# Who is Us: The Globalization of Innovation and Challenges to Assessing Technological Dependence*

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## Abstract

How do states assess technological self-sufficiency in a globalizing world? To sustain long-term growth and limit foreign dependency, rising powers pursue domestic sources of technological innovation. In recent decades, however, the hybridization of innovation — marked by increased cross-border financial flows and expanded mobility of high-skilled workers — has fostered hybrid firms that challenge emerging economies' ability to assess "independent" innovation. Borrowing Robert Reich's notation, the grounds for debate over "who is us" have fundamentally shifted. This article posits that, compared to their predecessors, rising powers today adopt more malleable boundaries for the corporate actors included within indigenous innovation because their technology ecosystems are more reliant on transnational technical communities and foreign direct investment. Case studies of how policymakers evaluated independent innovation in China, India, and Japan provide empirical support for the theory. These comparisons, across time and between states, illustrate how structural changes in the global economy have made it more difficult for rising powers to draw lines between "domestic" and "foreign" companies, resulting in unsettled assessments of independent innovation. This article contributes to academic and policy debates about the consequences of economic dependence, the efficacy of high-profile industrial policies, and how developing states manage the challenges of globalization.

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# I. Introduction

During an event in Taiwan in March 2015, Alibaba founder Jack Ma vented his frustrations about the e-commerce giant's identity: "In mainland China, Alibaba is considered a foreign-invested enterprise. The U.S. Secretary of Commerce says that Alibaba is a Chinese company…I'm confused. Which one is it?"[1]

Ma's confusion is both justified and revelatory. For Chinese leaders, it is remarkably difficult to answer the question: Is Alibaba a domestic or foreign company? On the one hand, Alibaba is a flagbearer for China's "indigenous innovation" [*zizhu chuangxin*] efforts. When the firm completed the largest initial public offering in history, Chinese authorities and media celebrated it as a Chinese company.[2] At the same time, Alibaba is led by a mix of non-Chinese and Chinese directors, and international investors own more than half of its shares. Chinese government documents sometimes classify Alibaba as a foreign-invested enterprise [*waizi qiye*].[3] Adding to the conundrum, this confusion over corporate nationality surrounds a mainstay of China's internet industry – a sector that the Chinese leadership considers essential to national security and strictly regulates to limit foreign dependence.

What gives? In this article, I show that the ambiguity over Alibaba's corporate nationality reflects a broader relationship between changes in the global economy and the ability of states to assess their technological independence. Over the past thirty years, globalization of both cross-border financial flows and high-skilled human capital flows has constituted a fundamental shift in the international economy. These trends have enabled the emergence of "hybrid" corporations, like

[1] Author's translation. Hao 2015.
[2] Zhao 2022.
[3] For example, an important set of science and technology indicators published by China's Ministry of Science and Technology lists Alibaba as a *foreign enterprise* applicant of invention patents, alongside companies like Intel and Mitsubishi (*Yellow Book on Science and Technology* [2016]).

Alibaba, whose leadership and financial backing are from countries different from those where their headquarters, most employees, and critical operations are based.

This specific type of globalization, which I label "the hybridization of innovation", complicates the efforts of states to measure foreign technology dependence. Faced with a choice between reluctantly embracing hybrid corporations or falling behind in technological development by rejecting them, states choose the former as the least bad alternative. As a result, they now adopt more expansive and malleable boundaries for the corporate actors that count as contributing to independent innovation, resulting in a larger "gray zone" between domestic and foreign companies. In short, the hybridization of innovation makes it more difficult for governments to benchmark indigenous innovation.

To test this theory, I conduct comparative case studies of how policymakers assessed foreign technology dependency in China (1990-2005; 2006-2020), Japan (1970-1990), and India (2003-2020). Facing this new globalization trend in recent decades, Chinese bureaucrats adopted more unstable and malleable interpretations of indigenous innovation, whereas their assessments of foreign technology dependence were less subject to varying interpretations during the 1990s and early 2000s. Japan's efforts to nurture technological autonomy shares many similar features with China's experience, with one key exception: it took place in a global economy unaffected by the hybridization of innovation. The Japan case analysis shows that this distinction made a meaningful difference in the ease and clarity of Japanese policymakers' assessments of foreign technology dependence. Lastly, a comparison to India's efforts to measure technological self-reliance demonstrates the salience of my argument in a different context.

This article makes several contributions. First, it intervenes in existing scholarship about the effects of globalization on states' ability to "go-it-alone" and adopt strategies of mercantile realism. Fruitful literature has shown that a particular type of globalization — the dispersion of technological

development by multinationals, growth of strategic alliances between firms, and increased dependence of firms on sales to foreign markets — compelled states to adjust their judgements of acceptable levels of foreign technology dependence, sometimes adopting a broader interpretation.[4] The most prominent version of this argument, as captured in Robert Reich's provocative "Who is Us?" article, questioned whether a Japanese-owned company that invested heavily in U.S.-based production facilities and jobs could be more "American" than a U.S.-owned company that offshored most of its activities and jobs.[5]

Yet, there were limitations to these claims about globalization's challenge to assessments of technological autonomy. Evidence showed that multinational corporations held on to their "national character", as evidenced by the fact that they based a small proportion of their R&D activities abroad.[6] Pointing out that globalization had not advanced to the extent Reich thought, mercantile realists argued that, in fact, states had little trouble determining "Who is us?" In pushing this debate forward, this article argues that a different type of globalization, the hybridization of innovation, has complicated the assessment of which corporate actors count as contributing to independent innovation — in a more fundamental way than previous globalization trends. While previous literature has centered the U.S. experience, my novel theory explores this relationship from the perspective of rising powers.

Second, this article contributes to the large, growing literature on the implications of economic dependence. One influential line of thinking explores how states "weaponize interdependence" by leveraging control over technological supply chains and other central economic nodes.[7] This article highlights that the consequences of dependence are contingent on the process by

[4] Brooks 2005; Moran 1990. Prakash and Hart 2000.
[5] Reich 1990.
[6] Pauly and Reich 1997; Tyson 1991.
[7] Farrell and Newman 2019. See also Christensen 2024.

which states assess autonomy, an understudied variable in international relations scholarship.[8] Existing scholarship tends to assume that there is an objective, straightforward process by which states evaluate dependence. This neglects the realities of how foreign dependency is measured in practice, by bureaucrats and policymakers that live in a messy, globalizing world.

Without further unpacking this process, theories of the consequences of dependence may give misleading expectations. Aaron Friedberg's *The Weary Titan* put forward the assessment of power as a "crucial, intervening variable" between structural shifts in the international system and state behavior.[9] This project aims to do the same for the assessment of dependence.

Indeed, this intervening variable of dependence assessment directly bears on recent discussions by policymakers and academics that highlight a technonationalist turn in industrial policy, under which states increasingly pursue measures that insulate their innovation systems from foreign influences.[10] In particular, China's brand of state capitalism and indigenous innovation efforts have drawn significant attention.[11] This article fills in a key gap, which most of these discussions gloss over: how do China and other rising powers measure success in the first place? This is a prerequisite to clear-eyed analysis of decoupling and the purported resurgence of technonationalism.

This article proceeds by first highlighting the relationship between globalization and states' efforts to assess technological self-sufficiency. Next, I specify how the hybridization of innovation, marked by increased global flows of finance and high-skilled human capital, has resulted in more unsettled assessments of foreign technology dependence, focusing on the uneasy alliance between

[8] Exceptions include Friedberg 1988; Moran 1990.
[9] Friedberg 1988.
[10] Pearson, Rithmire, and Tsai 2022. Chen and Evers 2023.
[11] McNally 2012; Wei, Ang, and Jia 2023. For instance, China's "Made in China 2025" plan, which outlines goals to enhance self-sufficiency in ten strategic technologies, became a key point of contention in the U.S.-China relationship.

rising powers and hybrid corporations. To support this argument, I provide detailed case studies of how policymakers in China, India, and Japan evaluated foreign technology dependence across different periods of globalization. The conclusion outlines the article's broader policy implications and scholarly contributions.

## II. Theory: Globalization's Challenge to Assessing Foreign Technology Dependence

To avoid dependency in industries critical to national security and economic vitality, states seek to nurture domestic sources of technological innovation. States that follow a strategy of "mercantile realism" may be especially sensitive to technological dependency, viewing protection of domestic markets as essential to national security as military strength.[12] To some extent, however, all states take account of technological dependency in their strategic calculus. In his book on how European states confronted their growing "technological gap" with the U.S. during the postwar period, Robert Gilpin writes, "From basic research through technological development and production, each nation wants to maximize its own self-sufficiency and minimize dependence on other nations."[13]

When it comes to dependence, as is the case with many key variables in international relations – power, threat, and security – perception is often more important than reality. If a state underestimates its dependence on other countries, it may adopt more aggressive foreign policies. For instance, regarding Germany's entry into World War I, scholars debate the degree to which German leaders comprehended the costs of an economic blockade that would cut off their access to strategic

[12] Heginbotham and Samuels 1998, 192.
[13] Gilpin 1968, 427.

goods.[14] On the other hand, states that overestimate their foreign dependence may adopt overly subordinate positions or take costly measures to disengage from international interactions.[15]

In grappling with how to accurately assess dependence, states confront a changing global economy. What is the effect of globalization on how states assess foreign technology dependence? Building from previous work on globalization's challenges to measuring technological self-sufficiency, this article provides a novel answer to this question.

One thread of existing research shows that traditional measures of trade dependence struggle to account for the growing significance of global value chains (GVCs), in which intermediate parts are sourced from suppliers in many countries.[16] Consider, by way of illustration, the discrepancy between where final goods are produced and where value is created in the global supply chain for iPhones. Using conventional import and export indicators, China captures a trade surplus of about $170 with the U.S. for each iPhone because the device's final assembly takes place in China. Yet, a measurement approach informed by GVCs reveals a different picture. For each iPhone, less than 4 percent of value-added activities occur in China, as many intermediary parts are produced by other countries.[17]

Scholars have also investigated how the increased geographic dispersion of technological sourcing by multinational corporations have influenced evaluations of foreign dependence in defense industries. For example, Steve Brooks's work has identified that the globalization of production requires assessments of foreign dependence in the defense industrial base to account for lower-tier suppliers in dual-use industries. Otherwise, such analyses were "likely to underestimate the extent of internationalization in U.S. weapons systems production."[18] To manage foreign

[14] Papayanou 1996; Ripsman and Blanchard 1996.
[15] Holsti 2016.
[16] Gereffi 2014.
[17] De Backer and Yamano 2007.
[18] Brooks 2005, 89.

dependence in globalizing defense industries, other scholars emphasized the need to measure the concentration ratio of key industries.[19]

As exemplified by Reich's famous "Who is Us?" article, some scholars contended that the globalization of production mounted a more radical challenge for assessments of foreign technology dependence.[20] In 1990, amidst the fervor of high-tech competition between the U.S. and Japan, Reich compared the "nationality" of two types of companies. Corporation A is headquartered in the U.S., led by U.S. directors, and owned by American investors; however, it conducts most of its operations, design, and research work abroad, where most of its employees are based. Corporation B is headquartered in a foreign nation and owned and managed by citizens from that nation; however, it conducts most of its operations, design, and research work in the U.S., and the majority of its employees are Americans. In suggesting that Corporation B could be the more "American" company, Reich raised difficult questions about globalization and how states judge which firms could be depended on.

There are limitations, however, to this previous literature base. For one, these studies mostly focused on the U.S.'s innovation system, neglecting the interaction between globalization and rising powers' efforts to benchmark their technological self-reliance. Second, the more sweeping claims about globalization's impact on corporate nationality were premature. Alongside the broader pushback against the idea of a "borderless world," scholars emphasized the importance of national identities for multinational corporations.[21] U.S. multinationals still based the vast majority of their assets and employees in their home country, and virtually no foreign-owned firms conducted most

[19] Moran 1990.
[20] Reich 1990.
[21] Jones 2006.

of their manufacturing and research in the states.[22] In other words, Corporation A and Corporation B did not exist.

## The hybridization of innovation

Who is Us in 2024? Even today, not many examples of Reich's Corporation A and Corporation B exist. Embedded in their domestic innovation systems, multinational firms continue to locate the vast majority of their R&D in their home countries.[23] In 2020, 84 percent of R&D expenditures by U.S. industry was performed in the U.S. — a figure that has remained generally consistent over the past two decades.[24] Most advanced economies rely on domestic sources of innovation. For OECD countries in 2020, only 11.6 percent of total business R&D came from abroad.[25]

In the three decades since Reich's comparison of Corporation A and Corporation B, changes in the global economy have posed a different "who is us" challenge. Consider a third type of corporation (Table 1). Corporation C is headquartered in China, and conducts most of its operations and research in China, where the majority of its employees are based; however, it is led by a mix of Chinese and non-Chinese directors, and largely owned by foreign investors. In fact, these parameters describe Alibaba, the Chinese internet giant that completed the largest initial public offering in history in 2014. They also apply to many other leading technology firms in not just China but other emerging economies.[26] Today, Corporation C exists.

[22] Pauly and Reich 1997; Tyson 1991.
[23] Kennedy 2018, 23.
[24] Author's calculations based on the National Science Foundation's 2020 Business Enterprise Research and Development Survey.
[25] Author's calculations based on OECD Research and Development Statistics 2020.
[26] Zhao 2022.

| Table 1: Three Models of Hybrid Corporations | | | |
|---|---|---|---|
| | Corporation A | Corporation B | Corporation C |
| Domestic ties | Headquarters; leadership; ownership | R&D and critical operations; employees | Headquarters; R&D and critical operations; employees |
| Foreign ties | R&D and critical operations; employees | Headquarters; leadership; ownership | Leadership; ownership |

Corporation C is a product of a particular trend of globalization that gained strength in the 1990s, which I label the hybridization of innovation. It is composed of two constituent parts: i) increased cross-border financial flows, including enhanced ties between emerging and developed markets; ii) expanded mobility of high-skilled workers. These two trends feed back into each other. As workers and students move back and forth across borders, they smooth the way for investment flows and they also sometimes become investors themselves; meanwhile, cross-border capital flows establish the types of companies that value and recruit people with international education and work experience.

First, financial globalization refers to a shift in the breadth of capital flows toward the global scale. These flows include foreign direct investment, purchases of bonds and equities, and lending. Between 1990 and 2006, the global ratio of foreign-owned assets to GDP almost tripled from 9 to 26 percent.[27] If one looks at the stock of global foreign investment (includes liabilities such as lending) relative to GDP, this ratio has increased from 51 percent in 1995 to 185 percent in 2007, where it has remained consistent.[28]

Crucially, this recent trend in financial globalization has linked together developed and developing economies. Brazil, China, Malaysia, Mexico, Russia, Saudi Arabia, and South Africa all

[27] Farrell et al. 2008, p. 73
[28] Lund et al. 2017. In this article, I focus on FDI since it is more "sticky" than other financial flows such as portfolio investment, which can be quickly moved around and does not give investors direct influence.

hold foreign investment assets and liabilities that exceed their GDP — a key measure of connectedness to the global financial system.[29] In 2021, newly industrialized countries accounted for 15 percent of the world's FDI stock.[30] This financial landscape diverges greatly from the one in the 1960s and 1970s, when Japan, Korea, and Taiwan experienced rapid rates of economic expansion with restricted FDI flows. In 2005, FDI inflows as a share of GDP averaged above 2 percent across the BRICS nations; by contrast, in 1980, this corresponding percentage was below .2 percent, on average, for Japan, South Korea, and Taiwan.[31]

It is also important to differentiate this phenomenon from financial integration during the 19th century, often regarded as a golden age of globalization. In making this comparison, Katzenstein, Keohane, and Krasner stated in 1998, "international financial markets were highly integrated at the end of the nineteenth century—perhaps even more so than they have been since, at least until very recently."[32] It is true that financial integration in the 1870-1914 period was extensive, relative to the decades that followed. Still, since the turn of the 21st century, the ratio of foreign capital stocks to GDP is more than double what it was in 1914. In addition, inward stock of FDI in developing countries was negligible up until 1960; in 2003, these FDI inflows accounted for almost 30 percent of the global total.[33]

Second, the increased mobility of skilled migrants is a crucial trend in today's knowledge-based economy. In 2015/2016, there were about 40 million highly-educated migrants (those with a tertiary degree) in the OECD. This figure has essentially doubled over the period between 2001 and 2016.[34] The globalization of human capital flows has been much more intense for highly-skilled

[29] Lund et al. 2017.
[30] Author's calculations based on OECD's FDI stocks indicator.
[31] Hsueh 2022, 9-10; see also Hsueh 2011.
[32] Katzenstein, Keohane, and Krasner 1998. See also Dunning 1983.
[33] Salles 2006. Furthermore, in the 19th century, most FDI was driven by natural resource extraction. Brooks 2005, 46.
[34] Kerr et al. 2016.

workers. In the period from 1990 to 2010, the number of migrants with a tertiary degree in OECD countries increased by almost 130 percent, while the number of migrants with only primary education in OECD countries increased by just 40 percent.[35]

As was the case with financial globalization, changes in talent flows have also featured close connections between emerging and advanced economies. Based on data from 2016, the two origin countries with the largest high-skilled diasporas in the OECD area were India and China, respectively.[36] A growing literature has highlighted the impact of "returnees," professionals and entrepreneurs who return to developing countries after studying or working in developed countries, on the technological "catch-up" of their home countries.[37]

Taking advantage of their linguistic and cultural fluency in two different settings, these highly-skilled migrants have formed global entrepreneurship networks. AnnaLee Saxenian's work has documented how highly-skilled immigrants in Silicon Valley have invested in their home countries or returned home, sometimes temporarily, to start new businesses – thereby marking a transformation from "brain drain" into "brain circulation."[38] According to one 2004 survey of CEOs of leading Indian software firms, 58 percent of firms were run by CEOs who had lived abroad, and these firms relied significantly more on financing from diaspora networks.[39]

Before describing the implications of this change in the global economy, it is worth clarifying that I do not probe the causes of the hybridization of innovation. Regarding financial globalization, one important factor has been the proliferation of international investment agreements since 1990.[40] As for the enhanced mobility of skilled migrants, some explanations highlight the impact of regional

[35] Kerr et al. 2016.
[36] d'Aiglepierre 2020.
[37] Kenney et al. 2013.
[38] Saxenian 2007.
[39] Nanda and Khanna 2010, 1001.
[40] UNCTAD 2015.

trade agreements that liberalized labor flows, changing strategies of multinational corporations (MNCs), and policies by developing countries to both send out and recruit back talent.[41] To be sure, the growing ease of transportation and communication contribute to both trends.

## New challenges to assessing dependence

What is the effect of the hybridization of innovation on how states assess their foreign technology dependence? The outcome of interest, the level of difficulty of making such assessments, draws attention to the process by which policymakers conceptualize and measure foreign technology dependence.

As states climb the ladder of technological development, they now do so on ground unsettled by the hybridization of innovation. As a result, emerging economies face a choice: embrace a more malleable interpretation of self-reliance that includes hybrid Corporation Cs, or cling to a more restrictive notion of corporate nationality that fails to incorporate the most dynamic firms. States that "choose" the latter option, whether by policy decisions that limit their involvement in global networks (e.g., Iran) or by not having the baseline skill base and institutions to support hybrid firms (e.g., some Latin American and African countries), will fall further behind the technological frontier.[42]

Thus, the hybridization of innovation poses new challenges for states seeking to benchmark their technological autonomy. To begin, as emerging economies become enmeshed in the globalization of financial and high-skilled human capital flows, they will host more firms like Corporation C. These hybrid firms will make it more difficult for governments to determine which entities count as or contribute to independent innovation. If my argument holds, we should expect

[41] Saxenian 2005.
[42] Saxenian 2007.

governments to accept, whether implicitly or explicitly, a larger "gray zone" between purely domestic and purely foreign companies. In this vein, it should become more common for governments to view a firm as either "foreign" or "domestic" depending on the specific context.

Moreover, it will be increasingly difficult for governments to employ quantitative indicators to assess and measure technological dependence. Related work on measuring power has found that certain indicators can significantly misrepresent the balance of power.[43] Friedberg's analysis of how British policymakers assessed economic dependence in the late 19th century finds that this process became dominated by a simplified indicator based on trade return data, which distorted debates about economic dependence.[44] In contrast, the hybridization of innovation makes it unlikely that simplified indicators will monopolize present-day debates about foreign technology dependence, as more malleable boundaries of corporate nationality make it so any measure will be subject to contested interpretations.

It should be noted that these effects on the assessment of foreign technology dependence are fundamentally distinct from challenges posed by previous waves of globalization. In the 1970s and 1980s, the geographic dispersion of production and interfirm alliances, such as those between IBM, Siemens, and Toshiba, became increasingly important in developing new technologies.[45] This change in the global economy did raise thorny questions about divvying up credit for technological innovation across national boundaries, but it did not encumber governments with doubts about the nationality of firms. After all, the Japanese government did not agonize over whether Toshiba was Japanese enough.

The hybridization of innovation's implications for measuring technological self-sufficiency also depart from those linked to globalization in the postwar period, when increased investment

[43] Beckley 2018.
[44] Friedberg 1988.
[45] Brooks 2005.

flows from the U.S. triggered European concerns about a growing technology gap. Although some European subsidiaries of large U.S. MNCs did have strong autonomy — leading some observers to comment that they "resembled 'hybrid' organizations rather than American ones"— western European policymakers did not consider them as European when measuring this technology gap.[46] European leaders clearly determined that having "national champion" companies in critical industries like aerospace and computers was crucial to check against dependence.[47] In these two threads, while the assessment of dependence was complicated by many factors related to the structure of the global economy, the nationality of corporate actors was relatively unambiguous.

In terms of scope conditions, this relationship between the hybridization of innovation and technology dependence assessment is most salient for newly industrialized countries that are attempting to transition from less developed economies to high-income ones. More advanced economies, in their efforts to enhance their technological capabilities, are not as dependent on foreign direct investment and returnee entrepreneurs. Furthermore, my argument is more applicable to larger countries subject to higher levels of geopolitical tensions, as opposed to countries such as Chile, which is an emerging economy that neither faces the pressures to pursue technological autonomy across a wide range of strategic sectors nor possesses the economic size to reasonably achieve this objective.

Lastly, this argument's scope is limited to certain technology domains. As a baseline, governments tend to pay particular attention to dependency concerns in some sectors. These strategic industries often generate positive spillovers to the national technology base and engender high barriers to entry due to cumulative effects such as first-mover advantages. For example, in 2022, the Biden administration deemed 19 technology areas as particularly important to national

[46] Jones 2006; Gilpin 1968.
[47] Gilpin 1968.

security, including: artificial intelligence, biotechnologies, semiconductors and microelectronics, and advanced computing. In addition, these industries are characterized by high rates of technological change, which force firms to constantly keep pace with the global frontier.

Not all strategic industries fall within the scope of my theory. Traditionally, governments avoid any foreign dependence in key infrastructure and energy industries, such as oil, electric power, telecommunications, and civil aviation. In these sectors, foreign influence is so sensitive that governments maintain clear lines when it comes to corporate nationality.[48] While it is important to note these sectoral bounds, the substantive significance of the sectors covered by my argument should not be understated: they are regular targets of industrial policy and economic statecraft, making them focal points of global technological competition.

## III. Evaluating the "Who is Us (redux)" Argument

To test my argument, this article conducts comparative case studies of how policymakers from different countries evaluated foreign technology dependence across phases of globalization. The primary case covers Chinese policymakers' assessments of foreign technology dependence before (1990-2005) and after (2006-2020) the hybridization of innovation became a defining feature of the international economy. Exploiting within-case variation in this feature of globalization, evidence from this case should reveal that the Chinese government's efforts to assess technological self-reliance were more stable during the 1990s and early 2000s; in contrast, these assessments should become more malleable and subject to varying interpretations in the later period.

This test is supplemented by two additional cases. Japanese technology strategists held many of the same beliefs and goals as Chinese planners today, yet the nature of globalization has fundamentally changed. Leveraging a most similar systems design, I expect that, compared to their

[48] Lind and Press 2018.

Japanese counterparts' efforts to assess technological self-sufficiency (1970-1990), Chinese bureaucrats, in recent decades, have encountered more difficulties with defining which firms count as contributing to indigenous innovation, resulting in more expansive and unstable interpretations. To probe the generalizability of my findings, I also study the hybridization of innovation's impact on India's efforts to assess foreign technology dependence (2003-2020).

In the analysis of these three cases, I draw on a variety of sources. To measure the "hybridness" of the internet and information technology industries in China and India, I collected data on foreign investment flows and senior personnel for 120 leading firms. The empirical sections also benefit from oral histories and reflections from business leaders about how states perceived the nationality of their firms, as well as from exchanges with experts on how bureaucrats in all three countries tracked levels of technological autonomy. Systematic reviews of debates about particular indicators of foreign technology dependence, including in influential Chinese-language forums, also aid the empirical analysis.

Not all globalizations are created equal. It is possible that the additional complications in assessing foreign technology dependence, which this article ties to the hybridization of innovation, can be explained by earlier developments linked to the globalization of production. One way the case analysis traces the effects of different globalization trends is by analyzing the characteristics of firms that confound government measures of technological self-reliance. If these firms fit the mold of Corporation C, then this finding would give weight to the hybridization of innovation. If, however, these firms are local subsidiaries of MNCs, then this would point to the impact of the globalization of production.[49]

[49] Moreover, if government leaders in China (1990-2005) and Japan (1970-1990) — periods when the hybridization of innovation's influence was limited — could make clear determinations of corporate nationality, then this would undercut the globalization of production as an alternative cause.

The cases are selected and structured to address three other alternative factors. First, a state's particular ideological orientation or strategic calculus could affect its capacity to clearly differentiate between foreign and domestic entities in terms of indigenous innovation.[50] States that hold strong mercantilist or technonationalist views may be more likely to make clear, easily measurable determinations of foreign technology dependence. The within-case analysis provides leverage here: even though China's technonationalism has intensified since 2003,[51] my theory expects that it has become more difficult for China to assess technological self-sufficiency — the opposite outcome of what this alternative explanation predicts. Moreover, in all three country contexts, leaders took aggressive stances on technological self-reliance; yet, regarding their facility in making assessments of this objective, outcomes differed.

Second, as noted above, a particular sector's strategic value can shape how states assess which corporate actors support technological autonomy. For instance, Roselyn Hsueh's research shows that the strategic-ness of certain sectors shapes corresponding Chinese government regulations on FDI and foreign collaborations.[52] To isolate the hybridization of innovatin's effects from these sectoral features, all the cases center on the information technology (IT) sector, which covers companies that provide internet services, software, hardware, and semiconductor equipment. In all three countries, government leaders have consistently scrutinized this critical technology sector in terms of foreign dependence concerns.

Third, "who is them" also matters. It is necessary to take into account the specific companies and countries on which states are concerned about being dependent. Studies of foreign acquisitions of U.S. critical technology firms, for example, have found that many of the acquirers are

[50] Heginbotham and Samuels 1998; Lind and Press 2018.
[51] Chen and Naughton 2016.
[52] Hsueh 2011.

based in countries that are U.S. security allies.[53] In these circumstances, U.S. policymakers should be less sensitive to corporate nationality. On this point, what is compelling about the Japan-China comparison is that the outcomes go against what is expected. Japanese policymakers should have been less strict about corporate nationality because the U.S., their primary technology partner, was a security ally; in contrast, Chinese policymakers should be more strict about corporate nationality because the U.S., also their primary technological source, is a geopolitical rival.

## China Case (2006-2020)

The hybridization of innovation has added an intriguing twist to China's quest for technological leadership. Even as China seeks to reduce its reliance on foreign technology, hybrid firms like Alibaba drive many of its advances in high-tech industries. In contrast to Japan's experience, China's technological rise has taken place in a world of globalized innovation.[54]

Concretely, China's push for indigenous innovation has been intermingled with two features of globalization. First, China is a key node in the circulation of scientific and technical human capital, which has intensified in recent decades. Based on the 2015/2016 update of the Database on Immigrants in OECD Countries, China has the second largest high-skilled diaspora in the OECD area, with 2 million tertiary-educated migrants.[55] Sea turtles [*haigui*], a Chinese slang term for overseas returnees, have started and led many of China's most notable technology companies, including Baidu, ByteDance, Ctrip, Didi, Meituan, and Xiaomi.[56]

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[53] Moran 1990, 44.
[54] The case analysis starts with the year 2006 for two reasons. First, by this time, we should expect the hybridization of innovation to influence policymakers' assessments of foreign technology dependence. Second, in 2006, China launched a national plan for science and technology development that set out clear measures for indigenous innovation.
[55] d'Aiglepierre 2020.
[56] https://nextbn.ggvc.com/podcast/s1-ep-33-chinese-overseas-returnees-hai-guis-opportunities-and-challenges/.

Second, enhanced cross-border financial flows between emerging and developed markets have also supported China's technological rise. From 2015 to 2017, China was the second largest recipient of inbound FDI.[57] The surge of U.S. investment into China has been especially striking. U.S. FDI into Chinese industries increased from an annual average of $4.82 billion in the 1990-2005 period to an annual average of $13.85 billion in the 2006-2020 period.[58] These two trends feed into each other. Research on Shanghai semiconductor design firms, for example, has found that high-skilled returnees are more likely to join firms with foreign investors.[59]

If my theory holds for China in this period, the case analysis should support the following observable implications. First, the main firms that present "who is us" challenges should be hybrid firms in the Corporation C model, as opposed to local branches of MNCs or other firms connected to other trends in the global economy such as the globalization of production. When confronted with these hybrid firms, the Chinese government should tolerate an extended "gray zone" between purely domestic and purely foreign companies. Second, even in strategic IT sectors, it should become increasingly common for Chinese bureaucrats to view a firm as either "foreign" or "domestic" depending on the specific context. Lastly, the Chinese government should face significant challenges with establishing clear definitions and indicators of indigenous innovation.

## Hybrids and China's VIE structure

The Variable Interest Entity (VIE) is one of the clearest examples of China's acceptance of an extended gray zone between domestic and foreign entities in indigenous innovation. This investment structure functions as a loophole that allows foreign entities to channel capital into Chinese companies in industries where the government restricts foreign capital. Essentially, the

[57] Woetzel et al. 2019.
[58] Author's calculations based on data from the U.S.-China Investment Project.
[59] Kenney et al. 2013.

Chinese firm registers a shell company in an offshore financial center like the Cayman Islands, into which the foreign investors funnel funds. This shell company controls the China-based entity via a web of contracts.[60]

First pioneered by Sina, the Chinese internet company that owns Weibo (China's Twitter), basically all successful Chinese internet firms, including Baidu, Alibaba, and Tencent (the BAT companies), have used the VIE structure to get foreign venture capital backing.[61] In 2011, China's central bank asked companies seeking licenses for providing mobile payment services to disclose whether foreign investors exerted control over their companies. Among the group of 27 companies that obtained licenses, including Alibaba's Alipay, about half used the VIE model.[62]

To more comprehensively gauge the prevalence of the VIE structure in China's internet sector, as well as this sector's "hybrid-ness," I analyzed the 100 top internet companies in China.[63] With the help of a research assistant, I collected data on these firms' foreign investment flows, use of business structures that facilitate foreign ownership, and nationality of senior management personnel — sourced from Bureau van Dijk's Orbis database.[64] In total, 49 out of China's top 100 internet companies employed a VIE structure; all of the top ten companies employ or used to employ VIE structures. Many of these firms also employed least one non-Chinese director at the senior management level: in the total sample, 33 companies qualified; among the top 50 companies, more than half were hybrids.

Throughout this period, there were consistent reports that proclaimed the impending demise of VIEs as China tightened its grip over foreign investment. If the Chinese government closed the VIE loophole, in line with the expectations of many scholars and commentators, then this would

[60] Zhao 2022.
[61] Zhou et al. 2016, chapter 3.
[62] Wang et al. 2011.
[63] This is based on the Internet Society of China's 2022 ranking.
[64] For a detailed description of the methodology, see supplementary appendix A.

undermine my argument. As one expert recently noted, "Pretty much every year for the last ten years, lawyers, analysts and experts have been predicting that a new structure will eventually replace the VIE, and that the Chinese government will have to clarify its stance instead of keeping mum."[65] Yet, even though it is "well aware of this aggressive penetration of foreign capital into its web market," the Chinese state continues to turn "a blind eye" toward the VIE loophole.[66] Prognosticators of the VIE's death overlook a key precept: rising powers in a world of hybridized innovation have to live in zones of ambiguity.

## Shifts in Corporate Nationality Based on Context

The semiconductor industry, a domain where China is especially dependent on foreign suppliers, further illustrates how the Chinese government has struggled to define which firms fall under the banner of indigenous innovation. Over the past two decades, despite the Chinese government's financial support for state firms, the most successful firms have been in the Corporation C mold, or what Douglas B. Fuller calls "hybrids": companies that are based in China but heavily rely on foreign investors and leadership (often ethnic Chinese with citizenship abroad).[67] These hybrids thrived because they could assimilate into China's innovation system and also access international resources, including financial discipline from offshore investors.[68]

For instance, China's leading chipmaker, Semiconductor Manufacturing International Corporation (SMIC), was founded by an American citizen, largely managed by Taiwanese engineers, and incubated with venture capital from Silicon Valley.[69] Among industry circles, it is well-understood that most semiconductor manufacturing companies are "Mainland skin and Taiwan

[65] Ma 2022.
[66] Shen 2017.
[67] Fuller 2016.
[68] Fuller 2016.
[69] Zhou et al. 2016, chapter 7; Nystedt 2005.

bones [*lupi taigu*]." "It's just that SMIC is the most obvious manifestation," notes one Caixin report. "Foreign employees account for nearly 80% of the middle and senior management team."[70]

How did Chinese bureaucrats determine whether these hybrids belonged to the indigenous innovation system? On the one hand, Chinese leaders perceived that these firms had strong attachments to the Chinese economy, shaped partially by ethnic ties. This made hybrids different from MNCs, which were sometimes viewed as not contributing to capacity development in local ecosystems.[71] According to related studies of Chinese returnee-run business in the IT sector, such firms are regarded as more patriotic and more trustworthy than MNCs.[72]

These hybrids have also earned government backing because they play an essential role in the broader industrial ecosystem. China hopes to domestically produce 70 percent of the chips it uses by 2025, a goal that will be impossible to meet without enhanced capacity from foreign-owned firms.[73] Local and regional government openness to foreign investments in China-based hybrids extends beyond the semiconductor industry, as these officials are incentivized to meet policy targets connected to overall industrial output.[74] These incentives, according to Fuller, have "promoted the firms most capable of IC industrial development *despite the political suspicion in which they are held*."[75]

On the other hand, the foreignness of hybrids still limits the degree to which Chinese bureaucrats can trust them. During leadership disputes within SMIC, for instance, state-affiliated actors have called attention to some managers' Taiwanese or Taiwanese American identity to push their preferred candidates.[76] In an oral history, Chiang Shang-yi, a former SMIC board member,

[70] Zhu 2011. Author's translation.
[71] Fuller 2016.
[72] Ye 2014.
[73] Segal 2021.
[74] Chen 2018, chapter 3.
[75] Fuller 2019, 301. Emphasis mine.
[76] Zhu 2011.

recalls that the Chinese government distrusted him because "this guy's not only Taiwanese, he's also [a] U.S. citizen."[77]

Additionally, the Chinese government has tried to undercut the foreign financial backing of these hybrids. In 2008, Datang, a state-owned enterprise (SOE), secured government backing to purchase a substantial stake in SMIC.[78] State funds have also supported efforts to de-list hybrid firms from international exchanges.[79] As Fuller concludes, "China's technonationalist ambitions for this sector fit uncomfortably with the existence and prominence of hybrid firms."[80]

Recent U.S. chip export controls have further exposed this tension between the Chinese semiconductor industry's reliance on hybrid firms and China's drive for self-sufficiency. In October 2022, the U.S. announced a rule that restricts U.S. persons from working at China-based semiconductor fabrication plants. Aimed at hindering the Chinese military's access to chips for use in high-performance computing and AI systems, this provision only has teeth because so many Chinese semiconductor companies rely on foreign nationals in key management and engineering roles, including Chinese and Taiwanese returnees from the U.S.[81]

## Difficulties with the foreign technology dependence ratio

In pursuit of technological self-reliance, Chinese policymakers have outlined specific indicators that would substantiate the attainment of these goals. One key metric is the foreign technology dependence ratio (FTD) [*duiwai jishu yicundu*], often computed as expenditures on technology imports as a percentage of the sum of domestic R&D spending and technology import

[77] Fairbairn and Chiang 2022.
[78] Fuller 2019.
[79] Weakened hybridity could impede the success of these firms. In the past, one of SMIC's main concerns was to avoid being transformed into a company that is "strongly nationalized." Zhu 2011.
[80] Fuller 2019.
[81] Inagaki et al. 2022.

expenses.[82] China's National Medium- and Long-Term Plan (MLP) for the Development of Science and Technology (2006-2020), an ambitious science and technology plan that kickstarted China's drive for indigenous innovation, outlined a target of reducing China's FTD to 30 percent by 2020.[83]

The conceptualization and operationalization of the FTD, however, has been contested.[84] Debates over this specific indicator of technological self-sufficiency provide further evidence of how, in the eyes of Chinese bureaucrats, the bounds of which firms count as contributing to indigenous innovation are still unsettled. In deliberations over the indicator, one line of criticism centered on the question of "what is foreign technology?"[85] Critics argued that the FTD masked China's dependence on the R&D capabilities and technology transfer channels of foreign-invested enterprises (FIEs), including hybrid firms. These firms played a major role in introducing new technologies, especially in high-tech areas where they accounted for over 60 percent of technology introduction expenses and one-third of R&D expenditures in 2012.[86]

Some groups proposed revised versions of the FTD, many of which were debated in the *Forum on Science and Technology in China*, a journal hosted by the Chinese Academy of Science and Technology for Development (CASTED). Affiliated under the Ministry of Science and Technology, this think tank initially proposed the FTD indicator.[87] Fan Jianting, Associate Professor at Shanghai University of Finance and Economics, in a 2015 piece in this journal, proposed a FTD formula where the numerator included not just expenditures on technology imports but also domestic R&D expenses by foreign-invested enterprises as well as technology transfers from foreign-invested enterprises to domestically-owned enterprises (Figure 1).

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[82] Wu and Gao 2007.
[83] Chen 2018.
[84] Chen and Naughton 2016.
[85] Fan 2015; see also Wu and Gao 2007.
[86] Fan 2015.
[87] Correspondence with Cong Cao, Professor in Innovation Studies at University of Nottingham Ningbo China, 1/12/22.

$$FTD = \frac{\text{expenditures on technology imports}}{\text{expenditures on technology imports + domestic R\&D spending}}\%$$

$$FTD\ (alternative) = \frac{\text{expenditures on technology imports + domestic technology transfer value of FIEs + domestic R\&D of FIEs}}{\text{expenditures on technology imports + total domestic technology transfer value + total domestic R\&D spending}}\%$$

*Figure 1*

Likewise, a CCID report, organized by the Ministry of Industry and Information Technology, proposed an alternative FTD metric that counted assets created and transferred from foreign-owned enterprises as dependency.[88] Using this revised metric to calculate China's FTD in electronics and information industries, the CCID team found that China's dependency was above 45 percent. To these FTD detractors, foreign-invested enterprises were not "Us."

At the same time, discussions about the FTD recognized the complexity of assessing technological autonomy. One 2011 *Study Times* piece acknowledged that the degree of dependence could also be an "an important indicator to measure the ability of catch-up countries and emerging countries to absorb foreign advanced technology and integrate global innovation resources."[89] Noting that some of the strongest local innovation systems, including Shanghai, had very high FTD rates (if foreign-invested enterprises were excluded from the domestic innovation system), one *Forum on Science and Technology in China* article stated, "We should not simply equate the degree of dependence on foreign technology with the ability and effect of independent innovation, and we should not one-sidedly pursue reducing the degree of dependence on foreign technology while ignoring the essence of the overall innovation ability of technology."[90]

This is just a small sample of the disputes over calculating FTD. To provide some systematic evidence of the varied, inconsistent measurements of foreign technology dependence, I scanned

[88] CCID 2010.
[89] Guo and Zhang 2011.
[90] Liu et al. 2013.

through articles in the *Forum on Science and Technology in China* that mentioned the specific FTD indicator. Meant to be more illustrative than exhaustive, this survey found 20 different methods for calculating foreign technology dependence.[91] To demonstrate the variance across these methods, consider the range of estimates for FTD in 2011. The lowest was about 4.6 percent, while the highest registered at 41.1 percent. By one measure, China had passed its goal of reducing foreign technology dependence with flying colors; by another, it still had a long way to go.

In 2016 the Chinese government stopped using the FTD, due to its "misleading nature."[92] The FTD indicator was established in the backdrop of continuing globalization, as financial and human capital flows became increasingly important channels of international technology transfer. Its checkered history illustrates the challenges governments face when developing indicators to assess and measure technological dependence.

## Comparison to pre-hybridization of innovation period (1990-2005)

How did the Chinese government evaluate indigenous innovation before the hybridization of innovation took full force? During the 1980s and 1990s, China attracted very low amounts of FDI, and outbound and return flows of Chinese students and scholars were relatively limited. According to my argument, these background conditions suggest that, during this period, Chinese government assessments of foreign technology dependence should have been more stable, in the sense that they should have been less subject to varying interpretations. In particular, one source of uncertainty that frustrates such assessments — questions about "Who is Us" and corporate nationality – should not have been as salient.

[91] See supplementary appendix B for details on the dataset that collects all 20 FTD estimation methods.
[92] This is based on Sun and Cao 2021, which cites a private communication with an analyst at a Ministry of Science and Technology think tank.

In the 20th century's last decades, large state-supported enterprise groups concentrated their investments in key sectors such as aerospace, electronics, and power generation. As evidenced by a State Council directives in 1991 and 1997 that identified 120 such groups to "steadily occupy and increase share of international markets so as to become the major force,"[93] Chinese industrial policy during this period facilitated the development of an "indigenous national team" of large enterprise groups, which accounted for over 35 percent of China's total industrial output by 2000.[94]

Evidence from the computer industry, which rose in strategic importance during this time, provides a more detailed view of how China gauged foreign technology dependence.[95] Reflecting the government's concerns about dependency in this domain, China's Ninth Five-Year National Development Plan (1996-2000) outlined a goal to develop two or three domestic computer manufacturing enterprises with over $1 million in annual production capacity.[96] The Center for Computer and Microelectronics Industry Development (CCID), an influential think tank affiliated with the Ministry of Information Industry, tracked China's domestic production and imports of personal computers.[97] According to CCID data, between 1991 and 1997, the share of domestic producers in the personal computer market increased from below 30 percent to 67 percent.[98]

Overall, the Chinese government could clearly delineate between domestic and foreign companies in the computer industry. The identifying characteristics of China's four largest enterprise groups in this industry – Stone, Legend, Founder, and China Great Wall Computer — support this claim. These companies were the clear forerunners in their respective specializations. For example, Stone held 80 percent of the Chinese word processor market, and Legend was the largest personal

[93] Sutherland 2003, 52-53.
[94] Sutherland 2003.
[95] Sutherland 2003; Lu 2000.
[96] Boulton et al. 2000.
[97] Lu 2000, 89.
[98] Lu 2000, 2.

computer maker in China.[99] All four raised start-up funds from government sources, and their founding teams came from SOEs or state research institutions.[100]

To the Chinese government, the dividing line between "us" and "them" was clearly drawn. In 1996, China's State Economic and Trade Commission chose Founder as one of six companies for priority development of key technologies.[101] Categorized as SOEs, Founder, Legend, and Great Wall belonged to the aforementioned "national team" of 120 enterprise groups. As for Stone, it was a collectively owned enterprise but this arrangement was a form of "quasi-state-ownership." For instance, when a Stone subsidiary listed on the Hong Kong Stock Exchange, government regulators required that the Stone Group keep control of certain assets.[102]

These trends extended to other strategic sectors. In the semiconductor industry, the Chinese government outlined self-sufficiency benchmarks, including a target for five key enterprises to fulfill over 60 percent of China's domestic sales by 1995.[103] At this time, the Chinese firm with the most advanced technology in the late 1980s, Huajing, was an SOE.[104] During the 1990s, the Chinese government initiated Project 908, an industrial policy that aimed to cultivate Huajing into a leading semiconductor firm. Five years later, after implementation delays with Project 908, the Chinese government put its support toward another SOE, Huahong, which was controlled by the Ministry of Information Industry's China Electronics Corporation.[105]

Notably, Chinese government actors could still make clear determinations of foreign dependence in critical technology sectors, even amidst other globalizing forces. During this period, the Chinese government opened up these markets to global competition by significantly reducing

[99] Lu 2000.
[100] Kennedy 1997.
[101] Sutherland 2003.
[102] Lu 2000, 53, 57.
[103] Mays 2013, 99.
[104] Mays 2013, 74
[105] Fuller 2019, 267-268.

import duties, and Chinese firms aggressively pursued joint ventures with foreign partners.[106] As the aforementioned semiconductor firms illustrate, though Huajing and Huahong both partnered with international firms in joint ventures, policymakers concerned about foreign technology dependence could assuredly consider them as domestic firms.

Finally, this analysis does not aim to prove that indicators of foreign technology dependence were immaculate. In a practice known as "round-tripping," Chinese firms would route funds through shell vehicles in Hong Kong to capitalize on benefits given to FIEs.[107] If not properly accounted for, these "fake FIEs" could skew measures of indigenous innovation. Relatedly, some domestic production estimates mistakenly included "gray market" computers, which were produced by foreign firms but sold as domestic products to avoid import duties.[108] In illustrating this paper's central argument, what stands out is that these complications did not manifest from uncertainty over corporate nationality.

## Japan Case (1970-1990)

Following its post-war recovery, Japan's economy registered impressive growth rates in high-technology sectors, bolstered in part by the government's commitment to nurturing technological autonomy.[109] Japanese firms gained competitive advantages in semiconductors, consumer electronics, and computers. According to one U.S. interagency estimate, based on data covering 1980 to 1987, the U.S. lost the lead to Japan in more than 75 percent of key semiconductor technologies.[110]

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[106] Hui and McKown 1993, 14; Kraemer and Dedrick 2001.
[107] Huang 2003, 35-41.
[108] Hui and Mckown 1993.
[109] Samuels 1994. I chose to analyze the 1970-1990 period because it covers two decades when Japan was growing into a major technological power, before the hybridization of innovation.
[110] National Science Foundation 1987.

Crucially, Japan's technological rise occurred *before* the hybridization of innovation became an essential element of the global economy. Prior to 1990, newly industrialized countries attracted a very low portion of global FDI stock; more broadly, the global ratio of foreign-owned assets to GDP was less than 10 percent; since then, that figure has increased to nearly 200 percent.[111] The transnational technical communities that connected high-skilled immigrants with their home countries were still embryonic, as evidenced by statistics on highly-educated migrants in the OECD and demographic data on engineers in key clusters like Silicon Valley.[112]

Thus, Japan was relatively insulated from globalized flows of financial investment and high-skilled human capital. Japan's annual inward FDI flows were very low during this period, averaging less than 1 percent of GDP throughout the 1980s.[113] In addition, its diaspora played a minimal role in its economic development. Many Japanese abroad only maintained limited contact with their home country, and most returnees in this period were low-skilled workers.[114]

Given this global landscape, we should expect Japan's assessments of indigenous innovation to be relatively fixed, in the sense that they are less likely to be manipulated into varying readings. The case evidence should also demonstrate that the Japanese state's evaluations of corporate nationality do not change based on context. Taken together, it should have been easier for the Japanese government to assess foreign technological dependence.

During this period, Japanese bureaucrats consistently tracked levels of foreign dependence in science and technology. Japan's Science and Technology Agency regularly assessed foreign technology dependence in a series of periodic reports, including: the "White Paper on Science and Technology" (*Kagaku gijutsu hakusho*), "Indicators of Science and Technology" (*Kagaku gijutsu yoran*),

[111] Farrell et al. 2008, 73.
[112] Kerr et al. 2016.
[113] Fukao and Paprzycki 2008.
[114] Kuroda et al. 2018.

and "Science and Technology Indicators" (*Kagaku gijutsu shihyo*).[115] Across many key industries, Japanese policymakers reported a domestic production ratio (*kokusanka*). In satellites and launch vehicles, for instance, the Japanese government set targets for replacing foreign content with indigenous technology.[116]

What is noteworthy is not Japan's performance on these indicators but rather the clarity and consistency of the indicators themselves. They were not subject to widely varying interpretations. This is not to say that these metrics were perfect. One flaw of domestic production ratios, for instance, was that they only evaluated first-tier manufacturers; in some cases, a deeper investigation of second-tier and third-tier suppliers would have shown that such indicators underestimated foreign technology dependence.[117] Still, these deficiencies were not tied to fundamental disputes over what constituted indigenous innovation.

Japan's assessments of foreign technology dependence were relatively unburdened by issues of corporate nationality. Consider the "Big Five" major electronics companies – Fujitsu, Hitachi, Mitsubishi, Nippon Electric (now known as NEC), and Toshiba – which were tasked by MITI to lead the Very Large Scale Integrated Semiconductor project, an important consortia that spurred the Japanese semiconductor industry in the 1980s. Throughout the period covered in this case, Japanese stakeholders owned and controlled all five companies, with many organized as conglomerate structures controlled by groups of wealthy Japanese families.[118]

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[115] Nakajama and Ojima 2002.
[116] Lee 2000, 100. Mastanduno 1991, 95-96. Notably, some of the technological self-sufficiency indicators were omitted from the official English translations of Japanese reports. Samuels 1994, 352fn53. I am grateful to Dick Samuels for his insight on these reports.
[117] Correspondence with Seungjoo Lee, Professor at Chung-Ang University (Seoul, Korea), 3/22/23. See also Lee 2000.
[118] Interestingly, before World War II, U.S. firms owned substantial shares of Japanese companies. As Koji Kobayshi, former CEO of NEC, states, "We must remember that NEC was born in the globalization process of Western Electric of the United States." Aspray 1993.

This trend extended beyond the electronics giants. According to data collected by University of Tokyo researcher Hiroaki Yamazaki from official yearbooks, of the 50 Japanese firms with highest net profits, there were no foreign-controlled firms in 1955, and only 1 in 1973 and 1984 (IBM Japan).[119] Furthermore, Japanese policymakers could make clear determinations of corporate nationality based on the leaders of these firms. One study of Japanese corporate governance finds that, before 1990, leadership positions on the board of directors for large Japanese firms were "occupied exclusively by Japanese nationals."[120] As Heginbotham and Samuels summarize, "The Japanese know exactly 'who is us,' and prefer to trade with (and transfer technology among) co-nationals."[121]

Can Japan's ideology of technological development explain its ability to clearly differentiate between "us" and "them" in assessing dependence? According to this view, the nature of the global economy – specifically, the absence of hybridization of innovation during this period – had little bearing. Instead, the outcome of this case could be explained by Japan's restrictions on FDI, as well as other policies that reinforced its commitment to technological autonomy as a guiding principle of national strategy.[122]

There is evidence, however, that suggests Japan's protectionist policies were contingent on the character and extent of globalization, not intrinsic to its domestic context. As the hybridization of innovation progressed, Japan relaxed its technonationalist commitments. Beginning in the early 1990s, the Japanese government actively promoted greater inward FDI.[123] In the late 1990s, the Japanese government opened up several R&D programs to allow participation by foreign firms and

[119] Yamazaki 1988.
[120] Schmid and Roedder 2021.
[121] Heginbotham and Samuels 1998, 200.
[122] Mason 1992.
[123] Paprzycki and Fukao 2008.

research institutions.[124] The Japanese government has also tried to boost international mobility and exchange as a way to overcome the "inward tendency" of Japanese students.[125]

These adjustments resulted in substantial changes in the Japanese economy. Soon after FDI reforms, foreign entities took controlling stakes in prominent Japanese companies, including Nissan, Japan Telecom, and Long Term Credit Bank.[126] According to two economists at Hitotsubashi University, "FDI flows into Japan during 1999 and 2000 combined outstripped the cumulative total of the three preceding decades."[127] From 1981 to 1995, the number of Japanese international students in the U.S. more than tripled.[128]

To be sure, the Japanese government's approach to assessing foreign technological dependence was influenced by shifts in technonationalist ideology and policies. Yet, global economic dynamics also compelled Japanese policymakers to loosen their technonationalist principles. It is not a coincidence that the timing of the aforementioned reforms coincided with that of the hybridization of innovation.[129] While pressure from foreign governments, demographic changes, and economic slowdown all contributed to Japan's decision to relax foreign capital controls, another key underlying factor was the growing awareness by Japanese leaders that it needed to embrace globalization to sustain future growth.[130] Indigenous technology development was still possible but, in a world of globalizing technology flows, it was becoming too costly.[131]

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[124] Yamada 2000.
[125] Kuroda et al. 2018.
[126] Midford 2013.
[127] Paprzycki and Fukao 2008, 2.
[128] Author's calculations based on Digest of Education Statistics (Snyder et al. 2018, 473).
[129] Paprzycki and Fukao 2008, 6
[130] Green and Samuels 1994.
[131] Green and Samuels 1994.

## India Case (2003-2020)

In 2020, India drafted a new Science and Technology Innovation Policy (STIP), which lays out a goal to "achieve technological self-reliance and position India among the top three scientific superpowers in the decade to come."[132] The STIP's emphasis on developing indigenous technologies was not surprising, given that India's prioritization of technological self-sufficiency has endured from its independence through to current Prime Minister Modi's "Atmanirbhar Bharat" (self-reliant India) campaign.[133] As Aradhna Aggarwal, Professor in Indian Business Studies at Copenhagen Business School, writes, "One such buzzword that has come to dominate the development policy landscape in India is self-reliance."[134]

India's pursuit of technological self-reliance has taken place alongside the hybridization of innovation. In 2020, driven by increased investment in the information and communication technology domain, India became the fifth largest recipient of FDI inflows in the world.[135] India also draws on the largest highly-educated diaspora based in the OECD area.[136] Saxenian's work details the connection between Indian nationals in Silicon Valley and tech startups in India: these returnees can effectively manage such startups by mobilizing U.S. venture capital funds and professional networks.[137]

If my argument extends beyond China's indigenous innovation drive, the case analysis should demonstrate that hybrid firms in the Corporation C mold presented substantial difficulties for India's efforts to assess foreign technology dependence. Evidence from this case should also

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[132] Ministry of Science and Technology 2020.
[133] By 2003, enough time had passed for the hybridization of innovation's theorized effects to take shape, and this year marked India's "Science and Technology Policy 2003," which laid out a series of technological self-sufficiency indicators.
[134] Aggarwal 2022.
[135] The Economic Times 2021.
[136] d'Aiglepierre et al. 2020.
[137] Saxenian 2005.

show that evaluations of technological self-reliance were easily molded into competing meanings. Like the China case, when it comes to distinguishing domestic and foreign companies in pushing forward indigenous innovation, the Indian government should have accepted a wide "in-between" zone.

Corporation C exists in India. Mphasis, one of India's largest IT companies, is headquartered in Bangalore and employs over 28,000 workers in its offices around India. At the same time, the company is controlled by foreign investors, including the U.S. investment management firm Blackstone, and was founded by Jerry Rao, who studied and worked in the U.S. before returning to India. India's pursuit of indigenous innovation depends on firms like Mphasis, which ranked as one of the top three private enterprises by R&D spending in 2017.[138]

Mphasis stands in for the broader hybridization of India's high-tech industries. Employing a method similar to the one used for identifying hybrid firms in China, I scanned a list of twenty leading IT services companies in India, released by India's technology industry association Nasscom.[139] Reflecting the penetration of foreign investment in this sector, eleven out of the twenty top firms were foreign-owned. Take Infosys, one of those nine firms, as an example. Though it is often seen as a "large and visibly Indian company," foreign investment institutions own 45 percent of its shares traded on Indian markets, and an additional one-fifths of its shares are traded on the NASDAQ exchange, which means that foreign investors own about 65 percent of Infosys.[140]

These Corporation-C firms have roots in the globalization of talent flows. Based on 2000 Nasscom data, former Indian residents in the U.S. founded or led 10 of the 20 most successful software firms in India.[141] That trend has held, and possibly even intensified, over the period

[138] Mani 2020.
[139] Supplementary appendix C provides details on this data collection effort.
[140] Rastogi and Pradhan 2011.
[141] Pande 2014.

covered in this case, as 2012 Nasscom figures show that 12 out of the top 20 IT firms were managed or founded by returning Indian expatriates.[142]

In light of the above trends, how does the Indian government define and measure technological self-reliance? As expected, the hybridization of innovation has complicated this process. Krzystof Iwanek, an expert on Hindu nationalism, identifies two interpretations of a key concept, *swadeshi*, which generally refers to insulating domestic products and firms from foreign competition. However, a reinterpretation of *swadeshi*, which has gained ground in policy circles in recent years, points out that supporting Indian companies does not necessitate limitations on FDI.[143]

To get a better sense of these debates, I reviewed over thirty-five articles published in *Economic and Political Weekly*, an influential publication that features commentaries from India's leading researchers and policymakers. In a series of articles about India's foreign technology dependence, Gautam Navlakha, this publication's longtime editorial consultant, questioned the widening gray zone over what constitutes indigenous innovation, citing the "definitional dilution" of "Make in India" provisions, which allows foreign-controlled entities that source from the domestic market to qualify as Indian vendors.[144] Navlakha states, "If the definition of 'indigenous' is made malleable…the very idea of self-reliance gets nullified."[145] In another article, Aggarwal comes to a similar conclusion about India's quest for technological self-reliance: "Its actual meaning is elusive and 'contested'...It is floating free of concrete objectives, indicators, and targets."[146]

While both India and China are rising powers concerned about the level of technological self-sufficiency in their emerging economies, they diverge in many crucial aspects. Comparative studies have found that, due in part to differences in diaspora interactions, India has been less

[142] Pande 2014.
[143] Iwanek 2020.
[144] Navlakha 2017.
[145] Navlakha 2016.
[146] Aggarwal 2022.

successful at integrating into global production networks and attracting FDI.[147] Since India is not as connected to global innovation systems as China, one might expect that this article's arguments may be less relevant, if at all. Yet, this case study illustrates that India's efforts to benchmark indigenous innovation are still influenced by the hybridization of innovation, suggesting that the theory extends beyond just China.

# IV. Conclusion

Focused on sustaining their rise, yet worried about dependence on others, rising powers have always sought domestic sources of technological innovation. In recent decades, however, the hybridization of innovation — marked by increased cross-border financial flows and expanded mobility of high-skilled workers — has fostered hybrid firms that present a new challenge to emerging economies' ability to measure independent innovation. This article has demonstrated that, compared to their predecessors which confronted other types of globalization, rising powers today adopt more malleable boundaries for the corporate actors included within indigenous innovation because their technology ecosystems are more reliant on transnational technical communities and foreign direct investment. Case studies of how policymakers evaluated independent innovation in China, India, and Japan provide empirical support for the theory. These comparisons, across time and between states, illustrate how structural changes in the global economy have made it more difficult for rising powers to assess their foreign technology dependence.

It is important to note the limitations of my argument. I do not thoroughly investigate the mechanisms by which the hybridization of innovation complicates the assessment of foreign technology dependence, but future research could unpack the agency of hybrid firms by studying how they play up their domestic and foreign ties in different contexts. Additionally, careful observers

[147] Ye 2014.

might note that the hybridization of innovation is waning, citing the intensifying U.S.-China rivalry and actions by some rising powers to nationalize hybrid firms and encourage their delisting from global exchanges.[148] First, it is too early to write off this form of globalization; as the China case illustrates, the death of the hybrid-enabling VIE structure has been declared too many times to count, and yet it endures. Second, even if some states pull back from accepting hybrid firms, my theory suggests that, without these firms as linchpins of dynamic, strategic industries, those states will retain less competitive innovation ecosystems.

This article also paves the way for future work on globalization and the assessment of technological dependence in other countries. My theory is most applicable to emerging economies, which are more dependent on foreign investment and returnee entrepreneurs than advanced ones. I also expect my theory to hold in countries that have embraced foreign investment and brain circulation. In addition, the arguments advanced in this article are most relevant for countries that face high levels of geopolitical threat, which drives concerns about technological self-sufficiency. Lastly, these dynamics are more likely to be at work in larger countries that possess the economic size to reasonably pursue technological autonomy. Based on these conditions, the five countries that are most likely to face similar dynamics as China are: Egypt, India, Mexico, Russia, and Turkey.[149] While this article's preliminary analysis of the India case does suggest that the argument travels to these other contexts, further investigation is required.

Much ink has been spilled on U.S.-China decoupling and the grand strategies of rising powers to achieve technological autonomy. Yet, after the flashy announcements, the implementation of these megatrends and policies rest on a critical, understudied variable: how states assess foreign technology dependence in the first place. Also, beyond the headlines, almost unnoticed, the global

[148] On the China's increasingly "securitized" approach to economic governance, see Pearson et al. 2022.
[149] Supplementary appendix D details how I picked out these five countries, including the operationalization and indicators for the scope conditions.

flow of capital, ideas, and peoples continues — albeit in a different form than previous iterations. When connected together, these two threads resurface a question that is at the heart of international politics: Who is Us?

# References


Aggarwal, Aradhna. "Export Performance and India's Tryst with Self-Reliance in the Globalised World." *Economic and Political Weekly* 57, no. 4 (2022): 55–62.

Aiglepierre, Rohen d', Anda David, Charlotte Levionnois, Gilles Spielvogel, Michele Tuccio, and Erik Vickstrom. "A Global Profile of Emigrants to OECD Countries: Younger and More Skilled Migrants from More Diverse Countries," 2020.

Beckley, Michael. "The Power of Nations: Measuring What Matters." *International Security* 43, no. 2 (November 1, 2018): 7–44. https://doi.org/10.1162/isec_a_00328.

Brooks, Stephen G. *Producing Security: Multinational Corporations, Globalization, and the Changing Calculus of Conflict*. Princeton, NJ: Princeton University Press, 2005.

CCID. "Research on the Current Dependence of China's Electronic Information Industry on Foreign Technology and Its Technological Innovation Strategy." CCID, 2010.

Chen, Ling. *Manipulating Globalization: The Influence of Bureaucrats on Business in China*. Redwood City, UNITED STATES: Stanford University Press, 2018. http://ebookcentral.proquest.com/lib/gwu/detail.action?docID=5347142.

Chen, Ling, and Barry Naughton. "An Institutionalized Policy-Making Mechanism: China's Return to Techno-Industrial Policy." *Research Policy* 45, no. 10 (December 1, 2016): 2138–52. https://doi.org/10.1016/j.respol.2016.09.014.

Christensen, Thomas J. "Mutually Assured Disruption: Globalization, Security, and the Dangers of Decoupling." *World Politics*, 2024. https://muse.jhu.edu/pub/1/article/918726.

De Backer, Koen, and Norihiko Yamano. "The Measurement of Globalisation Using International Input-Output Tables." OECD, 2007.

Fan, Jianting. "How to Understand and Measure Foreign Technology Dependence under Open Economy." *Forum on Science and Technology in China*, 2015.

Farrell, Diana, Susan Lund, Christian Fölster, Raphael Bick, Moira Pierce, and Charles Atkins. "Mapping the Global Capital Markets: Fourth Annual Report." McKinsey Global Institute, January 1, 2008. https://www.mckinsey.com/industries/private-equity-and-principal-investors/our-insights/mapping-global-capital-markets-fourth-annual-report.

Farrell, Henry, and Abraham L. Newman. "Weaponized Interdependence: How Global Economic Networks Shape State Coercion." *International Security* 44, no. 1 (July 1, 2019): 42–79. https://doi.org/10.1162/isec_a_00351.

Friedberg, Aaron L. *The Weary Titan: Britain and the Experience of Relative Decline, 1895-1905*. Princeton, N.J.: Princeton University Press, 1988.

Fuller, Douglas B. "Growth, Upgrading, and Limited Catch-Up in China's Semiconductor Industry." In *Policy, Regulation and Innovation in China's Electricity and Telecom Industries*, edited by Loren Brandt and Thomas G. Rawski, 262–303. Cambridge: Cambridge University Press, 2019. https://doi.org/10.1017/9781108645997.007.

———. *Paper Tigers, Hidden Dragons: Firms and the Political Economy of China's Technological Development*. Oxford University Press, 2016.

Gereffi, Gary. "Global Value Chains in a Post-Washington Consensus World." *Review of International Political Economy* 21, no. 1 (January 2, 2014): 9–37. https://doi.org/10.1080/09692290.2012.756414.

Gilpin, Robert. *France in the Age of the Scientific State*. Princeton, NJ: Princeton University Press, 1968.

Green, Michael J., and Richard J. Samuels. "Recalculating Autonomy: Japan's Choices in the New World Order." *The National Bureau of Asian Research* 5, no. 4 (1994): 5–22.

Guo, Tiecheng, and Chidong Zhang. "How Much Does China Depend on Foreign Technology?." *Study Times*, November 14, 2011.

Hao, Ni. "Is Alibaba a Chinese or Foreign Company? Jack Ma Is Also Confused." *Global Times (环球时报)* (blog), March 4, 2015.

Heginbotham, Eric, and Richard J. Samuels. "Mercantile Realism and Japanese Foreign Policy." *International Security* 22, no. 4 (1998): 171–203. https://doi.org/10.2307/2539243.

Hsueh, Roselyn. *China's Regulatory State: A New Strategy for Globalization*. Ithaca, UNITED STATES: Cornell University Press, 2011. http://ebookcentral.proquest.com/lib/gwu/detail.action?docID=3138246.

———. *Micro-Institutional Foundations of Capitalism*. Cambridge University Press, 2022.

Huang, Yasheng. *Selling China: Foreign Direct Investment during the Reform Era*. Cambridge University Press, 2003.

Hui, Saiman, and Hilary B. McKown. "China Computes: From Corporate Giants to Individual Hackers, Chinese Purchasers Are Eager to Buy." *China Business Review* 20 (1993): 14–14.

Iwanek, Krzysztof. "No, the 'Self-Reliant India Campaign' Is Not About Protectionism." *The Diplomat* (blog), June 23, 2020. https://thediplomat.com/2020/06/no-the-self-reliant-india-campaign-is-not-about-protectionism/.

Jones, Geoffrey. "Nationality and Multinationals in Historical Perspective." Harvard Business School, 2006. https://www.academia.edu/download/35087188/Nationality_and_Multinationals06-052.pdf.

Kennedy, Andrew. *The Conflicted Superpower America's Collaboration with China and India in Global Innovation*. Columbia University Press, 2018.

Kennedy, Scott. "The Stone Group: State Client or Market Pathbreaker?" *The China Quarterly* 152 (December 1997): 746–77. https://doi.org/10.1017/S0305741000047548.

Kenney, Martin, Dan Breznitz, and Michael Murphree. "Coming Back Home after the Sun Rises: Returnee Entrepreneurs and Growth of High Tech Industries." *Research Policy* 42, no. 2 (March 1, 2013): 391–407. https://doi.org/10.1016/j.respol.2012.08.001.

Kerr, Sari Pekkala, William Kerr, Çağlar Özden, and Christopher Parsons. "Global Talent Flows." *Journal of Economic Perspectives* 30, no. 4 (November 2016): 83–106. https://doi.org/10.1257/jep.30.4.83.

Kraemer, Kenneth L., and Jason Dedrick. "Creating a Computer Industry Giant: China's Industrial Policies and Outcomes in the 1990s." Center for Research On Information Technology and Organizations, 2001.

Lee, Seungjoo. "Technological Change, Sectoral Institutions, and Policymaking: Japanese Responses to United States Pressure in High Technology Industries." Ph.D., University of California, Berkeley, 2000. https://www.proquest.com/docview/249984942/abstract/65DFC9EC4B974C16PQ/1.

Lind, Jennifer, and Daryl G. Press. "Markets or Mercantilism? How China Secures Its Energy Supplies." *International Security* 42, no. 4 (2018): 170–204.

Liu, Jun, Li Wei, and Zhang Honghui. "Calculative and Comparative Research on Foreign Technology Dependence of High-Tech Industries in Regions." *Forum on Science and Technology in China*, April 2013.

Lu, Qiwen. *China's Leap into the Information Age: Innovation and Organization in the Computer Industry*. Oxford University Press, 2000. https://doi.org/10.1093/acprof:oso/9780198295372.001.0001.

Lund, Susan, Eckart Windhagen, James Manyika, Philipp Härle, Jonathan Woetzel, and Diana Goldshtein. "The New Dynamics of Financial Globalization." McKinsey Global Institute, 2017.

Lynn, Leonard H. "Japanese Technology at a Turning Point." *Current History* 84, no. 506 (1985): 418–32.

Ma, Rui. "The Bearish View on VIEs." Tech Buzz China, November 12, 2022.

Mani, Sunil. "India's Quest for Technological Self-Reliance." Kerala, India: Center for Development Studies, August 2020.

Mastanduno, Michael. "Do Relative Gains Matter? America's Response to Japanese Industrial Policy." *International Security* 16, no. 1 (1991): 73–113. https://doi.org/10.2307/2539052.

Mays, Susan K. "Rapid Advance: High Technology in China in the Global Electronic Age - ProQuest." PhD Thesis, Columbia University, 2013. https://www.proquest.com/openview/47a379c26e83b91d6b0486f4f59ce981/1?pq-origsite=gscholar&cbl=18750.

McNally, Christopher A. "Sino-Capitalism: China's Reemergence and the International Political Economy." *World Politics* 64, no. 4 (2012): 741–76.

Ministry of Science and Technology (Government of India). "Science, Technology, and Innovation Policy," December 2020. https://dst.gov.in/sites/default/files/STIP_Doc_1.4_Dec2020.pdf.

Moran, Theodore H. "The Globalization of America's Defense Industries: Managing the Threat of Foreign Dependence." *International Security* 15, no. 1 (1990): 57–99. https://doi.org/10.2307/2538982.

———. *Three Threats: An Analytical Framework for the CFIUS Process*. Vol. 89. Peterson Institute, 2009.

Nakajama, Shinobu, and Norio Ojima. "Comparison of Science and Technology Indicator Systems with Their Historical Development." National Institute of Science and Technology Policy, 2002.

Nanda, Ramana, and Tarun Khanna. "Diasporas and Domestic Entrepreneurs: Evidence from the Indian Software Industry." *Journal of Economics & Management Strategy* 19, no. 4 (2010): 991–1012.

Navlakha, Gautam. "A Hard Look at National Security." *Economic and Political Weekly*, 2016, 32–37.

Nystedt, Dan. "CEO of Chip Maker SMIC Giving up Taiwan Citizenship | InfoWorld." *InfoWorld*, August 22, 2005. https://www.infoworld.com/article/2669221/ceo-of-chip-maker-smic-giving-up-taiwan-citizenship.html.

*Oral History of Koji Kobayashi*. Executives Oral History Project Sponsored by Center for the History of Electrical Engineering. Tokyo, 1993.

*Oral History of Shang-Yi Chiang*. Computer History Museum. Mountain View, CA, 2022.

Pande, Amba. "The Role of Indian Diaspora in the Development of the Indian IT Industry." *Diaspora Studies* 7, no. 2 (2014): 121–29.

Papayoanou, Paul A. "Interdependence, Institutions, and the Balance of Power: Britain, Germany, and World War I." *International Security* 20, no. 4 (1996): 42–76. https://doi.org/10.2307/2539042.

Pauly, Louis W., and Simon Reich. "National Structures and Multinational Corporate Behavior: Enduring Differences in the Age of Globalization." *International Organization* 51, no. 1 (1997): 1–30.

Pearson, Margaret M., Meg Rithmire, and Kellee S. Tsai. "China's Party-State Capitalism and International Backlash: From Interdependence to Insecurity." *International Security* 47, no. 2 (October 1, 2022): 135–76. https://doi.org/10.1162/isec_a_00447.

Prakash, Aseem, and Jeffrey A. Hart. "Indicators of Economic Integration." *Global Governance* 6, no. 1 (March 2000): 95.

Rastogi, Gaurav, and Basab Pradhan. *Offshore: How India Got Back on the Global Business Map*. Penguin Books India, 2011.

Reich, Robert B. "Who Is Us?" *Harvard Business Review*, January 1, 1990. https://hbr.org/1990/01/who-is-us.

Ripsman, Norrin M., and Jean-Marc F. Blanchard. "Commercial Liberalism under Fire: Evidence from 1914 and 1936." *Security Studies* 6, no. 2 (December 1, 1996): 4–50. https://doi.org/10.1080/09636419608429305.

Samuels, Richard J. *"Rich Nation, Strong Army": National Security and the Technological Transformation of Japan*. First Edition. Ithaca: Cornell University Press, 1994.

Saxenian, AnnaLee. "From Brain Drain to Brain Circulation: Transnational Communities and Regional Upgrading in India and China." *Studies in Comparative International Development* 40 (2005): 35–61.

———. *The New Argonauts: Regional Advantage in a Global Economy*. Harvard University Press, 2007.
Shen, Hong. "Across the Great (Fire) Wall: China and the Global Internet." University of Illinois at Urbana-Champaign, 2017.
Snyder, Thomas D., Cristobal De Brey, and Sally A. Dillow. "Digest of Education Statistics 2016, NCES 2017-094." National Center for Education Statistics, 2018. https://eric.ed.gov/?id=eD580954.
Sun, Yutao, and Cong Cao. "Planning for Science: China's 'Grand Experiment' and Global Implications." *Humanities and Social Sciences Communications* 8, no. 1 (September 20, 2021): 1–9. https://doi.org/10.1057/s41599-021-00895-7.
Sutherland, Dylan. *China's Large Enterprises and the Challenge of Late Industrialisation*. Vol. 5. Routledge, 2003.
Tyson, Laura. "They Are Not Us: Why American Ownership Still Matters." *The American Prospect* (blog), January 1, 1991. https://prospect.org/api/content/2b7b977c-d3dd-5918-a69e-5a976cf3ecdf/.
UNCTAD. "World Investment Report 2015." United Nations Conference on Trade and Development, 2015.
Wei, Yifan, Yuen Yuen Ang, and Nan Jia. "The Promise and Pitfalls of Government Guidance Funds in China." *The China Quarterly* 256 (December 2023): 939–59. https://doi.org/10.1017/S0305741023000280.
Wu, Ceng, and Changlin Gao. "Looking at Technological Innovation in High-Tech Industries from the Perspective of Foreign Technology Dependence." 2007.
Yamazaki, Hiroaki. "The Development of Large Enterprises in Japan: An Analysis of the Top 50 Enterprises in the Profit Ranking Table (1929-1984)." *Japanese Yearbook on Business History* 5 (1989): 12–55.
Ye, Min. *Diasporas and Foreign Direct Investment in China and India*. Cambridge: Cambridge University Press, 2014. https://doi.org/10.1017/CBO9781107286214.
Zhao, Can. "Variable Interest Entity, Offshore Domesticated Foreign Finance, and the Political Economy of China's Internet Firms: The Case of Alibaba." *Social Sciences* 11, no. 3 (March 2022): 99. https://doi.org/10.3390/socsci11030099.
Zhou, Yu, William Lazonick, and Yifei Sun. *China as an Innovation Nation*. Oxford University Press, 2016.
Zhu, Yashi. "The Endgame of Infighting at SMIC." *Caixin Magazine*, July 18, 2011.