

Foreign Manufacturing Multinationals and the Transformation of the Chinese Economy: New Measurements, New Perspectives

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Abstract

What is the relationship between foreign manufacturing multinational corporations (MNCs) and the expansion of indigenous technological and managerial technological capabilities among Chinese firms? China has been remarkably successful in designing industrial policies, joint venture requirements, and technology transfer pressures to use FDI to create indigenous national champions in a handful of prominent sectors: **high speed rail transport, information technology, auto assembly, and an emerging civil aviation sector**. But what is striking in the aggregate data is *how relatively thin* the layer of horizontal and vertical spillovers from foreign manufacturing multinationals to indigenous Chinese firms has proven to be. Despite the large size of manufacturing FDI inflows, the impact of multinational corporate investment in China has been largely confined to building plants that incorporate capital, technology, and managerial expertise controlled by the foreigner. As the skill-intensity of exports increases, the percentage of the value of the final product that derives from imported components rises sharply. China has remained a low value-added assembler of more sophisticated inputs imported from abroad—a “workbench” economy. Where do the gains from FDI in China end up? While manufacturing MNCs may build plants in China, the largest impact from deployment of worldwide earnings is to bolster production, employment, R&D, and local purchases in their home markets. For the United States the most recent data show that US-headquartered MNCs have 70 percent of their operations, make 89 percent of their purchases, spend 87 percent of their R&D dollars, and locate more than half of their workforce within the US economy—this is where most of the earnings from FDI in China are delivered.

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I. OVERVIEW: THE ARGUMENT IN BRIEF

China became the world's largest destination for foreign direct investment (FDI)—almost all of which is FDI in manufacturing and assembly—in 2003, before falling back into a solid second place. These FDI flows have revolutionized China's industrial base and shifted the composition of Chinese exports from low-skill intensive to high-skill intensive goods and services.

This paper summarizes contemporary research on how manufacturing FDI is “transforming” the Chinese economy, and compares this impact with how FDI inflows affect other developing countries.

What is the relationship between foreign manufacturing multinational corporations (MNCs) and the expansion of indigenous technological and managerial technological capabilities among Chinese firms? How are foreign manufacturing MNCs changing the skill-intensity of activities and the extent of value-added of operations within the domestic Chinese economy? To what extent, might foreign direct investment be helping propel China to become an export superpower, “displacing Japan as the predominant economic power in East Asia”, as Ernest Preeg declares, making the country the “economic hegemon” in the region?¹ Are multinationals “trading technology for sales in China”?²

Multinational corporate investment in manufacturing and assembly can help “transform” developing host economies through four channels:³ 1) Foreign manufacturing investment can introduce new cutting-edge technologies, production processes, and management practices that are learned by local partners and imitated by domestic rivals who then set off on their own (*horizontal spillovers and externalities from foreign investors to indigenous firms*). 2) Foreign manufacturing investment can seek out and nurture supplier networks in a vertical direction that maintain world-class standards in cost and quality control, and upgrade their operations on a real-time basis (*vertical spillovers and externalities from foreign investors to indigenous firms*). 3) Foreign manufacturing investment can provide *export externalities*, introducing indigenous firms to international buyers and outlets. 4) Foreign manufacturing investment can build plants that incorporate capital, technology, and managerial expertise controlled by the foreigner, raising the productivity of a given set of activities in the host economy and providing

1. Ernest H. Preeg. 2008. *India and China: An Advanced Technology Race and How the United States Should Respond*. Washington, DC: Manufacturers Alliance/MAPI. p. 141–143, 69–71.

2. David Barboza, Christopher Drew, and Steve Lohr. 2011. “Trading Technology for Sales in China”. *The New York Times*. January 18, p. B-1.

3. This paper draws on my *Foreign Direct Investment and Development, Launching a Second Generation of Policy Research: Avoiding the Mistakes of the First, Re-Evaluating Policies for Developed and Developing Countries*. This PIIE volume offers an in-depth examination of each of these channels through which manufacturing FDI impacts the host economy — and investigates the obstacles and market failures that block each channel. FDI in extractive industries, and FDI in infrastructure, offer separate distinctive opportunities and challenges.

payments for materials and labor used in the operations of the foreign plants (*domestic value-added in foreign-owned plants*).⁴

China has been remarkably successful in designing industrial policies, joint venture requirements, and technology transfer pressures to use FDI via channels 1, 2, and 3 to create indigenous national champions in a handful of prominent sectors: **high speed rail transport, information technology, auto assembly, and an emerging civil aviation sector**. Prominent North American, European, Japanese, and Korean manufacturing multinationals rightly fear that they may find themselves launching rivals to their own market position when they weigh access to the vast Chinese market against technology acquisition and management imitation on the part of Chinese partners and other indigenous competitors. Bringing in new technology to gain access to the Chinese market—whether for domestic market penetration or as a base for exports—may therefore often appear to individual foreign multinationals as making a Faustian bargain with the devil. “China can strike deals,” asserts Steven Pearlstein, “that may provide short-term profits to one company and its shareholders but in the long run undermine the competitiveness of the other country’s economy.”⁵

But what is striking in the aggregate data is *how relatively thin* the layer of horizontal and vertical spillovers from foreign manufacturing multinationals to indigenous Chinese firms—and consequent export externalities—has proven to be.

Despite the large size of manufacturing FDI inflows, the impact of multinational corporate investment in China has been largely confined to the fourth dimension, building plants that incorporate capital, technology, and managerial expertise controlled by the foreigner. Within this foreign firm-dominated production array, FDI payments for Chinese materials and labor used in the operations of the foreign plants have increased as domestic value-added has increased, but such increase in domestic value-added has been concentrated at the lesser-skilled end of the export frontier. From a comparative perspective, the share of domestic value-added in FDI operations in China in high skill-intensive sectors such as computers and telecommunications ranges from *less than one-half to slightly more than one-half* of what is found in other developing countries where comparable measurements can be made, such as Mexico.

Across the expanse of the Chinese domestic economy, the accumulated evidence simply does not show FDI to be a powerful source for indigenous-controlled industrial transformation. In the case of exports, the production of increasingly sophisticated goods destined for international markets from China

4. There is a fifth channel for potential benefits from manufacturing FDI: foreign investors may offer compensation premia and training premia in their own plants; they may or may not also generate labor market externalities and labor *institution* externalities that affect other firms as well. While the evidence shows that MNCs pay workers a wage-premium in China, as elsewhere, FDI and labor market impacts in the Chinese economy are not thoroughly explored in this paper.

5. Steven Pearlstein. 2011. “China is following the same old script—the one that gives it all the best lines.” *The Washington Post*, p. A-11. January 19, 2011.

has been remarkably well constrained to and contained within the plants owned and controlled by foreign multinationals and their international suppliers. China has remained a low value-added assembler of more sophisticated inputs imported from abroad—a “workbench” economy largely bereft of the magnified benefits and externalities from FDI enjoyed by other developing countries. What appear to be the explanations and reasons for this relatively tepid infusion of technology and management into Chinese firms in a horizontal or vertical direction are explored below.

II. MANUFACTURING MULTINATIONALS AND HORIZONTAL/VERTICAL SPILLOVERS TO CHINESE FIRMS, WITH EXPORT EXTERNALITIES, IN HEADLINE INDUSTRIES

Recent controversy about “indigenous innovation” policies is only the most recent manifestation of Beijing’s determination to use the lure of participation in the rapidly growing Chinese market—whether as a base for domestic sales or as a site for exports—to pressure foreign manufacturing multinationals to transfer industry best practices to Chinese partners and other Chinese firms in certain target industries.

High Speed Railroad Transport

In high speed railroad transport, the State Council, Ministry of Railroads, and state-owned train builders (China North Car (CNR) and China South Car (CSR), have been particularly successful in combining access to the Chinese domestic market, favorable financing, and competition among foreign investors to induce transfer of technology and production processes to Chinese national champions. In 2004, the Chinese Ministry of Railroads solicited bids to produce train sets that could reach 200 km/h. Alstom of France, Bombardier Transportation’s German subsidiary, Siemens of Germany, and a Japanese consortium led by Kawasaki submitted bids, with all except Siemens winning part of the contract. Alstom teamed up with CNR’s Changchun Railways Vehicles, while the Kawasaki-led consortium joined with CSR’s Sifang Locomotive & Rolling Stock. The following year, Siemens won a contract to supply technology and build trains with CNR’s Tangshan Railway Vehicle Company. The same strategy was success in transferring technology and production experience for key components. CSR Zhuzhou Electric obtained traction motor know-how from Mitsubishi Electronic. Yongji Electric obtained traction motor know-how from Alstom and Siemens.

In less than four years of “digestion”, CSR mastered and improved what it received from Kawasaki, finally cancelling its cooperation agreement. According to Zhang Chenghong, the president of CSR, CSR “made the bold move of forming a systemic development platform for high-speed locomotives and further upgrading its design and manufacturing technology. Later, we began to independently develop

high-speed CRH trains with a maximum velocity of 300–350 kilometers per hour, which eventually rolled off the production line in December 2007.”⁶

Siemens and Bombardier remained active in China by signing a “cooperation agreement on joint action plan for the independent innovation of high-speed trains in China” with the Chinese Ministry of Science and Chinese Ministry of Railway to develop and build a new generation of trains with a top operations speed approaching 400 km/h, which came into service in late 2010.

On the basis of expertise acquired from joint ventures with MNCs in the Chinese market, Chinese firms have gone multinational themselves, either alone or alongside their international partners. Acting on their own, Chinese train-makers and railroad construction companies have signed agreements to build high speed railroad systems in Turkey, Venezuela, and Argentina, while bidding on high speed rail projects in Russia, Brazil (Sao Paulo to Rio de Janeiro), and the United States (Los Angeles to San Francisco). Teaming up with multinational allies first met in the home market, China Railway Construction Corporation joined with Alstom of France to win Phase I of the Mecca to Medina high speed rail line, while CSR has partnered with Siemens to bid on Phase II.

Aerospace

In aerospace, China similarly uses access to the Chinese market plus an informal “offset” policy to gain access to aviation technology and production expertise. Early in 2005, for example, China approached Airbus seeking an Airbus final assembly line to be built in China, and later in the same year signed a purchase order to import 150 Airbus A320s, worth approximately \$10 billion.⁷ Eighteen months later Airbus set up a joint venture company to assemble the A320 in Tianjin, and an Airbus spokesman acknowledged a quid pro quo.⁸ In 2009, the Airbus affiliate delivered the first mid-sized commercial airliner fully made in China.

For Boeing—as for Airbus—China’s offset negotiations appear to have pushed the output from made-in-China requirements into international markets. While it is difficult to verify exactly what is involved in offset agreements because they are private agreements between purchaser and supplier, Boeing’s website affirms that “Boeing is pleased to have been invited to help Chinese companies develop skills, achieve certification, and join world aviation and supplier networks.... China builds horizontal stabilizers, vertical fins, the aft tail section, doors, wing panels and other parts on the 737; 747 trailing

6. Chen Biao and Zhu Huijue. “Era of ‘Created in China’—an interview with CSR President Zheng Changhong.” China Pictorial online. May 10, 2010.

7. *Report to Congress of the US-China Economic and Security Review Commission* 2010. Washington DC: US Government Printing Office, p. 99.

8. *Ibid.*, p. 100.

edge wing ribs; and 747-8 ailerons, spoilers and inboard flaps. China also has an important role on the new 787 Dreamliner airplane, building the rudder, wing-to-body fairing panels, leading edge and panels for the vertical fin, and other composite parts.” On its website, Airbus reports that over half of its fleet worldwide contains components produced by Chinese companies.

As in high speed rail transport, international component companies have competed fiercely to supply inputs to Commercial Aircraft Corporation of China’s C919 project which is designed to carry up to 200 passengers and compete directly with Boeing 737s and Airbus 320s.⁹ The roster of US suppliers to the C919 includes Rockwell Collins, Honeywell, Hamilton Sundstrand, Parker Aerospace, Eaton Corporation, Kidde Aerospace, and General Electric. GE’s joint venture with Aviation Industry Corporation of China (AVIC) in Shanghai will focus on domestic production of the electronics for communication, navigation, cockpit displays, and controls that constitute the avionics “brain” for the new 787 Dreamliner of Boeing. “Doing business in China,” opine David Barboza, Christopher Drew and Steve Lohr, “often requires Western multinationals like GE to share technology and trade secrets that might eventually enable Chinese companies to beat them at their own game—by making the same products cheaper, if not better.”¹⁰

“What’s good for GE or Honeywell or Rockwell is,” claims Steven Pearlstein, “in this case, almost certainly not good for America and American workers.”¹¹

Information Technology

In information technology, Lenovo has its origins in the Chinese Academy of Sciences’ Institute of Computing Technology in 1984 as a distributor of foreign computers under the company name Legend. Legend/Lenovo moved from reseller into service, repair, and replacement parts, hence into assembly in 1990. By 1997 Legend/Lenovo was the leading retailer in China, ahead of IBM, with a market share of 40 percent, gradually pushing its way into the Asia-Pacific market. The boost to Lenovo’s global presence came from acquisition of IBM’s personal computer and laptop division in 2005, and by 2009 the company had established itself as the fourth largest vendor of personal computers in the world. Lenovo is slightly more than 50 percent owned by public shareholders, while 42 percent of the shares are held by Legend Holdings Limited. Because the Chinese Academy of Sciences owns 65 percent of Legend

9. David Barboza, Christopher Drew and Steve Lohr. 2011. “GE to Share Jet Technology With China in New Joint Venture”. *The New York Times*. January 17.

10. *Ibid.*

11. Steven Pearlstein. 2011. “China is following the same old script—the one that gives it all the best lines.” *The Washington Post*, p. A-11. January 19, 2011.

Holdings, the Chinese government is effectively Lenovo's largest shareholder with about 27 percent of the stock.

If Chinese government support has helped Lenovo along the path of foreign technology imitation and acquisition, the reverse has been the course for Huawei's climb to international prominence in IT hardware and software. Huawei was founded in 1988 by Ren Zhengfei, a former military technologist at the People's Liberation Army research institute. Foreign IT firms, along with two Chinese state-owned IT companies, were allowed to dominate urban markets in from the 1980s into the 1990s, so Huawei got its start as distributor of imported PBX systems in small towns and rural areas (the original PBXs made connections among the internal telephone lines, fax machines, and modems of a user and connects them to a public switched telephone network). After accumulating experience in servicing PBX systems, and accumulating revenues from the high margins in remote areas, Huawei launched its own digital switch system in 1993 and began to penetrate China's urban areas in the second half of the 1990s. Huawei's overseas presence followed somewhat the same path, with sales and service in more remote markets in Asia, Africa, and the Middle East. By 2004 the company's overseas sales exceeded sales within the Chinese domestic market even though Huawei did not secure its first significant contract in Europe until 2005.

Beginning in 1998, Huawei contracted with IBM for management consulting to transform its management and product development structure, a relationship that continues today. Ventures in technology acquisition included a joint venture with Siemens to develop TD-SCDMA¹² products, and with 3Com for Internet Protocol-based routers and switches. Huawei's R&D expenditures increased more than 27 percent year-over-year 2006–09, and in 2008 ranked as the world's largest patent applicant by the World Intellectual Property Organization (WIPO). In 2009, Huawei surpassed Nokia Siemens to become the second largest supplier of global mobile network gear behind Ericsson. In 2010 Huawei joined the roster of the Fortune Global 500. Huawei characterizes itself as a private company, owned by employee shareholders, and does not acknowledge any legacy of official Chinese government support in its rise to global prominence.

Automotive Sector

If the use of industrial policy to force technology transfer from foreign firms to indigenous companies is rather nuanced in China's IT sector, the results were initially quite counterproductive in the automotive sector.¹³ Under the label of market-for-technology, Chinese policies from the 1980s into the 1990s offered

12. TD-SDMA is a mobile telecommunication standard.

13. Guoqiang Long. 2005. "China's Policies on FDI: Review and Evaluation". In Theodore H. Moran, Edward M. Graham, and Magnus Blomstrom, eds. *Does Foreign Direct Investment Promote Development*. Washington, DC: Peterson Institute for International Economics, 2005).

foreign investors access to a high protected Chinese market in return for partnering with indigenous firms and promising to meet high domestic content requirements. Fearful of losing control over their intellectual property—as when the Chinese partner in the Audi-First Automobile Works “expropriated” the production technology after Audi’s license expired in 1997—international companies hesitated to introduce their most advanced technology into Chinese JV plants, and employed assembly processes that lagged world standards by almost ten years. After accession to the WTO, steady (albeit sometimes grudging) liberalization of the domestic market and rapid growth in internal demand allowed the major international auto companies to achieve economies of scale, rationalize production, and reach out to indigenous suppliers who themselves are able to enjoy full economies of scale. Help from foreign automotive investors in meeting the more stringent quality, safety, and anti-pollution standards may allow for expanding export opportunities to Europe and North America.

In diverse sectors ranging from high performance batteries, to electric engines, to wind power and other green industries, Chinese authorities have shown interest in enticing foreign investors to set up operations and share technology and management techniques with indigenous Chinese companies.

Beyond these headline industries what has been the outcome more broadly from China’s desire to use foreign manufacturing multinationals for indigenous industrial growth and penetration of high tech international markets?

III. MANUFACTURING FDI IN CHINA AND THE INCREASING SOPHISTICATION OF CHINESE EXPORTS: BEHIND THE HEADLINES

Turning from sectoral case studies to aggregate data, there is no other way to describe the impact of foreign manufacturing investment in China except as massive. In 2003 China overtook the United States as the largest destination for foreign investment in the world, and then settled into second place. FDI inflows reached \$168 billion in 2008, declining slightly to \$143 billion in 2009.¹⁴

Multinational corporations in manufacturing have been the force that has propelled China’s exports from low skill-intensive to high skill-intensive products. In 1992, the low skill-intensive sectors in China accounted for 55 percent of China’s exports.¹⁵ By 2005 these same low skill-intensive sectors’ share had fallen to 33 percent. The composition of exports had shifted from a predominance of agriculture, apparel, textiles, footwear, and toys into machinery and transport products. Here the strongest export growth has been machinery, and within this broad classification telecom equipment, electrical machinery, and office

14. UNCTAD. *World Investment Report 2010*. Annex Table 1.

15. Mary Amiti and Caroline Freund. 2010. “What Accounts for the Rising Sophistication of Chinese Exports?” in Robert C. Feenstra and Shang-Jin Wei, eds., *China’s Growing Role in World Trade*. Chicago: University of Chicago Press for the NBER.

machines constitute the largest shares. These more sophisticated sectors are dominated by processing trade, an arrangement in which imports are allowed into the country duty free where they are assembled for export. Processing trade exports of machinery and electrical products grew from \$9 billion in 1992 to \$323 billion in 2006, from 22 percent to 63 percent of all exports. Processing trade, in turn, is dominated by foreign multinationals (called foreign-invested firms or FIES, including both joint venture and wholly-owned affiliates of foreign multinationals), especially for more sophisticated products. The build-up of the foreign presence has been nothing short of remarkable.¹⁶ In 1992, foreign multinationals accounted for 5 percent of exports in ordinary trade and 45 percent of processing exports. By 2006, foreign multinationals account for 28 percent of ordinary exports, but 84 percent of processing exports. So today foreign multinational occupy a predominant place in processing trade, while maintaining a substantial presence in ordinary trade, too.

The share of processing trade—and the foreign firm share of exports—climbs rapidly as the skill-intensity of the products increases.¹⁷ For wearing apparel, processing exports as a share of industry exports in 2002 was 45.1 percent, with foreign firms accounting for 39.2 percent of industry exports. For household electrical appliances, processing exports as a share of industry exports was 79.1 percent, with foreign firms accounting for 56.9 percent of industry exports. For electronic devices, processing exports as a share of industry exports was 89.7 percent, with foreign firms accounting for 87.5 percent of industry exports. For telecommunications equipment, processing exports as a share of industry exports was 91.2 percent, with foreign firms accounting for 88.4 percent of industry exports. For computers, processing exports as a share of industry exports was 99.1 percent, with foreign firms accounting for 99.4 percent of industry exports.

So foreign manufacturing multinationals have been responsible for changing the composition of China's exports, but it is almost exclusively the foreign firms who are producing the more sophisticated exports.

The importance of this observation comes into clearer focus when examining China's growing presence in export of what are classified as "Advanced Technology Products".

The headline industry cases examined in the previous section, combined with China's rapid growth in Advanced Technology Products (ATP) to developed countries—leading, for example, to a

16. Robert C. Feenstra and Shang-Jin Wei. 2010. "Introduction" *Ibid.*

17. Robert Koopman, Zhi Wang, Shang-Jin Wei. 2008. How Much of Chinese Exports is Really Made in China? Assessing Domestic Value-Added when Processing Trade is Pervasive. NBER Working Paper 14109.

Chinese surplus in ATP goods in China-US bilateral trade—leads to speculation that China might be “leapfrogging” ahead technologically.¹⁸

But Who-Is-Us? that have been engaging in Advanced Technology Exports from China? Foreign manufacturing investors have been responsible for more than 92 percent of all Chinese ATP exports since 1996, and 96 percent since 2002. And within this 96 percent foreign investor-dominated channel, there has been a shift to wholly-owned MNC exporters from joint venture companies. State-owned Chinese enterprises have an ATP trade deficit with the US, while private Chinese firms and collective enterprises contribute very little to ATP trade.

And What-Is-Us? when the composition of Chinese Advanced Technology Exports and Imports comes under scrutiny?

The data show that there is a sizable technological gap between Chinese ATP imports and Chinese ATP exports. Chinese ATP imports from the United States consist of large-scale, sophisticated, high-valued equipment and devices, whereas ATP exports to the United States are small-scale products or components in the low-end of the ATP value-added chain.¹⁹ Some 40 percent of the unit value ratios between US-exported ATP products and China-exported ATP products falls between 1 and 10 times greater for the US ATP exports to China, one-third falls between 10 and 100 times greater for the US ATP exports to China, and more than 13 percent are at least 100 times greater for the US ATP exports to China. In some categories, China simultaneously imports and exports the same product—for example, microscopes—but the types imported from the US cost ten to twenty times more than the types exported to the US, suggesting a sizable difference in features and capabilities.

Separate measurements by Lawrence Edwards and Robert Lawrence show similar results: the unit values of US imports of medium- and high-technology goods from China lie between 15 and 30 percent of the same-category products exported by the United States.²⁰ Remarkably, they find that there has been no significant change in these relative unit prices over the entire 16 year period from 1990 to 2006. Edwards and Lawrence conclude that US imports of so-called high technology products from China are not close substitutes for US high technology exports to China.

18. Michael Ferrantino, Robert Koopman, Zhi Wang, Falan Yiung, Ling Chen, Fengjie Que, Haifeng Wang. 2010. “Classification and Statistical Reconciliation of Trade in Advanced Technology Products: The Case of China and the United States” Joint Working Paper on US-China Trade in Advanced Technology Products. US International Trade Commission.

19. *Ibid.*

20. Lawrence Edwards and Robert Z. Lawrence. 2010. *Do Developed and Developing Countries Compete Head to Head in High Tech?* Washington, DC: Peterson Institute for International Economics. Working Paper 10-8. June. Lawrence Edwards and Robert Lawrence, *Rising Tide: Is Growth in Emerging Economies Good for the United States?* Washington, DC: Peterson Institute for International Economics, forthcoming.

IV. DOMESTIC CONTENT AND VALUE-ADDED IN CHINA ON THE PART OF FOREIGN MULTINATIONAL EXPORTERS: A COMPARATIVE PERSPECTIVE

In processing trade where foreign investors are heavily represented, Nicholas Lardy shows that the import content of processing trade exports has steadily declined, overall, meaning that the domestic content and value-added in China have been on the rise.²¹ In the first half of the 1990s the import content of processing trade exports was approximately 80 percent (domestic content 20 percent); by the late 1990s, it was around 65 percent (domestic content 35 percent). By 2007, the import content of processing trade exports was 60 percent, with domestic content 40 percent.

But Robert Koopman, Zhi Wang, and Shang-Jin Wei find that the decline in the import content is concentrated at the low-skill intensive sectors of processing trade exports.²² As the skill-intensity of exports increases, the percentage of the value of the final product that derives from imported components rises sharply. For wearing apparel, the percentage of the value of the final product that derives from imported components is 62.4 percent. For household electrical appliances, the percentage of the value of the final product that derives from imported components is 76.3 percent. For electronic devices, the percentage of the value of the final product that derives from imported components is 85.2 percent. For telecommunications equipment, the percentage of the value of the final product that derives from imported components is 91.6 percent. For computers, the percentage of the value of the final product that derives from imported components is 96.1 percent.

Greg Linden, Kenneth L. Kraemer, and Jason Dedrick provide a fascinating look at who captures value in advanced electronics products exported from China, and where those who capture value are located.²³ Value-capture means the margin for the firm after paying for inputs and labor. Their target is Apple's iPod assembled in China with a retail price of \$299 in 2005. In their estimation by far the most costly input in the iPod is the 30GB hard drive from Toshiba, which costs \$73 or more than 50 percent of the total input cost, with a margin for Toshiba of about \$20, which they assign to Japan. The second-most valuable input is the display, with a factory price of \$20, plus margin of \$6 for Toshiba-Matsushita, which they again assign to Japan. Next are two microchips from US companies, Broadcom and PortalPlayer, leading to \$7 in margin assigned to the US. The SDRAM Memory comes from Samsung, with \$0.67 assigned to Korea. There are more than 400 additional inputs, with values from \$4 to fractions of a penny. Apple's gross profit meanwhile is \$80, or \$155 if distributed through Apple's own retail outlet. The

21. Nicholas R. Lardy. 2002. *Integrating China into the Global Economy*. Washington, DC: The Brookings Institution. Table 2-2, p. 38, and footnote 43.

22. Robert Koopman, Zhi Wang, Shang-Jin Wei. 2008. How Much of Chinese Exports is Really Made in China? Assessing Domestic Value-Added when Processing Trade is Pervasive. *Op. cit.*

23. Greg Linden, Kenneth L. Kraemer, Jason Dedrick. 2007. "Who Captures Value in a Global Innovation System? The case of Apple's iPod" Working paper. Personal Computing Industry Center, University of California, Irvine, June.

margins for the companies involved in the creation of the iPod (above costs of materials and labor) total \$190: \$163 accrue to the US, \$26 to Japan, \$1 to Korea, if the iPod is sold in the US. Some portion of \$75 allocated to retail and distribution would go to other players if the iPod were sold outside the US.

Linden, Kraemer, and Dedrick conclude that “the value added to the product through assembly in China is probably a few dollars at most” (the popularly accepted figure is \$4). They argue that while Apple’s margins are high within the electronics sector, the “geography” of value-capture for the iPod is fairly representative for the industry.²⁴ Robert Koopman, Shi Wang, and Shang-Jin Wei support this contention with their finding that Japan, the United States, and Europe (EU15) are the main sources of foreign content for computers and electronics in China, accounting for about 60 percent of imported components.²⁵

In 2010, Yuqing Xing and Neal Detert undertook a similar calculation of the value-capture in China in assembly of Apple’s iPhone.²⁶ They find that the value-added in China in 2009 for the iPhone was \$6.50 per unit, which was 3.6 percent of the total shipping price of the phone.

At the end of the day, China’s high tech export explosion represents multinational corporations bringing high skill-content high value-added inputs into China, assembling them into final products (or semi-assembled intermediates), and exporting them to world markets.²⁷ The contemporary corpus of sophisticated research on the evolution of China’s export base concludes that the increase in skill content at the sophisticated end of Chinese exports since 1992 is largely due to the increased skill content of imported inputs that are then assembled for export.

Somewhat surprisingly, moreover, the expansion of Chinese high tech exports is taking place along the intensive margin rather than the extensive margin.²⁸ In other developing countries, one of the principal contributions of foreign manufacturing investment is to continuously diversify the host export profile. This has clearly happened in China in the past, peaking around 1996, but from then on Mary Amiti and Caroline Freund find that the expansion of Chinese trade due to new product varieties

24. *Ibid.*, p. 10

25. Robert Koopman, Shi Wang, and Shang-Jin Wei . 2009. “A World Factory in Global Production Chains. Estimating Imported Value-Added in Chinese Exports”, UK: Center for Economic Policy Research, Discussion Paper 7430, September.

26. Yuqing Xing and Neal Detert. 2010. “How the iPhone Widens the United States Trade Deficit with the People’s Republic of China” Tokyo, Japan: Asian Development Bank Institute. ADBI Working Paper Series, No. 257. December.

27. Lee Branstetter and Fritz Foley note that US MNCs export very little of what they produce in China back to the US. Stephen Yeaple amends this to point out that US MNC exports to other countries in the region, perhaps for integration into final products elsewhere, is growing rapidly. Lee Branstetter and C. Fritz Foley. 2010. “Facts and Fallacies about US FDI in China (with Apologies to Rob Feenstra)”. Stephen Yeaple. “Comment” in Robert C. Feenstra and Shang-Jin Wei, eds., *China’s Growing Role in World Trade*. Chicago: University of Chicago Press for the NBER.

28. Mary Amiti and Caroline Freund. 2010. “What Accounts for the Rising Sophistication of Chinese Exports?” in Robert C. Feenstra and Shang-Jin Wei, eds., *China’s Growing Role in World Trade*. *Op. cit.*

cannot be more than one-fourth of the total. To be precise, manufacturing MNCs have been adding new products but these account for only a small share of export growth. In comparative perspective, China ranks between 80th and 100th out of a total of 133 developing countries in export growth along the extensive margin, depending upon the measurement system used.²⁹

Other comparative analytics substantiate the modest outcome China has achieved in using foreign multinationals to upgrade the indigenous industrial base. From a comparative perspective, the share of domestic value-added in FDI operations in China in high skill-intensive sectors such as computers and telecommunications, for example, ranges from *less than one-half to slightly more than one-half* of what is found in other developing countries where comparable measurements can be made, such as Mexico.

This comparative evidence comes from Justino de la Cruz, Robert B. Koopman, Zhi Wang, and Shang-Jin Wei who are able to compare the outcome of manufacturing FDI in China rigorously to other developing countries where there are similar processing-trade regimes.³⁰ The most accurate comparison can be made with Mexico where the maquiladora and PITEC (Program of Temporary Imports to Produce Export Goods) structures resemble China's processing-trade system.

In low-skill intensive industries—such as apparel—the FDI-dominated processing industries show a relatively large share of domestic value added in both countries: a 35.4 percent share for Mexico, a 37.6 percent share for China.

In the middle-skill intensive automotive sector, the FDI-dominated processing industries show what De La Cruz, Koopman, Wang, and Wei characterize as “medium” domestic value added in both countries: a 35.2 percent share in motor vehicles and 23.9 percent share in auto parts for Mexico, a 33.8 percent share in motor vehicles and a 28.7 percent share in auto parts for China—although Mexico scores a much higher 43.8 percent domestic value added share in “other transportation equipment” (for which there is no comparable category in the authors' data for China). For China, Nicholas Lardy notes that for some vehicle lines the domestic content has been climbing over time: the popular Santana, produced by a joint venture between Volkswagen and Shanghai Automotive, was launched in 1985 with a domestic content of 2 percent but recorded domestic content well over 90 percent by the late 1990s.³¹ Other large volume production vehicles, such as the Buicks produced by GM and Shanghai Automotive, followed a similar track.

29. Mary Amiti and Caroline Freund. 2010. “What Accounts for the Rising Sophistication of Chinese Exports?” *op. cit.*, p. 13.

30. Robert Koopman, Zhi Wang, Shang-Jin Wei. 2008. How Much of Chinese Exports is Really Made in China? Assessing Domestic Value-Added when Processing Trade is Pervasive. NBER Working Paper 14109. Table 5. Justino de la Cruz, Robert B. Koopman, Zhi Wang, and Shang-Jin Wei. 2010. “Estimating Foreign Value-Added in Mexico's Manufacturing Exports”. Working paper. Tables 7 and 8. Justino de la Cruz, Robert B. Koopman, Zhi Wang, and Shang-Jin Wei. 2009. “Domestic and Foreign Value-added in Mexico's Manufacturing Exports, power points, May 9.

31. Personal communication, November, 2010.

For high skill-intensive sectors, such as computers and telecommunications equipment, both countries have a much lower share of domestic value added in the FDI-dominated processing sectors. But, as noted above, Mexico's small domestic value added share (8.5 percent share in computers, 14.9 percent share in telecommunications) is nonetheless almost twice as large to well more than twice as large as the shares for these industries in China (3.4 percent share in computers, 8.4 percent share in telecommunications).

Turning from measurement of domestic content within foreign-owned factories to measurement of impact from FDI on surrounding firms within China, econometric assessments of horizontal and vertical spillovers from multinational investors to indigenous Chinese firms (private or state-owned) appear to be relatively weak in comparison to other countries in Asia, as do export externalities. The reasons include lower pay at Chinese companies and brain-drain from them to foreign MNCs, gaps in technology and quality-control standards, adaptability limitations, and intercultural communication problems. A summary of the econometric evidence and survey data on horizontal and vertical spillovers, and export externalities, in China—in comparative perspective—can be found as an appendix to this paper.

Bruce Blonigan and Alyson Ma investigate the extent to which Chinese domestic firms are “keeping up” or even “catching up” with foreign exporters.³² They do not try to measure spillovers directly. Instead, they compare the volume, composition, and quality of exports of the two groups. They find that the general pattern over the time period, 1997–2005, runs exactly counter to what one would expect if Chinese firms were catching up—foreign firm's share of exports by product category and foreign unit values relative to Chinese unit values are increasing over time, not decreasing. *Chinese exporters are not even “keeping up” let alone “catching up” with foreign multinational investors in China.*

To deepen the impact of foreign investment on the indigenous economic base in China—expanding the linkages from international investors and deriving more spillovers from their presence—will require improving the doing-business climate for private Chinese domestic firms, submitting state-owned enterprises to competitive market forces, upgrading worker skills, creating engineering and managerial talent, reforming financial institutions, and improving infrastructure. Many of these reforms are underway, to a greater or lesser extent. So positive contributions from foreign manufacturing multinationals to the indigenous Chinese economy—beyond the 13–14 million workers directly employed in foreign MNC plants—are likely to increase over time. Thus far, however, the aggregate data simply do not show FDI to be a powerful source for indigenous-controlled industrial transformation in China.³³

32. Bruce A. Blonigen and Alyson C. Ma. 2010. “Please Pass the Catch-Up: The Relative Performance of Chinese and Foreign Firms in Chinese Exports” in Robert C. Feenstra and Shang-Jin Wei, eds., *China's Growing Role in World Trade*. Chicago: University of Chicago Press for the NBER.

33. Lee Branstetter and Fritz Foley note that US MNCs actually do relatively little R&D in China (three tenths of one percent of their worldwide R&D and less than 13 percent of their R&D performed in the Asia-Pacific region), and most

V. FLOW-BACK TO THE MNC HOME ECONOMIES

Despite the appearance of small number of increasingly well-known Chinese national champions in manufacturing in the domestic market and abroad, most of the burgeoning new activities taking place in China have been remarkably well constrained to and contained within the plants owned and controlled by foreign multinationals and their international suppliers.

In their dissection of the “value-capture flows” for Apple’s iPod, summarized earlier, Greg Linden, Kenneth L. Kraemer, and Jason Dedrick suggest that the value-added attributed to the parent company that contributes a component or performs an integrative function to a product in China flows directly back to MNC headquarters. This is almost surely too simplistic—especially for US MNCs—given the American territorial tax system with the foreign tax credit and deferral that encourage US MNCs to use transfer pricing to keep accumulations of earnings offshore.

Rather than try to track down capital flows and hiding places within integrated MNC networks, the more sensible approach is to ask a slightly different kind of question: *if MNC headquarters use earnings from China, like earnings from elsewhere, to fortify their corporate position in world markets, what kinds of activities will those earnings help maintain or expand, and where will they be located?*

In coming to an answer for this question, it is striking to note—even in today’s globalized world—how remarkably home-based MNCs from developed countries have remained.

For the United States the most recent data show that US-headquartered MNCs have 70 percent of their operations, make 89 percent of their purchases, spend 87 percent of their R&D dollars, and locate more than half of their workforce within the US economy³⁴ This predominant focus on the home economy has persisted over time, and changes only very, very slowly at the margin.

The home-market-centered orientation for MNCs across the developed world is not dissimilar.³⁵

Thus, while manufacturing MNCs may build plants in China, shift production to Vietnam, outsource to Mexico, take a chance in Costa Rica or the Czech Republic, develop a new application in Israel, the largest impact from deployment of worldwide earnings is to bolster their operations in their home markets.

of R&D activity in China appears to consist of customizing innovations discovered elsewhere for the Chinese market. Lee Branstetter and C. Fritz Foley. 2010. “Facts and Fallacies about US FDI in China (with Apologies to Rob Feenstra)” in Robert C. Feenstra and Shang-Jin Wei, eds., *China’s Growing Role in World Trade*, *op. cit.*

34. Kevin B. Barefoot and Raymond J. Mataloni Jr. 2009. US Multinational Companies: Operations in the United States and Abroad in 2007,” *Survey of Current Business*, August, pp. 63–87. The latest Bureau of Economic Analysis (BEA) data are from 2007.

35. Alan M. Rugman. 2005. *The Regional Multinationals*. Cambridge: Cambridge University Press.

APPENDIX

ECONOMETRIC ANALYSIS AND SURVEY DATA ON HORIZONTAL AND VERTICAL SPILLOVERS, AND EXPORT EXTERNALITIES, IN CHINA IN COMPARATIVE PERSPECTIVE

FDI and horizontal spillovers in China

Multinational corporations in the manufacturing sector are quite explicit about taking great pains to avoid “leakage” of technology and managerial techniques to potential rivals in the horizontal direction³⁶ Despite their best efforts, horizontal leakages take place nonetheless.

In poorer developing countries horizontal spillovers often come via the movement of workers and managers. A World Bank study found that within six years of the beginnings of FDI-led growth in Mauritius, fifty percent of the investments in Export Processing Zones originated in domestic companies set up by owners who had learned their skills in foreign owned plants.³⁷ In Ghana, Holger Gorg and Eric Strobl trace a similar movement whereby managers move from foreign-owned plants to establish their own firms in the same industry.³⁸

In addition to the “leakage” of managers and workers, survey data from middle-income developing countries identify imitation of production techniques and marketing strategies as an important channel of vertical spillovers. One quarter of the managers of Czech firms and fifteen percent of the managers of Latvian firms reported in 2003 that they gained information about new technologies by observing the operations of foreign rivals that entered their industry.³⁹ Twelve percent of the Czech managers and nine percent of the Latvian managers added that they gained insights into new marketing techniques and sales outlets from the foreigners.

Econometric studies using micro firm-level panel datasets for China separate the relationship between FDI and state-owned enterprises, on the one hand, and private Chinese firms, on the other.

36. Benjamin Gomes-Casseres, “Ownership Structures of Foreign Subsidiaries: Theory and Evidence”, *Journal of Economic Behavior and Organization* 11, no. 1 (January, 1989), pp. 1–25. Paul W. Beamish and Andres Delios, “Incidence and Propensity of Alliance Formation by US, Japanese, and European MNEs”, in Paul W. Beamish and J. Peter Killing, eds., *Cooperative Strategies: Asian-Pacific Perspectives* (San Francisco: The New Lexington Press, 1997). Elisabeth Asiedu and Hadi Salehi Esfahani. 2001. “Ownership Structure in Foreign Direct Investment Projects,” *Review of Economics and Statistics*, 83, 647–66. Beata S. Javorcik and Kamal Saggi. 2010. “Technological asymmetry among foreign investors and mode of entry.” Draft.

37. Yung Whee Rhee, Katharina Katterback, and Jeanette White, *Free Trade Zones in Export Strategies* (Washington, DC: The World Bank, Industry Development Division, December 1990), p. 39. The authors are explicit in reporting that these new EPZ firm were founded by former-employees of the foreign multinationals.

38. Holger Jorg and Eric Strobl. 2005. “Spillovers from Foreign Firms through Worker Mobility: An Empirical Investigation.” *Scandinavian Journal of Economics* 107 (4): 693–709.

39. Beata Smarzynska Javorcik and Mariana Spatareanu. “Disentangling FDI Spillover Effects: What Do Firm Perceptions Tell Us”, in *Does Foreign Direct Investment Promote Development? Op. cit.*

Looking first at the horizontal relationship between multinational investment and the TFP performance of state-owned enterprises (SOEs) in China, Sourafel Girma and Yundan Gong find that within any given region the average SOE experiences negative intra-industry spillovers from the foreign multinational presence.⁴⁰ Besides suffering from market-stealing effects on the part of foreign firms, SOEs appear to find their more productive workers and managers moving to foreign investor companies where average wages are nearly 16 percent higher.

Turning to the horizontal relationship between foreign investors and private Chinese firms, with an extremely large industrial survey of more than 600,000 firms, Galina Hale, Cheryl Long, and Hirotaka Miura find that the impact of FDI varies by industry, sometimes with statistically significant positive effects, other times with statistically significant negative effects.⁴¹ Overall they estimate that the horizontal effects from FDI are either zero or quite small. Of particular note, they find no measurable horizontal spillovers in either the computer or the transportation equipment (including autos) industries, although there are positive horizontal spillovers in electronic equipment (excluding computers).

Using another firm-level panel dataset, Filip Abraham, Jozef Konings, and Veerle Sloomakers find that there are — on average—positive horizontal spillovers from foreign investors to private domestic firm productivity.⁴² But this “average positive impact” comes entirely through the channel of foreign investors partnering with a Chinese firm in joint ventures. Wholly-owned foreign investors have a negative horizontal impact on domestic Chinese firms.⁴³ Lee Branstetter and Fritz Foley note that 70 percent of US MNC affiliates in China are wholly-owned.⁴⁴

The prominence of the joint-venture channel for whatever horizontal spillovers take place in China has important implications for the quality of technology, management, and marketing available for domestic Chinese firms. Chinese policymakers at the national and provincial level have informally—and for some sectors formally—encouraged or required that foreign investors set up operation with a Chinese partner or undertake other actions that ensure technology transfer into the Chinese economy. As noted earlier in the body of the paper, current Chinese “pillar industry” policies that give preference to firms doing R&D within China are only the latest iteration.

40. Sourafel Girma and Yundan Gong. 2008. “FDI, Linkages and the Efficiency of State-Owned Enterprises in China”. *Journal of Development Studies*, Vol. 44, No. 5 728-749. May.

41. Galina Hale, Cheryl Long, Hirotaka Miura. 2010. Where to Find Positive Productivity Spillovers from FDI in China: Disaggregated Analysis. Working paper. February 25.

42. Filip Abraham, Jozef Konings, and Veerle Sloomakers. 2010. “FDI spillovers in the Chinese manufacturing sector: Evidence of firm heterogeneity” *Economics of Transition*. Volume 18 (1), PP. 143–182.

43. *Ibid.*, p. 163.

44. Lee Branstetter and C. Fritz Foley. 2010. “Facts and Fallacies about US FDI in China (with Apologies to Rob Feenstra)” in Robert C. Feenstra and Shang-Jin Wei, eds., *China’s Growing Role in World Trade*, *op. cit.*

But a comparative perspective shows that technology transfer requirements of various sorts almost invariably counterproductive results even when they do not deter inward FDI altogether. Edwin Mansfield and Anthony Romeo and—later—Edwin Mansfield and J.-Y. Lee show that parent firms supply technology to joint ventures in developing countries that is on average one-third older (3 to 4 years older) than technology provided to wholly-owned subsidiaries.⁴⁵ Contemporary evidence from Eastern Europe and the successor states of the Soviet Union shows foreign investors with more sophisticated technologies and marketing skills prefer entry via wholly-owned affiliate rather than joint venture.⁴⁶ Looking at technology sharing policies beyond joint venture requirements, Magnus Blomstrom, Ari Kokko, and Mario Zejan uncover a negative correlation between host policies that stipulate foreign investors must provide access to the parents' patents, perform research and development (R&D) in-country, or use the most advanced production processes available, and actual technology inflows into the host country.⁴⁷ When host authorities require technology-sharing as a condition of entry for Japanese investors, Shujiro Urata and Hiroki Kawai observe a negative coefficient for intra-firm technology transfer.⁴⁸

The evidence for China fits this same pattern. FDI that enters via joint venture brings technology, management, and quality control techniques that are well-behind the frontier in the industry. Survey data collected by Long Guoqiang show that wholly-owned or majority-owned affiliates in China are much more likely to receive the most advanced technology available to the parent than 50-50 or domestic majority-owned joint ventures.⁴⁹ Thirty-two percent of the wholly-owned foreign affiliates and 40 percent of the majority foreign-owned affiliates worked with technology as advanced as used by the parent firm, whereas only 23 percent of the 50-50 share ownership affiliates and 6 percent of the majority Chinese-owned affiliates worked with technology as advanced as the parent firm. The imposition of joint

45. Edwin Mansfield and Anthony Romeo. 1980. "Technology Transfer to Overseas Subsidiaries by US-based Firms." *Quarterly Journal of Economics*. 95:4. J.-Y. Lee and Edwin Mansfield, "Intellectual Property Protection and US Foreign Direct Investment", *Review of Economics and Statistics*, 1996, Vol. 78.

46. Beata S. Javorcik and Kamal Saggi. "Technological asymmetry among foreign investors and mode of entry". *Economic Inquiry*. Forthcoming 2010.

47. Magnus Blomstrom, Ari Kokko, and Mario Zejan. 1992. "Host Country Competition and Technology Transfer by Multinationals." Cambridge, MA: National Bureau of Economic Research Working Paper #4131.

48. Shujiro Urata and Hiroki Kawai, "Intrafirm Technology Transfer by Japanese Manufacturing Firms in Asia", in Takatoshi Ito and Anne O. Krueger, eds., *The Role of Foreign Direct Investment in East Asian Economic Development* (Chicago: The University of Chicago Press for the National Bureau of Economic Research, 2000).

49. Guoqiang Long. 2005. China's Policies on FDI: Review and Evaluation. In Theodore Moran, Edward M. Graham, and Magnus Blomstrom, eds. *Does Foreign Direct Investment Promote Development*. Washington, DC: Peterson Institute for International Economics, 2005).

ownership requirements, in short, hinders foreign affiliates from reaching the technological frontier in China, as elsewhere.

So even in those cases where horizontal spillovers can be observed in China, the channel—via joint ventures—is not likely to be as potent in placing Chinese firms along the cutting edge of technology and management in a given industry as is taking place in Singapore, Malaysia, Thailand, Brazil, Mexico, or India where wholly-owned foreign MNC operations are the norm.

There is a marked contrast in the results from Chinese use of industrial policy, joint venture and other technology transfer demands, local content requirements, and preferred public procurement in the handful of important high profile industries examined earlier in the body of this paper, and the Chinese economy more broadly.

FDI AND VERTICAL SPILLOVERS IN CHINA

In contrast to the horizontal direction, multinational manufacturers have a self-interest in creating vertical supplier networks. Comparative analysis shows that multinational manufacturers do not just to search out indigenous input suppliers where they operate but that they provide potential suppliers with technical assistance and other often-uncompensated help with lowering costs and enhancing quality.

The creation of MNC-host firm vertical relationships involve more than mere shopping-around for cheap inputs. Manufacturing MNC supplier networks often feature an intimacy and intensity— including two-way interaction, customization, and real-time mutual upgrading of technology and quality control—that is far different from impersonal arms-length purchase contracts.

Beginning in the early days of export-led growth in SE Asia in the 1980s, firm-level research on foreign investors in the electronics sector in Singapore reported that US and European firms provided engineering help to indigenous firms to enable them to meet precise design specifications.⁵⁰ Firm-level investigations in the telecommunications and semiconductor industries in Malaysia documented how MNCs assigned technicians to suppliers' plants to assist them in setting up large-volume production and quality control procedures.⁵¹ One study of nine Japanese electronics multinationals tracked “deliberate transfers” to Malaysian suppliers in the form of new product and process technologies, product-design specifications, advice on the use of equipment, and help with the solution of specific technical problems.⁵² These kinds of assistance to local firms could not be considered a genuine *externality* to the host economy

50. Linda Y. C. Lim and Pang Eng Fong. 1982. “Vertical Linkages and Multinational Enterprises in Developing Countries.” *World Development*. 10: 585-95.

51. R. Rasiah, *Foreign Capital and Industrialization in Malaysia*. New York: St. Martin's Press, 1995.

52. Giovanni Capanelli. 1997. “Buyer-Supplier Relations and Technology Transfer: Japanese Consumer Electronics”. *International Review of Economics and Business* 44, no. 3 (September): 633-62.

if the recipients remained as “captive suppliers” to those who provided the help, but in both Singapore and Malaysia the indigenous firms used the knowledge they acquired to become “contract manufacturers” to the electronics industry more generally. In the Singapore case, the multinationals introduced local suppliers to affiliates of the same parent in neighboring economies, following which the suppliers began to export more widely on their own (an export externality)—as discussed in the next section (Section IV) of this paper.

Efforts on the part of foreign multinationals to develop supplier networks in the host economy extend beyond Southeast Asia and the electronics industry. In the automotive sector, Wilson Perez Nunez reports that within five years after the international auto investors began to use Mexico as an export platform more than half of the thirty largest auto part exporters (excluding engines) were indigenous firms.⁵³ The Mexican affiliates of US, European, and Japanese auto investors helped these local companies improve quality control to the point where they could undergo certification as Original Equipment Manufacturers (OEM). In Thailand, Archanun Kohpaiboon finds that multinational automakers assigned technicians to take up residence in supplier factories.⁵⁴ Backward linkages and spillovers in Thailand came in tiers. The first tier of fully-certified OEM suppliers includes 287 affiliates of international auto-parts manufacturers, plus 10 Thai-owned firms. Among the latter, engineers at two companies (Somboon Group and Summit Auto Body) reported that Mitsubishi showed the owners how to purchase and install used-equipment from Japan and Germany, respectively, to meet Mitsubishi standards. The second tier is made up of approximately 1,000 Thai-owned companies that supply the first tier and the primary foreign assemblers. For the second tier, the foreign investors provide help with setting up testing facilities to ensure quality reliability.

The desire of foreign manufacturers to develop local supplier networks shows China is no exception. Firm level survey data of foreign investors from the US and UK in the eastern seaboard of China from 2003 indicate that some seventy-four percent have dedicated search initiatives to find local suppliers, and active vendor-development programs.⁵⁵ These foreign investors—almost three-quarters of those surveyed—provide explicit support for restructuring suppliers’ production processes, improving storage and transport facilities and capabilities, and training suppliers’ staff in production methods and quality assurance techniques.

53. Wilson Peres Nunez. 1990. *Foreign Direct Investment and Industrial Development in Mexico* (Paris: OECD), ch. 6.

54. Archanun Kohpaiboon 2009. *Global Integration of Thai Automotive Industry*. Thammasat University: Discussion Paper No. 0016, July 15, 2006. *Multinational Enterprises and Industrial Transformation: Evidence from Thailand*. Cheltenham, UK: Edward Elgar.

55. Andrew Millington, Markus Eberhardt and Barry Wilkinson. 2006. “Supplier performance and selection in China”. *International Journal of Operations & Production Management*. Vol. 26, no. 2, pp. 185–201.

What have been the results? The survey data clearly distinguished between State Owned Enterprises (almost uniformly negative comments) and private Chinese firms (more favorable comments). There is an interesting difference in the responses of FDI plant directors in comparison to the responses of FDI procurement officers who reported to them. The FDI plant directors emphasized the limited capabilities of local suppliers, poor quality of output, and likelihood of late delivery. Procurement officers in contrast had a higher regard for private Chinese firms. Both groups agreed, however, that creating local supply chains in China involves substantial investment of time and assistance to gain usable inputs.

The survey results from UK investors (representing more than half of the total population of UK investors in the eastern seaboard provinces of China) identified a specific “human resource” barrier to supplier development.⁵⁶ The UK affiliates reported that poor quality or late delivery were not in themselves considered reason for breaking a relationship with a supplier, at least in the initial stage of a relationship—the foreign buyers expected such difficulties. Faced with quality or timing issues, the foreign procurement officers would typically respond by helping the Chinese suppliers alter their processes and work practices. What would lead to a deterioration in the foreign-local supplier relationship was when the Chinese firms continually failed to communicate the real problems they faced, or failed to act on the advice and training given by the foreign investor. Suppliers would often not accurately report to buyer firms the problems they faced or would offer misinformation (“supplies wouldn’t show up and upon enquiry we would find out that the supplier had changed the schedule due to some problem which was almost definitely not the true reason without letting us know of the change”).⁵⁷ The survey data highlight the difficulty of building relationships of trust that depends upon reliable information exchange and an explicit sharing of problems followed by joint resolution—so important for tightly integrated vertical operations and just-in-time delivery systems.

For both US and UK investors the data suggest that soft performance criteria related to “relationship building” were often more difficult to achieve than “hard” performance criteria such as delivery, quality, and adherence to specifications per se.⁵⁸ This quasi-cultural inhibitor between Chinese suppliers and US or UK investors may not be so pronounced for the relationship between Chinese suppliers and foreign investment from ethnic Chinese companies, but such observation was outside the scope of this survey.

56. Barry Wilkinson, Markus Eberhardt, Julie McLaren, and Andrew Millington. 2005. “Human resource barriers to partnership sourcing in China. *International Journal of Human Resource Management* 16:10 October, pp. 1886–1900.

57. *Ibid.*, p. 1892.

58. Andrew Millington, Markus Eberhardt and Barry Wilkinson. 2006. “Supplier performance and selection in China”. *International Journal of Operations & Production Management*. Vol. 26, no. 2, p. 197. For a similar argument, see Howard Rosen. 1998. *Behind the Open Door: Foreign Enterprises in the Chinese Marketplace*. Washington, DC.: Peterson Institute for International Economics.

Turning to econometric analysis, Sourafel Girma and Yundan Gong find no discernible effects from upstream multinational FDI on State-Owned Enterprises.⁵⁹ With regard to downstream FDI, SOEs appear to suffer negatively when ethnic Chinese FDI moves into their region. Rather than enjoying new opportunities to become suppliers to the growing foreign presence, SOEs have reduced scope to sell intermediate inputs in downstream industries as ethnic Chinese foreign investors move in.

In the universe of private Chinese companies, Galina Hale, Cheryl Long, and Hirotaka Miura find diverse results as foreign investment increases, with more positive than negative effects from FDI to both upstream and downstream domestic firms.⁶⁰ Of particular note—once again—is that there is no significant aggregate evidence of vertical spillovers in either the computer or the transportation equipment (including autos) sectors.

These would seem to be rather tepid results for China in comparison to vertical spillovers from FDI in other developing countries, such as Indonesia and Eastern Europe.

When Garrick Blalock and Paul Gertler investigate the relationship between the presence of foreign investors and the total factor productivity of domestic firms that are suppliers to or buyers from the foreigners in Indonesia, they find an improvement in upstream and downstream local firms that is significantly associated with the rise in foreign investment.⁶¹ They are able to show that improvement in the performance of these indigenous firms, in turn, results in lower prices, increased output, higher profitability, and increased entry of vertically-linked firms. Moving beyond mere data correlation, Blalock and Gertler supplement their econometric investigations with survey data from both investors and suppliers. Foreign managers and the Indonesian local company executives reported help with production, quality control and business management flowing from one side to the other. US and Japanese affiliates assisted target suppliers to increase efficiency and reliability, increasing the size of purchases from local firms that showed promise. In the case of Japanese investors, the usual practice was to introduce successful Indonesian suppliers to other members of the parent company group elsewhere in Southeast Asia, an export externality reported earlier and discussed in the next section of this paper.

59. Sourafel Girma and Yundan Gong. 2008. "FDI, Linkages and the Efficiency of State-Owned Enterprises in China". *Journal of Development Studies*, Vol. 44, No. 5 728-749. May.

60. Galina Hale, Cheryl Long, Hirotaka Miura. 2010. Where to Find Positive Productivity Spillovers from FDI in China: Disaggregated Analysis. Working paper. February 25.

61. Garrick Blalock and Paul J. Gertler. 2008. "Welfare gains from foreign direct investment through technology transfer to local suppliers". *Journal of International Economics*. 74(2), 402-421, March. Garrick Blalock and Paul J. Gertler. Foreign Direct Investment and Externalities: The Case for Public Intervention. in *Does Foreign Direct Investment Promote Development? Op. cit.*

Similarly, Beata Smarzyska Javorcik finds productivity spillovers from foreign investors to upstream domestic firms in Lithuania.⁶² A one-standard-deviation increase in the foreign presence in downstream sectors is associated with a 15 percent increase in output of each domestic firm in supplying industries. She finds productivity spillovers from foreign investors to affiliates with shared local ownership, but no significant relationship with wholly-owned affiliates (an outcome she associates with the inclination of the latter to import more intermediate inputs).

While these studies that cover China, Indonesia, and Lithuania are quite different in many respects, it is interesting to note that the results from the latter two countries are robust to a large number of specifications while the results from China are more nuanced and are sensitive to sector and type of foreign investor.

As the data from Thailand (above) and from elsewhere show, vertical supplier relationships include foreign component producers that follow the major MNCs into the host economy as well as host country firms. This is true within China too. Flextronics, Jabil Circuit, Solectron, Sanmnina-Sci, Celestica, Hon Hai/Foxconn, Quanta, Compal and their colleagues in high performance electronics all have operations in China. So too do Dana, Lear, Robert Bosch, Magna International and their colleagues in advanced auto parts. So the vertical association that emerges in econometric studies does not necessarily point to indigenous supplier development. How the mix between foreign upstream component suppliers and indigenous upstream component suppliers in China compares to other developing countries is not known—whether the FDI electronics clusters around Penang Malaysia or the FDI automotive clusters around Sao Paulo Brazil contain more indigenous suppliers than comparable clusters in China requires further investigation.

Overall, the indications of vertical spillovers from foreign manufacturing investors to indigenous Chinese firms—whether from firm level case studies, survey data, or econometric analysis—do not appear to be as robust and vibrant as are present elsewhere. In the broad sweep of export-led growth in Southeast Asia and Latin America, firm and industry level data show indigenous firms becoming “contract manufacturers” for MNCs to be a major component of the electronics-centered industrial development of Singapore, Malaysia, and Thailand from the 1980s to the present.⁶³ In Latin America, qualification of local firms as Original Equipment Manufacturers to supply the automotive industry created large

62. Beata Smarzyska Javorcik. 2004. “Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers Through Backward Linkages.” *The American Economic Review*. Pp. 605–627. May.

63. R. Rasiah, *Foreign Capital and Industrialization in Malaysia*. New York: St. Martin’s Press, 1995. Rajah Rasiah. 1994. “Flexible production systems and local machine-tool subcontracting: electronics components transnationals in Malaysia” *Cambridge Journal of Economics* Volume 18, No. 3, June, 279-298. Archanun Kohpaiboon 2009. *Global Integration of Thai Automotive Industry*. Thammasat University: Discussion Paper No. 0016, July 15. 2006. *Multinational Enterprises and Industrial Transformation: Evidence from Thailand*. Cheltenham, UK: Edward Elgar.

manufacturing poles in Mexico and Brazil over the same period. Insofar as an explicit comparison can be made (see earlier discussion in the body of this paper), the share of domestic content in foreign investor operations in China is less than one-half to slightly more than one-half of the domestic content share of foreign investor operations in higher-skill sectors such as computers and telecommunications in Mexico.

This could change (it is hard to imagine that Chinese domestic content in the automotive sector, for example, will not expand substantially even if much of the expansion may take place within international component producers).

In comparative perspective, the extent and pace of expansion of backward linkages varies greatly. Relative success depends, in the first instance, upon a host country business-friendly climate that allows local firms to grow and prosper. It also depends upon how wide is the gap between the capabilities of the local business elite and the sophistication of what is demanded by the foreign purchaser: Ari Kokko shows that spillovers between foreign affiliates and local firms in Mexico varies as a function of the productivity differential between the two.⁶⁴ Ari Kokko, Ruben Tansini, and Mario Zejan observe the same phenomenon in Uruguay.⁶⁵ The development of indigenous supplier networks also varies as a function of the length of time the foreign investors have been resident in the host country.⁶⁶ Axele Giroud and Hafiz Mirza show that variations in local input linkages in Malaysia, Thailand, Vietnam, and Cambodia depend upon the age of the local foreign affiliate.⁶⁷ Rene Belderbos, Biovanni Capanelli, and Kyoji Fukao find that the proportion of local content purchased by Japanese multinationals from both foreign-owned and indigenous suppliers in a host economy is directly related to the length of Japanese affiliate's operating experience there.⁶⁸

Reasonably well-developed local financial institutions appear to be a necessary (if not sufficient) condition to enable local firms to become suppliers to multinationals. Beata S. Javorcik and Mariana Spatareanu find that Czech firms supplying foreign investors tend to be less credit constrained than non-suppliers. While some of these suppliers may be financially privileged via supply contracts, their results show that the supplier base is generally less liquidity-constrained before starting up a relationship

64. Ari Kokko. 1994. "Technology, Market Characteristics, and Spillovers." *Journal of Development Economics* 43, no. 4 (April): 279-93.

65. Ari Kokko, Ruben Tansini, and Mario C. Lejan. 1996. "Local Technological Capability and Productivity Spillovers from FDI in the Uruguayan Manufacturing Sector." *Journal of Development Studies* 32 (April): 602-11.

66. United Nations Conference on Trade and Development. 2001. *World Investment Report 2001: Promoting Linkages*. Geneva: United Nations.

67. Axele Grioud and Hafiz Mirza. 2006. "Factors determining supply linkages between transnational corporations and local suppliers in ASEAN." *Transnational Corporations*. Volume 15. Number 3. December.

68. Rene Belderbos, Biovanni Capanelli, and Kyoji Fukao. 2000. The Local Content of Japanese Electronics Manufacturing Operations in Asia. In Takatoshi Ito and Anne O. Krueger, eds. *The Role of Foreign Direct Investment in East Asian Economic Development*. Chicago: University of Chicago Press for the National Bureau of Economic Research.

with an MNC. Indigenous firms with greater access to credit are more likely to self-select into supplier status. Laura Alfaro, A. Chanda, Sebnem Kalemli-Ozcan, and Selin Sayek provide a formalization of how this process might take place, and Alfaro, Salemi-Ozcan, and Sayek—using data from 72 countries for the period 1975–95—show that countries with better quality financial institutions enjoy improvements in total factor productivity among suppliers and not just more capital accumulation.⁶⁹

What seems clear is that broad-based economic development via strong and vibrant supplier relationships with the vast FDI presence in China has not yet taken place in any dramatic way, and difficult and complicated reforms are likely to be required before it does.

FDI AND EXPORT EXTERNALITIES IN CHINA

Firm and industry-level studies surveyed earlier in this paper show foreign multinationals in countries other than China introducing host country firms to sister affiliates in the region, following which these host firms begin to penetrate international markets more broadly.

In the econometric literature, most investigations of export spillovers from multinational firms examine whether the export probabilities or export volumes of local firms are enhanced by proximity to multinational firms. This is the question Brian Aitken, Gordon Hanson, and Ann Harrison address, in the period after Mexico began to liberalize trade and investment in 1985.⁷⁰ Isolating the relationship between the presence of foreign investors and the export behavior of indigenous firms requires deft analysis since the natural expectation is that all export behavior will take place where the infrastructure is best, or where proximity to borders is closest, or where some other comparative advantage benefits all outward-looking firms. To identify an export spill-over from foreign firms, therefore, they control for overall concentration of economic activity in a region, and for possible region-specific or industry-specific shocks, so as to eliminate the impact of unobserved fixed factors that might affect the export behavior of all firms. Somewhat surprisingly, their results showed that the probability of doing “more-than-expected” exporting was positively correlated with close-by presence of foreign investors but uncorrelated with close-by concentration of export activity more generally.

For China, Huiya Chgen and Deborah Swenson, in contrast, looks at whether proximity to multinational firms is associated with an expansion in the export relationships—increase in the density of their trade networks or increase in the size of newly introduced transactions—of private host country

69. Laura Alfaro, A. Chanda, Sebnem Kalemli-Ozcan, and Selin Sayek. 2006. “How Does Foreign Direct Investment Promote Economic Growth?” NBER Working Paper 12522. Laura Alfaro, Sebnem Kalemli-Ozcan, and Selin Sayek. 2009. FDI, Productivity and Financial Development. *World Economy*. Vol. 32, no. 1. January. Pp. 111–136.

70. Brian Aitken, Gordon H. Hanson, and Ann E. Harrison, “Spillovers, Foreign Investment, and Export Behavior”, *Journal of International Economics*, 43, no. 1-2 (August 1997), pp. 103–32.

exporters⁷¹. Their results show that the volume of new private Chinese company exports is positively related to the presence of multinational firms, and negatively related to the size of near-by multinational firm activity. Chgen and Swensen interpret their dichotomous results as indicating that a foreign company presence generates initial information spillovers but the growth of multinational operations may intensify competition in local factor and product markets. The information spillover hypothesis appears confirmed since the positive association is especially large in differentiated goods industries where information is particularly important.

But the positive effect is only present in China's interior provinces.

In the coastal regions of China Chgen and Swensen find that the presence of own-industry MNCs does not lead to new export activity on the part of private Chinese firms whatsoever.⁷²

Worse, Filip Abraham, Jozef Konings, and Veerle Sloomakers find that foreign investment from greater-China has a negative impact on local export-oriented Chinese firms and firms located in special economic zones.⁷³

Is there some way of making an aggregate appraisal of how indigenous Chinese exporters are evolving overall in relation to the influx of foreign multinationals?

As summarized in the body of the paper (*infra*), Bruce Blonigan and Alyson Ma offer a perspective that follows a different investigative path from the measurement of spill-overs *per se*.⁷⁴ They do not attempt an econometric investigation of the relationship between FDI presence and export performance of domestic firms. Instead they examine data on the relative share and unit value of Chinese exports by sector and type of enterprise to investigate the extent to which domestic enterprises are “keeping up” or even “catching up” to foreign multinational investors in the volume, composition and quality of their exports. They find that the general pattern over the time period, 1997–2005, runs exactly counter to what one would expect if Chinese firms were catching up. The evidence they amass shows that foreign firms' share of exports by product category and foreign unit values relative to Chinese unit values are increasing over time, not decreasing. Chinese exporters are not even “keeping up” let alone “catching up” with foreign multinational investors in China.

71. Huiya Chgen and Deborah L. Swenson. 2007. “Multinational Firms and New Chinese Export Transactions. *Canadian Journal of Economics*, 121(1): 199-218.

72. *Ibid.*, p. 609.

73. Filip Abraham, Jozef Konings, and Veerle Sloomakers. 2010. “FDI spillovers in the Chinese manufacturing sector: Evidence of firm heterogeneity” *Economics of Transition*, *op. cit.*

74. Bruce A. Blonigan and Alyson C. Ma. 2010. “Please Pass the Catch-Up: The Relative Performance of Chinese and Foreign Firms in Chinese Exports” in Robert C. Feenstra and Shang-Jin Wei, eds., *China's Growing Role in World Trade*. Chicago: University of Chicago Press for the NBER.