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CRUCIAL COLLABORATORS OR PETTY PLAYERS? THE GLOBALIZATION OF R&D AND THE RISE OF CHINA AND INDIA

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Abstract:

In recent decades, research and development has become a key new arena of globalization. Whereas multinational corporations once conducted R&D primarily in their home countries, it is now often dispersed across multiple locations around the world. Has this process transformed economic ties between the world's dominant state and its would-be rising powers in ways that imply an important power shift? Focusing on China and India's growing collaboration with the U.S., this paper argues that it has not. China and India remain considerably more reliant on the globalization of R&D than the U.S. does, and this remains a potential source of leverage for Washington. This vulnerability mainly reflects the fact that U.S. R&D investments in China and India are far more important for these two Asian countries than they are for the U.S. These investments loom larger in the Chinese and Indian innovation systems than they do in their American counterpart, and it is difficult to imagine any country substituting for the U.S. in this regard. In contrast, the U.S. cannot derive a great deal of leverage as a platform for R&D. Both China and India are considerably less dependent on the U.S. in this respect.

Introduction

Few topics in international relations today are more important, more fascinating, and more contentious than the rise of China and India. Focusing on China's rapid economic growth, Arvind Subramanian writes that China's "eclipse" of the U.S. in coming decades is virtually certain (Subramanian 2011). Iain Johnston and Sheena Chestnut offer a more cautious view, noting that China failed to close the gap vis-à-vis the U.S. in many important respects between the early 1990s and the mid-2000s (Chestnut and Johnston 2009). Michael Beckley is even more skeptical, arguing that the U.S. lead in key indicators continues to grow and that there are good reasons to believe that unipolarity will endure (Beckley 2012). While scholars have devoted less attention to India's rise, the South Asian giant should not be overlooked. Between now and 2030, the U.S. National Intelligence Council suggests, India's growth rate is likely to accelerate while China's growth moderates, and India could become "the rising economic powerhouse that China is seen to be today" (U.S. National Intelligence Council 2012, 15). Yet India's ascent is hardly assured. Seasoned observers emphasize that India's economic growth depends heavily on the country's politics, which offers both reasons for hope and for despondency (Mehta 2012).

Clearly, there is no consensus regarding how fast China and India are rising. In fact, there is no consensus over which indicators are most important. International relations scholars, as well as more popular pundits, have often focused on gross domestic product (GDP) as a means of gauging the progress of power transitions. This variable may be readily quantified, which helps to explain its appeal, but possessing the world's largest economy hardly guarantees global primacy. As other scholars have noted, the U.K.'s economy was smaller than that of India and China for all of the eighteenth century and most of the nineteenth century (Beckley 2012, 58). The U.K. did possess the world's most advanced economy, however, and this advantage helped it to dominate both of these much larger countries. It is not simply shifting economic weight that should concern us, therefore, but technological sophistication and capacity for innovation as well.

Robert Gilpin was among the first international relations scholars to emphasize how important technological innovation is to the balance of power (Gilpin 1975, 181–182). Since then, "long cycle" theorists have probed the relationship between innovation, economic dynamism, and power transitions with particular interest (Thompson 1990; Modelski and Thompson 1996). Drawing on Joseph Schumpeter's work, they argue that new countries become dominant because they develop a series of innovations in new commercial and industrial sectors, and these innovations undergird their economic vitality, military power,

and political primacy. In recent years, a new generation of IR scholars has further explored the changing geography of innovation and the implications of such changes for the distribution of power (Drezner 2001; Taylor 2012; Moe 2009).

In this context, it is a welcome development that more and more attention is devoted to the emergence of China and India as "technological powers." Even so, consensus over how rapidly China and India are rising in this regard remains elusive (Kennedy forthcoming). Some scholars maintain that China and India are making rapid progress and cite a range of indicators from R&D spending to patent data to make their case (Dahlman 2007; Preeg 2008; Hu 2011). Others are less impressed, or even dismissive, and critique the institutions and relationships that undergird China and India's national innovation systems (Beckley 2012; Krishnan 2010). Still others take a more equivocal view of China and India's capacity for innovation and remain more or less undecided about their prospects (Segal 2011; Brandt and Thun 2010; Cao, Simon, and Suttmeier 2009). This debate is difficult to adjudicate. Some scholars reach different conclusions mainly because they employ different definitions of "innovation," which are appropriate for different purposes. In addition, investments in new technologies can take a long time to pay off, so it is difficult to reach firm conclusions about countries that are relative newcomers to innovation in the modern era.

If considerable attention has focused on China and India's changing capacities for technological innovation, relatively little scholarship has been devoted to a key facet of this process, one that could be readily assessed today. Most studies focus on the distribution of some resource (or set of resources) that is believed to confer power when it is relatively abundant – such as national R&D spending or the quality of the national innovation system. While comparing national resources remains important, it is insufficient in a world in which innovation processes often transcend national borders. Whereas in the past multinational companies often moved manufacturing overseas but conducted R&D in their home countries, more and more of them are now conducting R&D overseas. In 2010, for example, U.S. companies invested nearly US$40 billion in R&D overseas through their foreign affiliates (U.S. Bureau of Economic Analysis 2013a). Foreign firms, meanwhile, spent more than $42 billion on R&D in the U.S (U.S. Bureau of Economic Analysis 2013b). Nor is it simply a US-centered phenomenon. European firms are doing R&D in Asia, and Asian firms are doing the same in Europe. To a lesser extent, Latin America, Australia, and Africa are involved as well.

What does this new form of interdependence imply for the balance of power between today's dominant state and its would-be rising powers? IR scholars have long recognized that interdependence can be an important source of power, particularly when one side is more reliant on the relationship than the other. It is important to ask, therefore, how the globalization of R&D is changing the nature of interdependence between the U.S. on the one hand and China and India on the other. Are China and India becoming key players in global innovation processes, and perhaps even essential partners that U.S. firms cannot do without? If so, one aspect of U.S. power would seem to be waning. Alternatively, it may be the case that China and India play only marginal roles in global R&D processes, and that U.S. reliance on them is not nearly as great as one might suppose.

This essay explores these questions in a series of steps. First, it briefly reviews the literature on interdependence and power in order to develop an analytical framework that can be applied to these questions. Second, the essay considers R&D investments that U.S. firms are making in China and India and the extent to which these investments are changing the nature of interdependence between the U.S. and these Asian giants. Third, the essay considers R&D investments that Chinese and Indian firms are making in the U.S. and again asks how much these investments are changing the nature of interdependence between these countries. The conclusion sums up the findings, considers their implications, and suggests new directions for future research.

Interdependence and Power

The relationship between interdependence and national power has attracted scholarly interest for centuries (Baldwin 1980, 475–476). In the modern era, Albert Hirschman's *National Power and the Structure of Foreign Trade* is widely regarded as a classic in this regard (Hirschman 1945). Hirschman noted that every country possessed the sovereign power to interrupt its trade with other countries. To the extent that a given country relied on such commercial exchange less than its partners, he argued, that country could derive leverage from threatening to impede such commerce. While Hirschman's focus was trade, his basic logic – that uneven levels of dependence between states could be a source of influence – could be applied to many kinds of exchange between states (Baldwin 1980, 479). Subsequently, Kenneth Waltz, as well as Robert Keohane and Joseph Nye, differentiated between two types of interdependence: sensitivity and vulnerability (Waltz 1970, 210; Keohane and Nye 1977, 11–19). The former refers to the degree to which conditions in two interconnected countries co-vary. The latter refers to the opportunity

costs of breaking a relationship. As Keohane and Nye noted, it is the pattern of vulnerability (rather than sensitivity) that generates power in a given relationship. Two states might be highly sensitive to each other, but if both have ready alternatives to the relationship, then neither one is vulnerable and neither one has power over the other. Subsequent scholarship has reinforced the idea that power arises in interdependent relationships through uneven patterns of vulnerability (Baldwin 1980).

Assessing power in interdependence, then, means assessing the vulnerability of the actors involved. That is, we must ask: what costs would countries A and B incur if their relationship (or some aspect of it) were severed? Answering this particular question entails addressing two more specific questions. First, how interested is each government in continuing the relationship? Scholars frequently attempt to answer this question by focusing on the current status of the economic relationship between the two countries concerned. Scholars concerned with trade, for example, often focus on the current level of trade asymmetry between two states (i.e., comparing how much of each state's total trade consists of trade with the partner in question) (Mansfield and Pollins 2003, 12). The question is not simply how much economic interaction there is, however, but how each of the government involved values that interaction. We can consider levels of economic interaction as a first step toward answering this question, but we must also ask how much each government values these exchanges, since it is the preferences of government decision-makers that are ultimately of interest here (Wagner 1988, 464; Caporaso 1978, 21–22).

The second step to assessing vulnerability is asking whether each country has alternatives to continuing the relationship. If the relationship were severed, how readily and completely could the countries involved compensate for the loss? As noted above, it is entirely possible that states can find ready substitutes for a given economic partner, in which case their vulnerability is quite limited. In other cases, however, replacing a relationship may be impossible. North Korea, to give an extreme example, would have great difficulty replacing China as a trade partner. In 2012, North Korea conducted nearly 70 percent of its trade with China, a relationship that totaled $6 billion and included crucial oil imports for Pyongyang (Yoo 2013). While North Korea might theoretically conduct this trade with other states, existing sanctions and political pressure from the U.S. and other countries would likely make this extremely difficult. Because China is not comparably reliant on North Korea for trade, the economic relationship is clearly a potential source of leverage for Beijing.

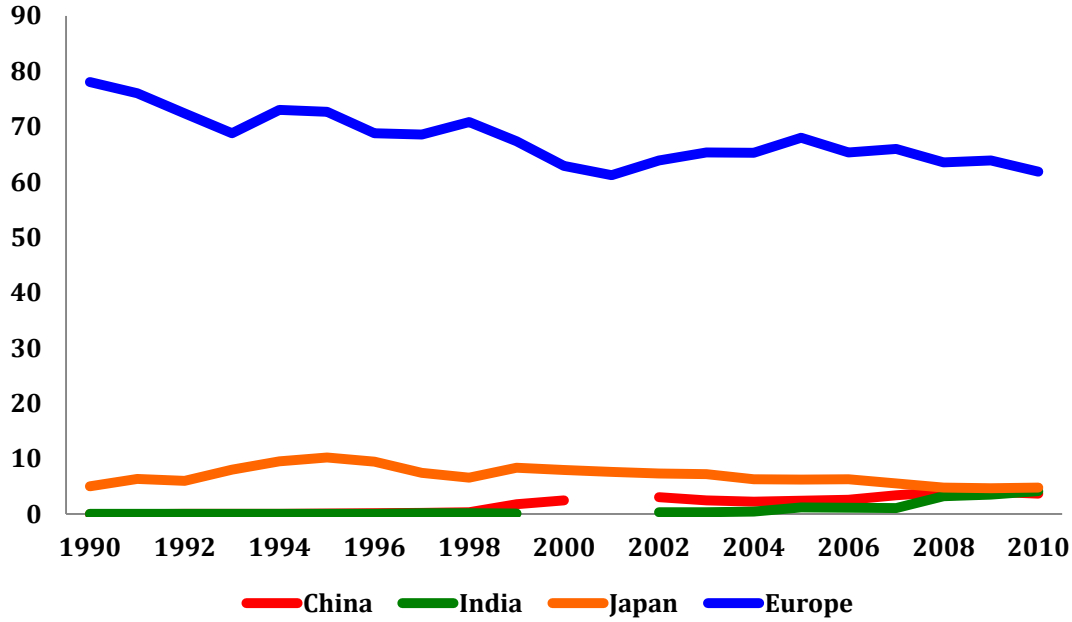
This example leads to a final point. The leverage derived from asymmetric interdependence is not so much a source of power as *potential* power. As Keohane and Nye put it, it is "a first approximation of initial bargaining advantages available to either side" (Keohane and Nye 1977, 19). This is not the same as actual power. The latter also takes into account the intensity of state preferences concerning the issue in dispute, the political cohesiveness of each government, and the distribution of other relevant resources – including interdependence in other areas (Baldwin 1980, 498; Keohane and Nye 1977, 18). To return to the example above, North Korea may depend on China for trade, but China depends on North Korea to maintain stability in northern Korea and to maintain a buffer between China and South Korea. North Korean leaders may also have more intense preferences concerning issues in contention with China – such as the status of North Korea's nuclear program. China's actual power over North Korea is therefore less great than the asymmetry in the trade relationship would suggest.

With this discussion as foreground, the following two sections consider the mutual vulnerability incurred by China and India on the one hand and the U.S. on the other as a result of the globalization of R&D.

U.S. R&D in China and India

Let us begin by considering U.S. R&D investments in China and India. In 2010, foreign affiliates of U.S. companies invested $1.64 billion in R&D India and $1.45 billion in R&D in China. These investments represented just 4.2 percent and 3.7 percent of all U.S. R&D conducted overseas. This was roughly comparable to Japan's share (4.8 percent) but far below the share of European countries (62 percent). As shown in Figure 1 below, China and India's share has been increasing since 1990, while that of European countries has been in decline, but this process has been quite gradual.

Figure 1. Share of U.S. R&D Investment Abroad (Percent)



Source: U.S. Bureau of Economic Analysis, U.S. Direct Investment Abroad, Financial and Operating Data for U.S. Multinational Companies, "Research and Development Performed by Affiliates, Country by Industry," various years, http://www.bea.gov/international/di1usdop.htm, accessed September 27, 2013. Note that the data for 2010 are preliminary.

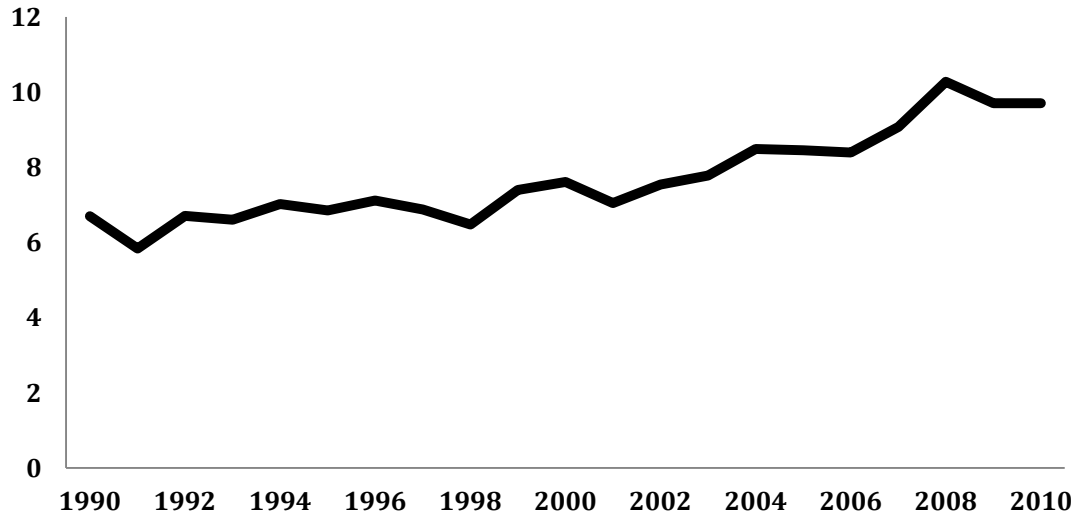
To be sure, one must take price differences into account when comparing R&D investments around the world. Indeed, one reason that foreign companies began to conduct R&D in China and India was to access talented but relative cheap labor. The cost of operating an R&D center in these rapidly developing countries has increased significantly in recent years, however. For China, one recent estimate suggested that junior staff may be 25 to 30 percent cheaper than in the U.S. or Europe, middle managers are equally expensive, and senior managers can cost 20 to 25 percent more, due to short supply and competition to attract the best talent (Waldmeir 2012). In India, recent evidence suggests that R&D centers cost roughly 25 percent less than they do in China (Krishnadas 2011). These figures suggest that the data above slightly understate the actual value of these R&D investments in China and India but do not greatly understate their value, at least in terms of purchasing power.[1]

It is also worth noting that the R&D conducted by U.S. companies overseas remains a small fraction of domestic R&D spending in the U.S. In 1990, R&D by U.S. overseas affiliates was 6.7 percent of domestic R&D spending; in 2010, that figure had risen to 9.7

[1] Note that R&D costs in European countries are not identical to those in the U.S.; some countries are more expensive, and some are less expensive (Dougherty et al. 2007).

percent (see Figure 2 below). We see a similar pattern if we ask what percentage of U.S. business R&D is conducted overseas: the figure was 10.5 percent in 1990 and 14.8 percent in 2010 (OECD 2013).

Figure 2. R&D by U.S. Affiliates Overseas as a Percentage of Domestic U.S. R&D



Sources: U.S. Bureau of Economic Analysis, U.S. Direct Investment Abroad, Financial and Operating Data for U.S. Multinational Companies, "Research and Development Performed by Affiliates, Country by Industry," various years, http://www.bea.gov/international/di1usdop.htm, accessed September 27, 2013; "National Patterns of R&D Resources: 2010–11 Data Update Detailed Statistical Tables," NSF 13-318, April 2013, http://www.nsf.gov/statistics/nsf13318/.

In short, R&D spending by U.S. companies in China and India is a relatively small share of U.S. R&D overseas, which in turn is a small figure when compared to R&D spending within the U.S. This suggests that R&D investments in China and India remain of marginal importance for the U.S. If we consider U.S. R&D in more qualitative terms, this basic picture is reinforced: it is not the case that R&D conducted in China and India is of greater complexity or greater importance than that conducted in other countries. In some cases, to be sure, U.S. companies are conducting high-end research in China and India. For example, Microsoft Research Asia, established in Beijing in 1998, has become the company's second-largest research organization, after its counterpart in the U.S., and is known for cutting-edge research in areas ranging from next-generation multimedia to computer science fundamentals. In India, General Electric's John Welch Technology Centre was founded in 2000 in Bangalore and has become known for cutting edge work as well. In other cases, however, U.S. companies are mainly concerned with exploiting existing technology and adapting products to local markets. This may involve making

products less advanced in order to suit outdated local processes or to compete on price (Steinfeld 2010, 152; Brandt and Thun 2010, 1566–69). In short, while there are certainly examples of U.S. companies conducting ambitious R&D in China and India, such work represents only a portion of the work being done in these countries.

How important is U.S. R&D in China and India for the host countries? In simple quantitative terms, it would seem fairly important for India. As noted above, U.S. firms invested $1.64 billion in R&D activities in India in 2010. This was an all-time high, and a dramatic increase over the figures for 2005 through 2007, which ranged between $300 million and $400 million. It was also a significant fraction of all business R&D in India as of 2009, which was less than US$7.5 billion (Government of India 2013, 5). U.S. R&D investments in China, meanwhile, loom less large in terms of total R&D spending. U.S. firms invested an average of $1.57 billion in China in 2008-2010. China's national R&D spending, however, was already $121 billion in 2008, of which businesses contributed $87 billion. These figures are misleading, however, because the productivity of Chinese R&D spending is well below that in developed countries (Yang and Zhao 2009). Even the Chinese government has criticized the innovative capacity of Chinese firms as "weak" (State Council 2006). For that reason, recent studies have suggested that foreign-owned R&D centers play an important role in China's national innovation efforts, and even that foreign R&D centers "*are* the Chinese innovation system" (Steinfeld 2010, 172). In short, while U.S. firms loom less large in terms of total R&D spending in China than in India, they still play an important role.

Let us turn to the attitude of the Chinese and Indian governments toward foreign R&D investment. While the recent revival of "techno-nationalism" in China has received considerable attention, Beijing remains fundamentally pragmatic when it comes to attracting foreign investment, particularly in high-technology sectors (Kennedy 2013). In fact, the key Chinese documents on technology development from the past decade emphasize that the country must deepen its integration with the outside world in order to advance. In 2006, the National Medium- and Long-Term Program for Science and Technology Development (2006-2020), known as the MLP, argued that China should try to expand its technology collaboration with the rest of the world (State Council 2006). Universities and research institutes were exhorted to set up joint laboratories with foreign ones, and multinational corporations were invited to set up more R&D centers within China. In 2010, the circular announcing the Strategic Emerging Industries (SEI) initiative also stressed the need for continuing international cooperation (State Council 2010). Like

the MLP, it also called for foreign companies to set up R&D centers in China and for more foreign investment in key sectors. To be sure, there was some initial resistance to the establishment of foreign R&D centers in China when this process started in the late 1990s (Breznitz and Murphree 2011, 106). And some relatively left-wing individuals within the government continue to have misgivings about this development (author's interview with Chinese central government official, July 3, 2013). The more prevalent view, however, is that such investments should be welcomed, and this is clearly expressed in the MLP and SEI circular.

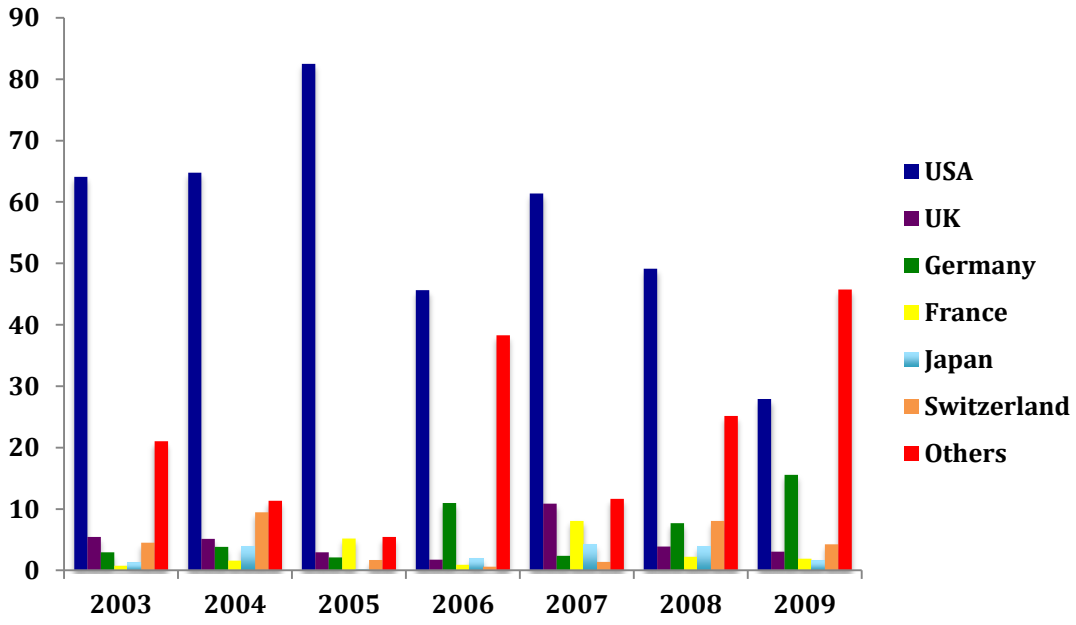
India appears more ambivalent about foreign investment in its economy, including in high-technology sectors. On the one hand, the government is under pressure to attract more FDI in general, which has declined in recent years and put pressure on the rupee. The government is also clearly interested in increasing domestic R&D spending. India's latest Science, Technology, and Innovation (STI) Policy, which was released in early 2013, called for doubling the country's research and development (R&D) spending to 2 percent of GDP over five years, through a mix of public-private partnerships and greater private investment (Government of India 2013). This goal had been previously articulated on a number of occasions, and it is hard to imagine India achieving it without foreign investment playing a role in the process. On the other hand, India's STI policy makes no mention of profiting from foreign investment. This is presumably due to the fact that FDI is a contentious issue within the coalition of left-leaning parties that make up the current United Progressive Alliance (UPA) government. In fact, one coalition member withdrew its support for the government in 2012 partly because of its efforts to liberalize FDI (Dhar 2012). The upshot is that the Indian government alternates between wooing foreign investment and restricting it. In July 2013, for example, Finance Minister P. Chidambaram flew to the U.S. to stimulate interest in investing in India (Kumar and Daniel 2013). Around the same time, however, the government suggested deal-killing preconditions in negotiations with the U.S. over a bilateral investment treaty (Goel and Goel 2013). India has also moved to create new restrictions on foreign acquisitions of domestic firms in the pharmaceutical sector ("House Panel for Complete Ban on Takeovers of Large Domestic Drugmakers by MNCs" 2013). Indeed, India seems considerably more enthusiastic about "greenfield" FDI in R&D – investments that create new centers and facilities – than about foreign acquisitions of domestic firms.

Taking all this into account, both the Chinese and Indian governments seem interested in luring more R&D FDI, albeit to differing degrees and with some important

caveats in the Indian case. The question remains, however, to what degree China and India have alternatives to the U.S. in this regard. How readily could the firms of other countries substitute for U.S. companies?

Let us first look at India. The most recent evidence indicates that the U.S. is not only the largest FDI investor in India but also the largest investor by far in R&D activities. Between 2003 and 2009, U.S. firms accounted for 591 of 897 R&D investments in India (or 66 percent) in which the nationality of the firm was stated (Mrinalini, Nath, and Sandhya 2013, 771).[2] This was well ahead of the second-most prominent investor, the U.K., which made 51 of 897 investments (5.7 percent). U.S. prominence was also apparent in the amount of money invested. Between 2003 and 2009, U.S. firms accounted for 52.8 percent of FDI spending on R&D in India, and its lead was apparent on an annual basis (see Figure 3 below). Germany was a distant second at 7.9 percent. In fact, the most serious rival to U.S. prominence was the category "other countries," which was generally the second-largest source of funds and which actually surpassed the U.S. in this regard in 2009. It remains unclear to what extent this latter outcome reflected the economic downturn in the U.S. at that time, as opposed to other factors.

Figure 3. Share of FDI in R&D in India, by Country and Year



Source: Mrinalini, Nath, and Sandhya 2013, 771.

[2] There were 67 investments in which the nationality of the firm was not available.

If we turn to China, the picture appears to be similar. China does not make available comprehensive data regarding the number of R&D centers established by different foreign countries in China or the amounts invested in these centers. The studies that have been done, however, suggest that U.S. firms are not only the largest investors in such centers but also that the U.S. lead in this regard is quite substantial. A 2007 study based on media reports, for example, identified 168 distinct multinational R&D centers in Beijing, Shanghai, and Guangzhou (Liu and Liu 2007, 232). The U.S. accounted for 114 of these, while Japan, France, and Germany accounted for 24, 11, and 9, respectively. Subsequently, a 2010 survey of 385 foreign R&D centers found that U.S. companies accounted for 149 (39 percent) while Japanese companies accounted for 79 (21 percent) (Cui and Gao 2010, 226). No other country accounted for more than 10 percent. To be sure, not all R&D centers in China are equally substantial or innovative, but it does not appear that the centers established by U.S. firms are less ambitious than those of other countries. In fact, in a 2008 study that identified 51 multinational firms carrying out "innovative" R&D (i.e., R&D that was relevant to the firm's global R&D operations), 22.5 firms were American, 9.5 were Japanese, and four were German (Schwaag-Serger 2009). In short, the evidence available strongly suggests that the U.S. accounts for a sizable share of foreign R&D investment in China. It is hard to imagine any other economy – or even Europe as a whole – substituting for this U.S. in this regard.

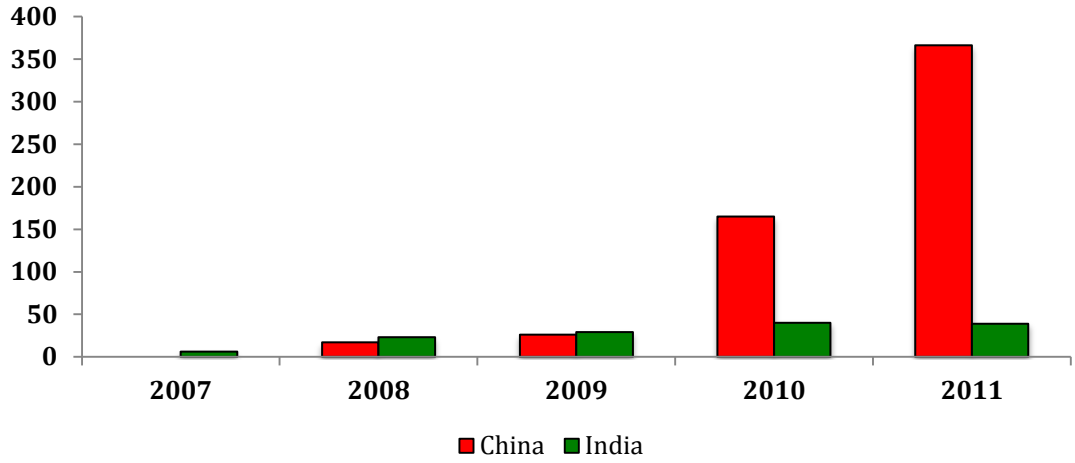
To sum up, R&D by U.S. firms in China and India does not play a large role in the innovation efforts of U.S. firms worldwide. It does play a substantial role in the Chinese and Indian innovation systems, however, and the Chinese and Indian governments are (to differing degrees) interested in continuing such investments. China is particularly eager to woo more R&D investment from the U.S. and other countries. While India is more ambivalent, R&D spending by U.S. companies in India is a significant fraction of all private R&D in India – and the government clearly wishes to increase the latter figure. Nor do China and India appear to have alternatives to relying on the U.S. for R&D investments. The U.S. is easily the leading foreign investor in R&D in both China and India, and it is hard to imagine that other countries could substitute for it in this regard.

Chinese and Indian R&D in the U.S.

Let us turn to Chinese and Indian R&D investment in the U.S. Such investments have become considerably more common in recent years. Figure 4 shows how Chinese

investments in R&D in the U.S. have increased rapidly to $366 million in 2011, while Indian investments have risen more moderately to $39 million in that year.

Figure 4. Chinese and Indian R&D Investments in the U.S. (US$ million)



Source: U.S. Bureau of Economic Analysis, Foreign Direct Investment in the United States, Financial and Operating Data for U.S. Affiliates of Foreign Multinational Companies, "Selected Financial and Operating Data of All Bank and Nonbank U.S. Affiliates by Country of UBO," various years, http://www.bea.gov/international/di1fdiop.htm, accessed September 30, 2013.

From the U.S. perspective, these investments do not loom terribly large, at least in economic terms. China's $366 million investment in R&D in the U.S. in 2011 was less than 1 percent of the $45 billion that majority-owned foreign affiliates spent on R&D in the U.S. for that year. India's $39 million investment was less than 0.1 percent. And whereas U.S. companies in China and India are (in some cases) raising the level of sophistication in these economies, Chinese and Indian companies are not playing the same role in the U.S.

These investments are significant for China and India, however. While the total amounts remain modest, particularly for India, they are being made by some of China and India's top technology companies. Chinese companies that have R&D centers in the U.S. include Lenovo, Huawei, ZTE, Alibaba, TCL, and Haier. Indian companies that have established such centers include Infosys, Dr. Reddy's Laboratories, and Lupin. These are often important investments for these companies as they seek to become more innovative and to compete with companies from more advanced countries. Dr. Reddy's Laboratories, for example, seeks to move beyond generic drugs and into higher value-added segments of the pharmaceutical industry. In 2013, the company relocated their North American headquarters and set up an R&D facility in Princeton, New Jersey "to tap into local talent" and establish a presence in a leading center of innovation in the industry, according to the

CEO (Dr. Reddy's Laboratories 2013). California, meanwhile, is a magnet for Chinese IT companies, and both Huawei and ZTE have opened R&D centers in the state in recent years (Rosen and Hanemann 2012, 35 and 50).

China and India's emerging R&D activities in the U.S. are thus of some significance for some of the most prominent firms in these countries. For this reason, the Chinese and Indian governments are generally supportive of such investments. The Chinese government began calling for domestic firms to "go out" and invest overseas in the late 1990s. The MLP, in turn, pledged to "support our country's enterprises in their 'going out' efforts" in order to promote access the foreign skills and expertise. In particular, it called for "encouraging and helping [Chinese firms] to establish R&D centers or industrialization bases overseas" (State Council 2006). The SEI initiative also encouraged domestic enterprises to set up R&D centers in foreign countries. While India is not as preoccupied as China with setting up foreign R&D centers, the government has become much more supportive of outward FDI over the past decade. As a result, India's outward FDI rose from $1.0 billion in 2000-2001 to $16.8 billion in 2010-2011 (Khan 2012). Allowing Indian firms better access to foreign technology and know-how has been one of the goals of this more liberal policy. As Harun Khan, Deputy Governor of the Reserve Bank of India, has put it, "the overseas investment of the domestic corporate sector through FDI has provided them better access to global networks and markets, transfer of technology and skills and also enables them to share research and development efforts" (Khan 2012). Although the government has recently taken steps to rein in outward investments in order to arrest the rupee's recent downward slide, it has also stressed that these are temporary measures.

The U.S. is thus of some value as an R&D platform for both China and India, and the Chinese and Indian governments both appear to value the opportunity for their firms to make such investments overseas. To what degree do China and India have alternatives to the U.S. in this regard?

In general, it would be much less difficult for China and India to replace the U.S. as an R&D platform than as a source of investment in their own economies. There are more alternatives to the U.S. as an FDI destination, and they are clearly being exploited for R&D as well as other purposes. China's FDI in the EU, for example, has outpaced that in the U.S. in recent years by a considerable margin. In 2011 and 2012, China's FDI in the U.S. totaled $11.2 billion, but was more than $20 billion in the EU (Hanemann 2013). India, meanwhile, invested more in Singapore ($14.11 billion) and the Netherlands ($6.54) than it did in the U.S. ($3.97 billion) between 2008 and 2012 (Khan 2012). Data for R&D FDI in

particular are harder to acquire, but the figures that are available are suggestive. A recent European Commission study noted that in 2007 (the latest year for which data were available), Indian companies spent €77 million (US$148.1 million) on R&D in the United Kingdom, €21 million (US$27.6 million) in Germany, and €14 million (US$18.4 million) in Belgium (Dachs et al. 2012, 40).[3] India's R&D investment in Europe in 2007 was thus significantly greater than its investment in the U.S. in 2010 ($36 million). The same study reported that China invested €8.7 million (US$11.4 million) in Germany, the only country for which there was data on Chinese R&D investments. Once again, the corresponding figure for the U.S. was lower: 0. A 2010 study comparing Chinese R&D in Europe and the U.S. also offers some illuminating results (Zhang 2010, 27). The study identified 31 Chinese R&D centers in the U.S. and 32 in Europe. It also identified 25 such centers in other parts of the world, including 12 in Japan. In short, the data available suggest that both China and India rely quite a bit on countries besides the U.S. to conduct R&D overseas.

In fact, Chinese and Indian companies that conduct R&D abroad often rely on locations spread across multiple countries. The Chinese firm Huawei is a striking example: as of 2013, the company had 16 R&D centers overseas spread across Germany, Sweden, France, Italy, Russia, India, as well as the U.S. (Huawei 2013). The Indian firm Dr. Reddy's Laboratories has R&D centers in the UK and the Netherlands in addition to its new facility in the U.S. (Dr. Reddy's Laboratories 2013). The Chinese firm Lenovo acquired an R&D center in North Carolina after taking over IBM's personal computer business, but it also does R&D in Japan as well as China (Lenovo 2013). To be sure, the lure of Silicon Valley may be difficult to resist for information technology companies, and this is obviously a key investment destination for ambitious firms in this industry. Yet there are also cases in which Chinese and Indian firms do conduct R&D abroad, but none in the US. The Indian pharmaceutical firm Glenmark has three R&D centers spread across India, Switzerland, and the UK, while wind energy firm Suzlon does R&D in Germany, the Netherlands, and Denmark (Suzlon 2013; Glenmark 2013). In short, internationally-oriented Chinese and Indian firms often treat the U.S. as one of several R&D platforms and sometimes do not rely on it at all.

To sum up, R&D investments by Chinese and Indian firms in the U.S. are not of great importance for the U.S. They are more significant for China and India, since they represent opportunities for top Chinese and Indian firms to become more innovative and to

[3] The data for a number of countries, including France, Switzerland, Austria, Netherlands, Poland, Ireland, Hungary, Malta, Portugal, Finland and Sweden, are not available.

compete with companies from developed countries. The Chinese and Indian governments support these investments for that reason. The amount of money invested (particularly for India) remains relatively modest, however. In addition, China and India clearly have alternatives to the U.S. in this regard, and they have made ample use of them. The U.S. can thus derive only a limited degree of leverage from the asymmetry in this aspect of its interdependence with China and India.

Conclusion

The globalization of R&D is not rapidly changing the nature of economic interdependence between China and India on the one hand and the U.S. on the other. China and India remain considerably more vulnerable to a disruption of their relationships with the U.S. than the U.S. does, and this remains a potential source of leverage for Washington. This vulnerability mainly reflects the fact that U.S. R&D investments in China and India are more important for these two Asian countries than they are for the U.S. These investments loom larger in the Chinese and Indian innovation systems than they do in their American counterpart, and it is difficult to imagine any country (or even the EU) substituting for the U.S. in this regard. In contrast, the U.S. would not seem able to derive as much leverage from Chinese and Indian R&D investments in the U.S. While these investments are growing, and while they are supported by the Chinese and Indian governments, they remain relatively modest. In addition, both China and India have alternatives to the U.S. as an R&D platform.

To be sure, the globalization of R&D could be augmenting Chinese and Indian power more substantially in other ways. In addition to spurring economic growth, these investments may be fostering the development of innovative capabilities in domestic firms in these countries. Indeed, that is the hope of the Chinese and Indian governments. Recent studies have cast some doubt on this possibility, however, or at least suggest that positive spillovers from foreign R&D are contingent on other factors. In the Chinese case, Xiaolan Fu and Yundan Gong argue that foreign R&D actually has a negative effect on technical change in domestic firms (Fu and Gong 2011). They suggest that this could be the result of several factors: the inappropriateness of foreign R&D for local firms, increased competition for local talent, zealous MNC efforts to protect intellectual property, and the tendency of MNCs to do core R&D in their home countries. In the Indian case, Anabel Marin and Subash Sasidharan maintain that only foreign R&D that seeks to create new technology has a positive effect on domestic firms (Marin and Sasidharan 2010). Foreign R&D that

exploits existing technology for the local market, in contrast, has a negative effect. The point here is not that China and India would be better off without these investments, and that their governments would be wise to shun them. This body of research will presumably evolve in years to come, as both China and India develop and as more data becomes available. It is already clear, however, that the globalization of R&D should not be seen as conveyor belt rapidly transferring innovative capacity from foreign companies to Chinese and Indian firms. It is instead a complicated process that may generate both positive and negative effects for Chinese and Indian companies.

Lastly, we should not equate the globalization of R&D with the globalization of innovation. While corporate R&D is obviously a key ingredient in innovation, the creation of new products also reflects a range of other processes and variables. Academic research often plays a crucial role in generating new knowledge that businesses can exploit, although this is more true in some industries (biotechnology, for example) than in others. Scholars have also begun to focus on the importance of "innovative manufacturing" in innovation, noting that knowledge can flow back and forth between designers and manufacturers in the creation of new products (Nahm and Steinfeld 2012). Lastly, and most obviously, demand for new products should not be taken for granted, and close interaction with consumers is a key ingredient in inspiring specific types of innovation in the first place. It is thus worth asking what kind of roles China and India are playing in each of these regards, to gain a broader sense of their roles in global innovation.

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