mining
195	1.0	Kalahari Minerals PLC	UK	Uranium-radium-vanadium ores	Kalahari Minerals PLC	UK	Uranium-radium-vanadium ores

Table 3. Continued

Rank	Acquiring company	Home economy <sup>a</sup>	Industry of the acquiring company	Ultimate acquiring company	Ultimate home economy	Industry of the ultimate acquiring company	Shares acquired (%)
20	Sinopec International Petroleum Exploration & Production Corp	China	Investors, nec	Sinopec Group	China	Crude petroleum and natural gas	30
32	China Three Gorges International (Europe) SA	Luxembourg	Investors, nec	China Three Gorges Corp	China	Electric services	21.35
46	Investor Group	Hong Kong, China	Investors, nec	Investor Group	Hong Kong, China	Investors, nec	100
55	Dalian Wanda Group Corp Ltd	China	Operators of nonresidential buildings	Dalian Wanda Group Corp Ltd	China	Operators of nonresidential buildings	100
57	Sinopec International Petroleum Exploration & Production Corp	China	Investors, nec	Sinopec Group	China	Crude petroleum and natural gas	33.33
62	Shareholders	Hong Kong, China	Investors, nec	Shareholders	Hong Kong, China	Investors, nec	18
73	HKEx Investment (UK) Ltd	UK	Investors, nec	HKEX	Hong Kong, China	Security and commodity exchanges	100
86	China United Network Communications Corp Ltd	China	Telephone communications, except radiotelephone	China Unicom(Hong Kong)Ltd	Hong Kong, China	Telephone communications, except radiotelephone	100
87	Bright Food (Group) Co Ltd	China	Noncommercial research organizations	Bright Food (Group) Co Ltd	China	Noncommercial research organizations	60
103	American International Assurance Co Ltd	Hong Kong, China	Life insurance	American Intl Assurance Group	Hong Kong, China	Life insurance	100
113	Investor Group	China	Investors, nec	Investor Group	China	Investors, nec	100
118	Yancoal Australia Pty Ltd	Australia	Bituminous coal and lignite surface mining	Yan Kuang Group Co Ltd	China	Bituminous coal and lignite surface mining	100
122	Sinopec International Petroleum Exploration & Production Corp	China	Investors, nec	Sinopec Group	China	Crude petroleum and natural gas	49
130	China United Network Communications Group Co Ltd	China	Telephone communications, except radiotelephone	China United Network	China	Telephone communications, except radiotelephone	4.56
136	Yuexiu REIT 2012 Co Ltd	Hong Kong, China	Real estate investment trusts	Yuexiu Real Estate Investment	Hong Kong, China	Real estate investment trusts	99.99
138	China Petrochemical Corp (Sinopec Group)	China	Crude petroleum and natural gas	Sinopec Group	China	Crude petroleum and natural gas	10
147	MMG Malachite Ltd	Hong Kong, China	Nonferrous die-castings, except aluminum	China Minmetals Corp	China	Nondurable goods, nec	100
148	Taurus Minerals Ltd	Hong Kong, China	Investors, nec	Peoples Republic of China	China	National government	57.26
179	Investor Group	Hong Kong, China	Investors, nec	Investor Group	Hong Kong, China	Investors, nec	24
194	1629835 Alberta Ltd SPV	Canada	Investment offices, nec	Winsway Coking Coal Hldg Ltd	Hong Kong, China	Coal and other minerals and ores	100
195	China Guangdong Nuclear Power Holding Co Ltd	China	Electric services	Peoples Republic of China	China	National government	100

<sup>a</sup> where the immediate acquired/immediate acquiring company is located. Cross-border M&A sales and purchases are calculated on a net basis as follows: Net cross-border M&A sales in a host economy = Sales of companies in the host economy to foreign TNCs (-) Sales of foreign affiliates in the host economy; net cross-border M&A purchases by a home economy = Purchases of companies abroad by home-based TNCs (-) Sales of foreign affiliates of home-based TNCs. The data cover only those deals that involved an acquisition of an equity stake of more than 10 per cent.

attached to innovative R&D.<sup>11</sup> The model is divided into two stages: the first stage concerns the problem of inducing “in-country innovation” in the state-dominated economy with questionable IPR enforcement, and the second stage focuses on the economic argument for foreign acquisition of the “spillover effects”, either through M&A or by acquiring the skilled labor.

The transition economy is populated by  $j$  risk-neutral firms with a strong and powerful state actor that will both create and invest in its enterprises  $E_S^{j,T}$  (where  $S$  is state and  $T$  is transition economy legal structure). The two major distinguishing factors separating transition economy firms and their market counterparts revolve around their ability to acquire an initial wealth  $W^{j,T}$  at capital costs substantially lower than their competition in the market economy, as well as their ability to successfully innovate in the context of a “work in progress” legal enforcement of IPR.

In order to consider the options available to  $E_S^{j,T}$ , we begin by focusing on the decision to innovate.

### *The Decision to Innovate via Immigration*

There are two firms: one located in  $C^L$  and the other in  $C^T$ . Assume initially that both firms have constant marginal costs  $c$ . In period 1, they can endeavor to initiate an innovation that reduces their marginal costs by  $x_i$ ,  $i$  representing either a firm in  $L$  or  $T$  environments. For simplicity, assume that research R&D investment has diminishing returns and that the R&D expenditure function is quadratic (Qiu, 1977), such that:

$$V(x_i) = \frac{\sigma x_i^2}{2} \quad \text{where } \sigma > 0 \quad (3)$$

where the parameter  $\sigma$  measures the efficiency or productivity of the R&D technology.

In order to innovate, each firm has to hire scientists and engineers (S&Es). Once the decision to innovate is made, the next question is the cost of that skilled human capital. In a multi-country context where there is a free flow of skilled labor, one can postulate that  $C^L$  and  $C^T$  environment firms compete on a regular basis for skilled human capital and that competition is captured fully in terms of wage competition.<sup>12</sup> One can presume a framework where firm  $i$  in  $C^T$  offers wages  $w_{i,T}^{j,L}$  ( $i \neq j$ ) for firm  $j$ 's S&Es and  $w_{i,T}^{i,T}$  for their own S&Es. Assuming competitive markets, a scientist or engineer from firm  $j$  will switch locations from  $C^L$  to  $C^T$  if  $w_{i,T}^{j,L} > w_{j,L}^{j,L}$ , otherwise he or she continues to work for firm  $j$ . To attract S&Es from firm  $j$ , firm  $i$  needs to offer a wage that is higher than  $w_{j,L}^{j,L}$  by some  $\tau$ .

The wage differential  $\tau$  offered by firm  $i$  in  $C^T$  must reflect the differential human capital skills and additional expected performance of  $i$ . While some of this information is known, the full differential in performance can only be determined with some degree of certainty after the wage contract is offered and the employee comes on board. If an S&E moves to firm  $i$  in  $C^T$ , this firm obtains an immediate cost reduction equal to  $x_j$  accounting for the technical hire and by the knowledge spillover  $\Omega$  from knowledge while employed in firm  $j$  in  $C^L$ . So its marginal production costs will be:

$$c_i^T = c - x_i - \Omega x_j \quad (4)$$

where the parameter  $\Omega \in [0, 1]$  captures the extent of spillovers. The reduction in costs reflected in equation (4) arises because of the assumption that the required human capital to reduce production cost is completely transferable to other firms.



Furthermore, we assume that the cost reductions are complementary. Hence, if a firm can motivate an S&E of the competing firms to move, he or she will be able to replicate the original cost reduction in his new firm. For the sake of completeness, one can also assume that knowledge can be duplicated within the firm losing its valued scientist or engineer. If firm  $i$  in  $C^T$  loses an S&E to its local  $C^T$  competitors after investing at least the wage differential  $\tau$ , then we assume that it has already internalized the cost savings so that its costs remain  $c - x_i$ .

The value to firm  $i$  in  $C^T$  of attracting foreign skilled workers becomes apparent when we introduce competition between firm  $i$  in  $C^T$  and firm  $C^T$  and firm  $j$  in  $C^L$ . For simplicity, assume that the two firms produce homogeneous goods. The inverse market-demand schedule of the consuming countries is given by:

$$p = \alpha - \beta(q_i^T + q_j^L); \quad i \neq j; \quad \alpha > 0 \quad (5)$$

where  $q_i^T$  is the quantity of firm  $i$ 's (in  $C^T$ ) production. (The homogeneity assumption can be easily transformed by letting  $q_j^L = \gamma q_j^T$ , where the degree of product differentiation decreases with the parameter  $\gamma$ .)

Let  $\pi_i^T$  represent firm  $i$ 's profits excluding the cost of innovation. Then given the firm's decisions to undertake R&D,

$$\pi_i^T = p_i^T q_i^T - (c - x_i - \Omega x_j) q_i^T. \quad (6)$$

The two firms choose output to maximize their respective market profits, and the resulting Cournot–Nash equilibrium would be:

$$q_i^* = \frac{1}{4 - \gamma^2} [(\alpha - c)(2 - \gamma) + (2 - \Omega\gamma)x_i + (2\Omega - \gamma)x_j]. \quad (7)$$

### *The Decision to Acquire R&D*

As an alternative strategy to importing skilled S&E workers, firm  $i$  in  $C^T$  can begin the process of acquiring via M&A the research firms relevant to its production. Whitney and Gaisford (1999) have suggested that firm  $i$  in  $C^T$  may be able to acquire the R&D-generating firm itself. Incorporating this assumption brings the current discussion closer to the strategic trade policy models of Brander and Spencer (1985), Dixit (1984), Eaton and Grossman (1986), Dixit and Kyle (1985), Branson and Klevorick (1986), Grossman (1986), Gal-Or (1985) and Vives (1984).

As noted above, let  $\Omega$  denote the “spillover effect” or, in terms of the acquisition, the probability that firm  $i$ 's agents in  $C^T$  successfully penetrate firm  $j$  in  $C^L$  new technology. The probability that firm  $i$  will fail to penetrate firm  $j$  is  $1 - \Omega$  and the probability where firm  $i$  is successful is simply  $\Omega$ . Given that the marginal cost attainable with previous generation technology is  $c - x_i$  and the marginal cost reduction attributable to the new technology post spillover is  $\Omega x_j$ , firm  $j$  would maintain its superior position as long as firm  $i$  is prevented from accessing the R&D. Firm  $j$  produces more than firm  $i$  and earns higher profits because its cost advantages remain intact, when firm  $i$ 's corporate incursion is unsuccessful. Following Qiu (1977), we assume that  $\alpha - (c - x_i) - \Omega x_j$  is strictly positive such that firm  $i$  continues to produce even if its attempt to acquire the R&D is unsuccessful. Once firm  $i$  manages to succeed in its acquisition of the R&D, the symmetry assumption will guarantee that in both firms, profits, outputs and costs will be identical. All the potential outcomes in this Cournot–Nash duopoly R&D acquisition model are presented in Table 4. A successful bid to

Table 4. Potential Outcomes in a Cournot–Nash Duopoly R&amp;D Acquisition Model

Description	Firm $C_i^T$ does not receive the cost saving technology from firm $C_j^L$	Firm $C_i^T$ does receive the cost saving technology from firm $C_j^L$
Firm $C_i^T$ 's MC	$c - x_i$	$c - x_i - \Omega x_j$
Firm $C_j^L$ 's MC	$c - x_i - \Omega x_j$	$c - x_i - \Omega x_j$
Firm $C_i^T$ 's output	$\frac{(\alpha - x_i - \Omega x_j)}{3\beta}$	$\frac{(\alpha - x_i + \Omega x_j)}{3\beta}$
Firm $C_j^L$ 's output	$\frac{(\alpha - x_i - 2\Omega x_j)}{3\beta}$	$\frac{(\alpha - x_i + \Omega x_j)}{3\beta}$
Firm $C_i^T$ 's profit	$\frac{(\alpha - x_i - \Omega x_j)^2}{9\beta}$	$\frac{(\alpha - x_i + \Omega x_j)^2}{9\beta}$
Firm $C_j^L$ 's profit	$\frac{(\alpha - x_i - 2\Omega x_j)^2}{9\beta}$	$\frac{(\alpha - x_i + \Omega x_j)^2}{9\beta}$
Consumer surplus	$\frac{2(\alpha - x_i + 0.5\Omega x_j)^2}{9\beta}$	$\frac{2(\alpha - x_i + \Omega x_j)^2}{9\beta}$

penetrate firm  $j$  by firm  $i$ , would increase firm  $i$ 's Nash equilibrium output by  $\frac{2\Omega x_j}{3\beta}$  and its profits by  $\frac{4\Omega x_j(\alpha - x_i)}{9\beta}$ , reduce firm  $j$ 's Nash equilibrium output by  $\frac{\Omega x_j}{3\beta}$  and its profits by  $\frac{2\Omega x_j(\alpha - x_i + (3/2)x_j)}{9\beta}$  and increase industry output by  $\frac{\Omega x_j}{3\beta}$  and consumer surplus by  $\frac{2\Omega x_j(\alpha - x_i + (3/4)\Omega x_j)}{9\beta}$ .

### 3. MICRO Data on the PRC Path to Acquire Foreign R&D

Employment of foreign experts in China has been on the rise since 2001. While small in number, relative to the Chinese labor market, its significance is that it is predominantly in economics, technology and management; education, science, culture and public health. On the demand side, the definition of "foreign expert" in economy, technology and management experts includes engineers, senior technicians and managerial staff members. In the past 20 years, the number of invited foreign experts has added up to over 2 million from more than 50 countries and territories. Currently, over 240,000 foreign experts are invited to work in China.<sup>13</sup> There is no data on their distribution by industry and no figure for the ones engaging in S&E activities.

If R&D is an expensive endeavor with enormous risks to investors and, in the case of the PRC, to the state, then there is a strong incentive to acquire proven innovation in the market economies, but the real "bargains" are in R&D operations that have not yet proven their true market value.

The best publicly available micro data on PRC outward M&A activity is provided by the Heritage Foundation. In Table 5, we present the data for M&A activities by PRC TNCs worth US\$100 million or more between 2005 and 2013. These deals represent about 25% of all the successful M&A deals in 2011. Of equal note are the list of troubled M&A deals presented in Table 6. All of these deals are in the technology area.

Table 5. Cross-Border M&A Deals in Technology Worth More Than US\$100 Million Between 2005 and 2013

Year	Investor	US\$millions	Share size (%)	Partner/target	Sector	Subsector	Country
2013	Fosun	240	96	Alma Lasers	Technology	Telecom	Israel
2013	CDH	110	10	Mobile World	Technology		Vietnam
2013	Mindray Medical	110	100	ZONARE Systems	Technology		USA
2013	Shanghai Micro Port Scientific	290		Wright Medical	Technology		USA
2013	Tencent	350	6	Activision	Technology		USA
2013	Huawei	200			Technology	Telecom	Britain
2012	Huawei	1,500			Technology	Telecom	Hungary
2012	CIC	490	7	Eutelsat	Technology	Telecom	France
2012	Tencent	330	40	Epic Games	Technology		USA
2012	Lenovo	150		Digibras	Technology		Brazil
2012	Huawei	150			Technology	Telecom	India
2012	Xinwei	300			Technology	Telecom	Nicaragua
2012	BGI	120	100	Complete Genomics	Technology		USA
2011	Lenovo	180	51	NEC	Technology		Japan
2011	China Unicom	500	1	Telefonica	Technology		Spain
2011	Tencent	400	84	Riot Games	Technology		USA
2011	ZTE	200			Technology	Telecom	Brazil
2011	Lenovo	670	82	Medion	Technology		Germany
2011	Huawei	130			Technology	Telecom	Italy
2010	Tencent	300	10	Digital Sky Technologies	Technology		Russia
2010	Shanda Games	100	100	Eyedentity Games	Technology		S. Korea
2010	Sinochem	270	50	DSM	Technology	Medical	Netherlands
2009	Unicom	1,000	1	Telefonica	Technology	Telecom	Spain
2009	China Mobile	500			Technology	Telecom	Pakistan
2008	Wuxi PharmaTech	160	100	AppTec Lab Services	Technology		USA
2008	Mindray Medical	200		Datascopie	Technology		USA
2007	China Mobile	280	89	Paktel	Technology		Pakistan
2007	China Mobile	180	11	Paktel	Technology		Pakistan
2005	Lenovo	1,740		IBM	Technology		USA

Source: Heritage Foundation.

*Table 6. Cross-Border Incomplete and Troubled M&A Deals in Technology Worth More Than US\$100 Million Between 2005 and 2013*

<i>Year</i>	<i>Investor</i>	<i>US\$m</i>	<i>Share (%)</i>	<i>Partner</i>	<i>Sector</i>	<i>Subsector</i>	<i>Country</i>
2013	China Mobile	600	12	Fareastone	Technology	Telecom	Taiwan
2010	Huawei	480		2Wire	Technology	Telecom	USA
2010	Huawei	1,300		Motorola	Technology	Telecom	USA
2010	Huawei and ZTE	5,000		Sprint	Technology	Telecom	USA
2008	ZTE	300			Technology	Telecom	The Philippines
2008	Huawei	600	17	3Com	Technology	Telecom	USA
2008	Great Wall	300	43	Iomega	Technology	Telecom	USA
2006	China Mobile	5,300		Millicom	Technology	Telecom	Luxembourg

*Source:* Heritage Foundation.

In order to empirically test the theoretical justifications for PRC TNC overseas activities require a much richer data set than we can access publicly today. Irrespective of this data constraint, however, the theoretical construct we present here is a reasonable explanation of the activities by the PRC TNCs in overseas markets.

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## Notes

1. The original texts of all of the PRC policy statements with respect to their long-term plans in the area of OFDI can be found in International Institute for Sustainable Development (2012).
2. Data on PRC OFDI are taken from both the Heritage Foundation (2014) and the MOFCOM (2013).
3. China moved up from the sixth to the third largest investor in 2012, after the USA and Japan. In 2012 China was one of the main drivers of OFDI and is expected to continue in this role (UNCTAD, 2013).
4. The Heritage Foundation estimates that over 90% of Chinese OFDI by value is state owned enterprise (SOE) investments. According to MOFCOM official statistics, by the end of 2011, SOEs represented 66.2% of the country's OFDI stock. In non-financial sectors, OFDI stock from SOEs was US\$60.17 billion, accounting for 77% of the total. Much of the data confusion arises from MOFCOM use of Hong Kong as the final destination of Chinese OFDI. Furthermore, there is confusion about the concept of SOE. MOFCOM attributes the OFDI to *zhongyang qiye*, or "central enterprise", which refers specifically to SOEs under the direct control of the central government, as opposed to the more generic *guoyou qiye*, which simply means "state-owned enterprise".
5. For instance, in 1988, the Shougang (Capital) Iron and Steel Corp. purchased 70% of the California-based Mesta Engineering and Design Inc. and thus obtained access to the company's high-tech design capability in steel-rolling and casting equipment (Pei and Lei, 2001). Another example is Lenovo's purchase of IBM's personal computer division in 2005. With this purchase Lenovo was able to gain managerial and commercial experience in the international PC market, making Lenovo the number 2 global supplier of PCs and other computer equipment.
6. Not all PRC efforts have proven successful. In 2010, Sprint Nextel Corp. excluded Chinese telecommunications-equipment makers Huawei and ZTE from a contract worth billions of dollars largely because of national security concerns about the two companies' ties to the Chinese government and military, and the security implications of integrating their equipment into critical US telecommunications infrastructure (Lublin and Raice, 2010).
7. See note 1 above.
8. A similar profile in the financial sector is not currently available.
9. *Wall Street Journal* (2014).
10. The spillover effects are assumed to be occurring over a number of periods.
11. The record of PRC acquisitions up to 2012 (presented in Tables 1–3) supports the idea that  $S^T$  is attempting to fill the gap in new innovations created by  $C^T$ —the "work in progress" legal enforcement of IPR.
12. We assume that the transition economy has reduced or eliminated any restrictions in their policies with respect to foreign skilled labor.
13. Ministry of Human Resources and Social Security (2014).