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Innovation Drag: China's Economic Impact on Developed Nations

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An examination of the scholarly literature shows that China's mercantilist-powered economic rise and trade expansion have slowed the progress of innovation in the global economy—particularly in North America and Europe.

KEY TAKEAWAYS

- Policy debates about China's economic impact on developed nations have largely focused on jobs. But the negative impact on innovation is likely to have been even greater.
- Conventional trade theory holds that global market integration enhances welfare by increasing allocative and dynamic efficiency. But it's time for economists and policymakers to consider that mercantilist trade is different from market-based trade.
- The scholarly literature shows China's rise, backed largely by unfair, mercantilist policies, has harmed innovation in the global economy—particularly in North America and Europe.
- Mercantilist trade can reduce innovation by shrinking markets and cutting profits innovators need to invest in R&D. China exacerbates both dynamics by propping up weak competitors, closing markets, creating overcapacity, and limiting revenue.
- Especially in innovation-driven industries, mercantilist-powered trade is likely to be welfare- and innovation-reducing, not just for affected nations, but globally.

INTRODUCTION

For many years, the prevailing view—particularly among those in trade policy circles—was that the rapid growth of China's economy after it joined the World Trade Organization (WTO) in 2001 had a positive effect on developed economies. Any deleterious impacts were thought to be largely temporary and borne by only a relatively modest number of workers in particular subnational regions. But as more and better research has since been performed, it has become clear this view was overly optimistic, if not Pollyannaish, and the harms were worse than many had forecasted. To date, most of this discussion has been focused on the impact of the rise of China on jobs in Western economies. Much less attention has been given to the impacts on innovation in those economies, and even less on the impacts on global innovation writ large.

The Information Technology and Innovation Foundation (ITIF), supported by the Smith Richardson Foundation, has embarked on a year-long project to examine—and hopefully answer—this question of how China's rise and its policies, many mercantilist in nature, have affected technological innovation globally. As a first product of this research initiative, this report examines and summarizes the scholarly literature on the effect of Chinese economic growth and trade on innovation in developed economies. Here, the key question is not whether Chinese policies spur innovation in China—while there is some debate over this point, the evidence suggests they do. Indeed, how could funneling hundreds of billions of dollars in subsidies, including for research and development (R&D), and instituting policies such as providing free intellectual property (IP) to Chinese firms (via theft or forced technology transfer) not have increased Chinese innovation? The question for this project is whether that innovation success came at the expense of innovation in foreign firms and economies. While the results of a few studies suggest it was beneficial, most, including those that convincingly rebut the former studies, find the effect of Chinese economic growth and trade expansion has been negative for innovation in most developed nations—particularly in North America and Europe.

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As this report argues, this likely had less to do with China itself joining the trading system than with the nature of Chinese economic and trade policy—such as showering massive subsidies on domestic companies, manipulating its currency to gain unfair price advantage in foreign markets, and obtaining massive amounts of foreign IP without paying for it—which was extremely distortionary and unfair. These and other policies have conferred an unfair advantage to Chinese companies—which on average are significantly less innovative than their foreign competitors, the very reason China embarked on its "innovation mercantilist" efforts.[1] These "innovation mercantilist" polices have created such intense competitive pressures that many foreign companies have either closed or cut back, including on their R&D expenditures and other innovative activities.

While later reports in this series will go into more detail on industry case studies and appropriate policy responses to this unfair Chinese innovation competition, the key conclusion from this research is that the problem did not arise from deeper global integration between developed nations and low-wage nations such as China. Indeed, most studies of globalization prior to China joining WTO have found increased global integration, including with low-wage nations, actually *increased* innovation in developed economies, in part because it let their economies specialize more in innovation-based activities. Rather, the unfair competition problem stemmed—and continues to stem—from the unprecedented nature of Chinese innovation mercantilism, which, on net, has hurt innovation in affected industries and economies. And as China dramatically steps up its efforts with initiatives such as its "Made in China, 2025" plan, it will likely cause even greater harm for the overall rate of global innovation progress.

THE CONVENTIONAL ECONOMICS VIEW OF TRADE AND ECONOMIC WELFARE

Over the last decade, economists have conducted a number of studies on the relationship between trade and innovation. Most have been prompted by the "China shock": the large rise in Chinese exports in the 2000s after China joined WTO in 2001. Virtually all studies examine the period of the 2000s wherein the impact was more on traditional industries, in contrast to the last decade when China turned its focus to gaining competitive advantage in advanced industries. The studies generally look at the Chinese impact on a particular nation or region (e.g., parts of the EU) rather than on innovation globally. With a few exceptions, these studies have concluded that the effect of Chinese trade has been to reduce R&D and innovation in the impacted nations, including the United States.

Before discussing the findings of these studies, it is important to take a step back and note that most, if not all, of this work is grounded in conventional neoclassical economics and Ricardian trade theory. The latter holds that global market integration increases allocative efficiency and, as such, is welfare-enhancing. "Allocative efficiency" refers to the allocation of scarce resources in such a way that maximizes the net benefit attained through their use, while also producing the quantity and mix of goods and services that is most beneficial to society. A market economy characterized by allocative efficiency is one in which scarce goods and services are consumed on the basis of the prices consumers are willing to pay, and produced on the basis of equality between marginal cost and price. As such, according to theory, any expansion of market size, including by global trade or investment, moves both national economies and the global economy in the direction of allocative efficiency. To use Ricardo's famous example, it leads to more efficiently produced English textiles and Portuguese wine. This assumption only works when such trade is based on market—rather than mercantilist—forces.

Because, in conventional trade theory, trade is allocative-efficiency maximizing, most economists have concluded the massive surge in Chinese exports in this context boosted welfare in both China and its trading partners. In this framing, the only thing different about China's impact on trade was the speed and magnitude of the efficiency-enhancing impact, not its nature or type. As such, most scholars refer to the increase in Chinese exports in the 2000s as a "shock"—a naturally occurring phenomenon of the kind that occasionally occurs in economies, and one that, if an economy is to maximize allocative efficiency, requires negatively affected firms (and workers) to just "deal with it."

Most economists studying the impact of global trade on innovation, and on China specifically, apply conventional trade theory insights. As David Autor et al. noted, "General-equilibrium trade theory suggests that expanded trade with low-wage countries raises innovation in high-wage countries."[2] Likewise, Bloom et al. wrote that the conventional view is "greater competition and trade openness typically increase innovation."[3] The reason for this belief is the theory of comparative advantage, which predicts that when developed economies increase trade with developing economies, the former lose lower-wage and less-innovative industries and firms because developing economies have less capital and more low-wage labor—and thus have a comparative advantage in the production of such goods and services. The increase in trade, though, means developed nations can specialize in more-advanced goods and services, many of which are more knowledge or capital intensive. In other words, with global integration, developed nations might lose industries such as textiles and furniture, but gain in semiconductors and chemicals. As Bloom et al. wrote, "When trade barriers fall between the EU/U.S. and China, the high-tech industries will grow relatively faster than low-tech industries in the EU/U.S. The opposite will occur in China."[4] Likewise, as Kim stated, "Increasing trade with low-wage countries like China would result in shrinking low-tech firms and growing high-tech firms (where Canada has comparative advantages). The opposite would occur in China."[5]

Indeed, many studies of the process of increased integration and trade between developed and developing nations do find this result. A study by Bernard, Jensen, and Schott of the exposure to low-wage nations of U.S. manufacturing plants from 1977 to 1997 (largely before the massive increase in Chinese exports) concluded:

> Across industries, we find that plant survival and growth are disproportionately lower in industries with higher exposure to imports from low-wage countries. Within industries, the higher the exposure to low-wage countries, the bigger is the relative performance difference between capital intensive plants and labor-intensive plants in terms of survival and growth. Finally, we show that some U.S. manufacturing plants adjust their product mix in response to competition from low-wage countries. Plants facing higher shares of imports from low-wage countries are more likely to switch industries. When plants do switch, they jump towards industries that are on average less exposed to low-wage countries and are more capital and skill intensive. These results support the view that the U.S. manufacturing is shifting resources towards activities consistent with U.S. comparative advantage.[6]

While this transition was painful for the firms and workers in the negatively affected industries and regions, it was welfare-maximizing for both the United States and developing nations. This is why more *market-based* global integration is a force for progress—even if it does create some "losers"—and most economists defend free trade so strongly. As Bloom et al. wrote, "Because these benefits are less visible than the losses that firms and workers can face from an unexpected increase in trade, and because these effects can take decades to be realized, it is as important as ever for economists to understand why it may be so important to pursue and protect the gains from trade."[7]

But this theory is an accurate representation of real-world workings of economies only under certain conditions. As we have moved into a world wherein many nations—with China at the forefront—engage in trade that is based not solely or even principally on markets but on government protectionism and mercantilism, it should be increasingly clear conventional trade theory fails as a guide to policy. Indeed, when some economies, such as China's, seek near autarky in advanced manufactured goods, massively create subsidized overcapacity in industries such as steel, and practice overt state capitalism, it should be clear this kind of economic structure operates very differently than the market-based economies at the heart of conventional international trade theory—and could very well produce outcomes that are not mutually welfare-enhancing.[8]

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But many, if not most, economists remain tied to conventional trade theory, and are unwilling or incapable of distinguishing between trade with a relatively market-based economy and trade with a state capitalist, mercantilist economy. A recent article in *Foreign Policy* about how "Economics Has Failed America," makes that clear.[9] The author quoted a number of economists, most prominently Paul Krugman, who offer mea culpas for underestimating the harm done by China to the U.S. economy—yet they all still persist in viewing the problem as one of only some workers (more than they thought at the time) being hurt by globalization. Robert Kuttner, hardly a conventional neo-classical economist, is the only one quoted who made the distinction between trade with market-based economies and mercantilist economies. Some economists, such as William Baumol and Ralph Gomory, have tried to make this distinction, but they remain a minority.[10]

Indeed, conventional trade theory remains stuck in the old framework of market-based comparative advantage, and has not fully recognized the impact on theory and actual outcomes of engaging with a system of trade in which there is government-based competitive advantage. Surprisingly, none of the studies reviewed in this report looking at the impact of China on foreign innovation consider the foundational question of whether the trade in question is market-based? In other words, is it based principally on such market factors as the cost of labor, availability of workers, size of markets, and the like—or it is significantly shaped by distortive and mercantilist government policies, such as currency manipulation and government subsidies to artificially lower export prices, forced localization in exchange for market access, and IP theft? And if more trade is based on the latter factors, what are the implications for trade theory? Unfortunately, modern trade theory is almost completely devoid of such considerations, instead assuming trade is largely market-based and therefore welfare-maximizing. The increasingly popular mea culpas today don't stem from a recognition that economists failed to get this key point right; rather, it stems from an acknowledgement that more workers were hurt than they'd predicted. But more trade with a nation such as China is still welfare-maximizing, they tell us.

This oversight is striking because conventional economics would never fail to make this distinction when it comes to domestic policy. Indeed, there is a deep scholarly literature on the harmful effects of such policies to domestic markets.[11] Consider the following thought experiment: The U.S. Department of Justice (DOJ) randomly assigns half of U.S. corporations to be A-corps and half to become B-corps. For A-corps, nothing changes. But B-corps now enjoy special privileges and rules. They are exempt from laws governing IP theft, and may copy from innovators with impunity. They receive more-favorable tax incentives, including being subject to a lower corporate tax rate. They are recipients of massive government subsidies, including funds to help them buy out their A-corps rivals. Workers are forbidden to unionize in B-corps. And B-corps are able to enlist DOJ to bring and win capricious cases against A-corp rivals. Virtually all economists would rightly decry such a policy regime as harmful to economic welfare and innovation. But when the two systems are in different nations, with one nation (e.g., the United States) having essentially A-corps and the other (e.g., China) having B-corps, most trade economists continue to assume market forces are at work, and trade is welfare-enhancing.

The result of such a domestic experiment would be dire: The best, most innovative A-corp firms would lose market share; A-corps would be loath to invest in R&D, given the B-corp rivals could purloin it; and there would be massive waste as inefficient B-corp firms expand more than market forces would dictate. And there is considerable reason to believe the current global "experiment" of fundamentally different economic systems is also leading to reduced economic welfare and innovation.

But general equilibrium trade theory remains largely based on the assumption of comparative advantage, and that nations are "playing by the rules." To be sure, if China had been playing by the rules (e.g., not using unfair trade practices to move up the value chain and run consistent trade surpluses), then it is likely innovation would have increased in North America and Europe through a greater global division of labor: To be sure, the two developed regions would have shed low-value, less-innovation-based activities to China—but would have at least made up for it with expansion of higher value, innovation-based activities, much of which they would have sold to China to pay for increased imports of low-value added production. But this optimal and ideal condition is only true theoretically if China does not distort market conditions, tries to compete based upon its factor advantages (e.g., market-based low wages rather than currency-enhanced low wages), and does not run large and sustained trade surpluses in manufactured goods and services. Otherwise, conventional trade theory and the policy recommendations that stem from them could lead to seriously flawed and suboptimal strategies. To be clear, this argument is not meant to give succor to protectionists, who would limit global integration even when it is based on market forces and is welfare-maximizing. However, it is time for economists and policymakers to clearly distinguish between market-based trade that is welfare- and innovation-maximizing, and mercantilist-based trade—especially of the innovation mercantilist variety—which is likely to be welfare- and innovation-reducing, not just in the affected nations, but globally.

A FRAMEWORK FOR UNDERSTANDING THE IMPACT OF TRADE ON INNOVATION

There are clearly good reasons to believe that just as distorting domestic economic policies reduces domestic economic welfare, so too do foreign economic and trade policies—and not just in the practicing nation, but in other nations, and indeed in the entire global economy. One way to understand why is to examine the theory of the relationship between competition and innovation, because foreign entry and growth in domestic markets represents an increase in competition, at least in certain markets.

There has been a long tradition of scholarship to understand the relationship between competition and innovation. Stylistically, this has been portrayed as a debate between two leading economists: Kenneth Arrow and Joseph Schumpeter. Innovation-economist Joseph Schumpeter argued firms with temporary market power from innovation (e.g., a patented product) would have both the resources and the incentive to innovate further. In contrast, firms with little market power and "normal" (e.g., low) rates of profits would not have the resources to effectively innovate.

Schumpeter's argument was challenged by Arrow, who contended innovation would be greater in more competitive markets.[12] Kim reprised Arrow's argument that increased competition, including from trade, "fosters innovation as it reduces the relative profitability of low-tech products. Firms cannot get rid of their 'trapped' inputs easily, having more incentives to allocate them to inventing new products or technologies."[13]

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There is considerable reason to believe that, on balance, Schumpeter is correct. As the Obama Council of Economic Advisers reported, "Allowing firms to exercise the market power they have acquired legitimately can maintain incentives for research and development, new product introduction, productivity gains, and entry into new markets, all of which promote long term economic growth."[14] Likewise, William Baumol emphasized the extent to which even oligopolistic markets could produce innovation when firms compete in innovation rather than prices. He compared this oligopolistic competition to an arms race "that participants cannot easily quit."[15] Baumol went on to note:

> Oligopolistic competition among large, high-tech, business firms, with innovation as a prime competitive weapon, ensures continued innovative activities, and very plausibly, their growth. In this market form, in which a few giant firms dominate a particular market, innovation has replaced price as the name of the game in a number of important industries. The computer industry is only the most obvious example, whose new and improved models appear constantly, each manufacturer battling to stay ahead of its rivals.[16]

However, one way to square this circle between Schumpeter and Arrow comes from certain scholars who argue the relationship between competition and innovation resembles an inverted "U."[17] When a market is dominated by one or two firms, and the firms might have the revenues to invest in innovation but lack the competitive pressures to do so, innovation is hindered. In contrast, in fragmented and hypercompetitive markets, particularly ones made up of many small firms, firms tend to produce less innovation because, while they have the competitive motivation, they lack the revenues from superior profits to invest in costly R&D. The classic example of this is agriculture, for which many nations, including the United States, have developed shared innovation systems supported by government to take on part of the innovation task. In the case of the United States, these are the land grant colleges and the United States Department of Agriculture laboratories and Agricultural Extension Services.[18] For manufacturing, America likewise created the Manufacturing Extension Program.

Numerous studies have confirmed this theory, including one of U.K. manufacturing firms.[19] Scherer and Mukoyama found a similar pattern.[20] Similarly, in a study of U.S. manufacturing firms, Hasmi found that too much competition led to reduced innovation.[21] Schmidt found that increased competition increases managerial effort to increase profit, including innovation, but when competition becomes too great, managerial effort may decline.[22] At the same time, other studies have found a linear and inverse relationship. For example, Hasmi found that from 1976 to 2001, the average innovative activity in U.S. manufacturing industries was slightly positively related to the average markups. Either way, there is strong evidence that too much competition can reduce innovation.[23] Firms need to be able to obtain Schumpeterian profits to reinvest back into innovation—which is both expensive and uncertain.

This relationship may also affect firms differently. A number of economists have talked about one dynamic response from competition as the "escape competition," wherein firms are more motivated to innovate in order to reduce price-based competition. Shu and Steinwender wrote, "Aghion et al. show in a model that the escape-competition effect dominates when competing firms are neck-and-neck in their levels of technological advancement, whereas the Schumpeterian effect dominates for the laggards who are far behind the leaders at the technological frontier, and have a low chance of catching up."[24] Moreover, there is great variation between industries and nations in terms of where industries are on the inverted U. If industries are on the right side of the U, then more competition from trade might very well spur more innovation. In contrast, if they are at the peak or on the left side, more competition might reduce innovation.

So how exactly could competition from trade reduce innovation? There are two main ways. The first is by reducing the size of the market for the innovative firms. Large markets enable firms to sell more. But if larger markets come with an even larger number of competitors, total sales per firm can fall. This matters because innovation industries usually have high fixed costs for design and development, but relatively low marginal costs for production. In other words, the cost of the first product is extremely high, while subsequent items are much less costly. In these industries, larger markets better enable firms to amortize those fixed costs over more sales, so unit costs can be lower and revenues for reinvestment in innovation higher. Firms in most innovation industries are therefore global. If they can sell in 20 countries rather than 5—thereby expanding their sales by a factor of 4—then their costs increase disproportionally less. Numerous studies have found the ratio of cash flow to capital stock has a positive effect on the ratio of R&D investment to capital stock.[25] Assuming competition, the more sales, the more revenue that can be plowed back into generating more innovations. A study of European firms found that for high-tech firms, "their capacity for increasing the level of technological knowledge over time is dependent on their size: the larger the R&D investor, the higher its rate of technical progress."[26] Indeed, expanded markets coming from globalization providing an increasing market size for firms due to expanding trade opportunity may encourage innovation, as firms can spread the fixed costs of innovation over the larger market. This is why Bombardini, Li, and Wang found that "getting access to bigger markets due to export liberalization has been found to induce firms to switch to skill intensive technology, increase R&D spending and engage in more innovation."[27]

When increased trade limits domestic firms' market size—either by the introduction of more competitors to the domestic market, or one-sided trade that does not open a foreign market—sales for domestic innovators could shrink. Trade barriers and distortions can limit scale economies if they limit market access to foreign firms in favor of domestic firms, and raise total global innovation costs by enabling more firms than necessary. Many of these barriers stem from policies that favor domestic over foreign innovation firms. China's "indigenous innovation policies" are a case in point.[28] They are designed to favor Chinese-owned innovation firms, and include discriminatory government procurement; land grants and other subsidies; preferential loans; tax incentives; benefits to state-owned enterprises; generous export financing; government-sanctioned monopolies; and use of domestic rather than international technology standards. These policies can hurt foreign innovators when the Chinese firms either export into foreign markets or reduce sales in the Chinese market from foreign firms.

In addition, "forced localization" policies, which include government procurement restrictions, tariffs, tax incentives, and other policies to pressure foreign firms to produce locally, can also harm innovation if they lead to suboptimal plant size. For example, the Indian government has proposed a Preferential Market Access program wherein, by 2020, 80 percent of all information technology (IT) goods consumption in India must be domestically produced.[29] Establishment-level barriers allow foreign firms to access markets, and encourage them to locate production facilities within the market. These barriers raise the number of establishments, which can increase global production costs. A biopharmaceutical firm, for example, may only need one plant in order to produce a drug for global sale. But if certain nations require that firm to manufacture locally in order to sell locally, then it would need to build multiple plants, thus increasing the firm's costs and reducing the resources available for investing in innovation. If the firm chooses to not build the plant and thereby forfeit those sales, then it would be worse off than if it had been able to serve the market through exports.

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Another way competition limits innovation is by reducing revenues and profits needed to reinvest in the next generation of innovation. In other words, competition can hurt both current and future innovation. As Carl Shapiro noted, "Innovation incentives are low if ex-post competition is so intense that even successful innovators cannot earn profits sufficient to allow a reasonable risk-adjusted rate of return on their R&D cost."[30] True innovation is not about risk in the sense that it can be modeled after there being an "x" percent chance a given investment will yield a certain return. Innovation is about uncertainty that cannot be modeled, as reflected by Thomas Watson, the chairman of IBM, who in 1943 proclaimed, "I think there is a world market for maybe five computers." Likewise, in a now-infamous study for AT&T, the consulting firm McKinsey predicted there would be a market for 900,000 cell phones by 2000. They were off by 99 percent.[31] Because innovation is about uncertainty, failure is often rampant. For every Apple succeeding with an iPhone, there are multiple companies that fail. Moreover, innovation industries face not just loss of market share from competition, but loss of existence. This reality evokes Joseph Schumpeter's dictum that "every piece of business strategy must be understood against the perennial gale of creative destruction."[32] This is why, for innovation industries, so-called Schumpeterian profits—those that arise when firms are able to appropriate the returns from innovative activity—are so critical. For if firms are assured, at best, of only normal returns from successful innovation, no innovator would take the enormous risk of investing in innovation. Moreover, because innovation is so expensive, higher returns enable companies to invest more in R&D and other innovation-based activities.

Unfair, innovation mercantilist-based trade can have the effect of reducing profits by leading to more market overcapacity and lower prices for competitive products than what market forces would produce. Some nations seeking high-paying innovation industries, and the jobs they create, unfairly subsidize new entrants or incumbents, leading to more competition than market forces might otherwise produce. This in turn can reduce revenues needed to invest in the next round of innovation. One example is China's solar energy policies. After the 2008 "Great Recession," the Chinese government poured hundreds of billions of yuan into their solar energy firms to help them gain global market share.[33] As a result, Chinese crystalline solar PV prices decreased by 85 percent between 2009 and 2017—and China exported 38 percent of the world's solar panels in 2018.[34] A country that had produced hardly any solar panels in 2006 came to account for 60 percent of global production a decade later.[35] If the Chinese firms were innovation leaders, this might advance clean energy innovation. But they are not. At least through the 2000s, Chinese solar firms invested a much lower percentage of revenue on R&D compared with American and European solar firms—and clean energy patents in China were 4 percent of U.S. levels and just 1 percent of Danish levels, when controlling for population.[36] The result of this government-induced overcapacity was the bankruptcy of innovative solar firms in the United States, and a reduction in global solar R&D (private-sector solar R&D fell 1 percent in 2012.)[37]

China has pursued the same policy in aviation. Designing and building jet airplanes, especially larger, multi-aisle planes, is incredibly expensive and risky. Given this, it is not surprising there are just two major competitors: Boeing and Airbus. But this has not deterred the Chinese government from attempting to artificially create a third competitor. Commercial Aircraft Corporation of China, Ltd. (COMAC), the state-owned Chinese commercial aircraft company, benefits from a wide array of mercantilist policies, including massive subsidies, discriminatory procurement, and forced technology transfer in exchange for market access.[38] If COMAC ultimately sells any planes, the result will be reduced revenues for Boeing and Airbus to invest in next-generation aviation innovation.

One form of strong competition relates to IP. The purpose of IP protection (e.g., patents) is to enable firms investing in innovation to make enough returns over a fixed period of time to recoup their costs and more, while at the same time enabling information disclosure. As such, weak IP protection, state sanctioned IP theft, and other forms of non-market-based technology transfer weaken innovation.

Many nations believe the way to accelerate the development of innovation industries is to appropriate IP.[39] There are two main processes of IP theft. The first is pure theft, such as copying, bribing of employees to obtain trade secrets, and cyber-espionage. The second is forced technology transfer, whereby a nation makes market access contingent on transferring technology to domestic producers.

Nations also use market access as a means of forcing technology transfer. In China, it is commonplace to require firms to transfer technology in exchange for being granted the ability to invest in China. As BASF chairman and chief executive Jürgen Hambrecht stated, foreign companies doing business in China face "forced disclosure of know-how."[40]

Yet firms in innovation-based industries depend on intangible capital, much of it IP. Strong IP rights spur innovative activity by increasing the appropriability of the returns to innovation, thereby enabling innovators to capture more of the benefits of their own innovative activity. By raising the private rate of return closer to the social rate of return, IP addresses the knowledge-asset incentive problem, allowing inventors to realize economic gains from their inventions, thereby catalyzing economic growth. In addition, as they capture a larger portion of the benefits of their innovative activity, innovators obtain the resources to pursue the next generation of innovative activities. However, if competitors are able to enter and remain in the market because they obtain an innovator's IP at less than the fair market price (either through theft or coerced transfer), they are able to siphon off sales that would otherwise go to innovators. Why would a firm invest in IP when other firms could copy it to compete against them? For example, one study found that with nonexclusive IP rights, competition can decrease the market available to each firm, and lower the returns from innovation.[41]

Another advantage some nations, particularly China, can have is state-supported enterprises, many of them state-owned enterprises (SOEs). As Bejkovský wrote,

> A Chinese SOE has the advantage over the competition in the barriers to entry for foreign or private competition, it can receive preferential loans, receives grants for research and development, gets free land, has tax rebates and cheap inputs of materials from other SOEs. The result of this system is naturally a product that is highly competitive on world markets, which is the goal of the Chinese government. Its price, however, does not reflect the market situation and is not made on the basis of market determinants.[42]

To be sure, this does not mean market-generated competition, be it from domestic or foreign sources, is detrimental. As William Lewis, the former head of the McKinsey Global Institute, has argued, there is perhaps no factor more important to driving economic growth than the presence of competitive markets: "Differences in competition in product markets are much more important [than differences in labor and capital markets]. Policies governing competition in product markets are as important as macroeconomic policies."[43] However, this does not mean more competition is always better. Normally, markets do not produce an excess number of competitors in innovation industries. But governments often do, through financial bailouts, discriminatory government procurement, or other policies that favor weaker domestic innovation firms by allowing them to remain in the market, drawing off sales from stronger firms and reducing their ability to reinvest in innovation.

This is not to advocate for a strict free-market orientation that sees all government policies for innovation support as inherently distortionary and mercantilist. To be clear, government innovation policies can be pro-innovation if they help innovative firms overcome particular challenges. For example, public-private research partnerships, such as the Fraunhofer Institutes in Germany, are a case in point.[44] But these institutes, designed to help firms in an industry solve complex technical challenges, are different than mercantilist policies subsidizing or protecting particular firms that otherwise would exit the market. Indeed, an exhaustive literature has shown domestic policies—including support for a robust science and engineering workforce, an entrepreneurial culture, public investment in research, and favorable tax treatment of R&D—all support innovation, and can correct for identifiable market failures.[45] However, while some nations focus on fair and non-distortive domestic innovation policies, many, especially China, default to innovation mercantilist policies.[46]

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In other words, to assess the impact of foreign firms and economies on innovation, one needs to determine where on the inverted U the competition exerts itself. It is likely "normal" global competition supported by market-consistent government innovation policies exerts itself on the left side of the inverted U and improves innovation, both by spurring a more-competitive response among incumbents and generating an innovation-based division of labor with developed nations specializing more in innovation-based activities. In contrast, innovation mercantilist competition likely exerts itself on the right side of the inverted U and harms innovation.

This framing provides a key insight into understanding the impact of Chinese policies on innovation. How this then applies to Chinese competition depends in part on where on the curve the firms and the competition are. As one study of the effect of Chinese competition on U.S. innovation argues, "On the one hand, some firms may invest more in R&D to improve product quality and differentiability in order to rise above the competition. On the other hand, higher competition lowers the market share of domestic firms, thus causing firms to reduce R&D investment."[47]

STUDIES OF EFFECTS OF CHINESE INDUSTRY ON INNOVATION IN OTHER ECONOMIES

In the last several years, a number of scholars have conducted econometric studies to examine the impact of Chinese competition on R&D and innovation in other, mostly Western, economies. Most, but not all, have found the effect was negative, harming innovation. Before discussing the findings, it is important to note the difficulty of causally examining the relationship between Chinese competition and reduced innovation in foreign economies. The reasons relate to limited data and the difficulty of designing models that account for all causal variables. Nonetheless, a number of researchers have constructed sophisticated methods for identifying causation.

One problem with the literature on the impacts of trade on innovation is most economists assume a priori that trade is welfare-enhancing for both nations. The simple Ricardian model predicts that a country gains from trade by specializing in its comparative advantage with respect to productivity. But among the flaws of the Ricardian model is the fact that it models free trade between two countries, not free trade that is one-sided, with one country playing by the rules and the other not. In this situation, it is not necessarily the case that both nations benefit.

Second, most models look at trade openness on the basis of tariffs, despite being among the least-important factors when it comes to innovation industries. Oher policies such as model government subsidies, IP theft, and closed markets are more important.

In the last several years, a number of scholars have conducted econometric studies to examine the impact of Chinese competition on R&D and innovation in other, mostly Western, economies. Most, but not all, have found the effect was negative, harming innovation.

Third, in part because of data availability, most studies examine the period between 2000 and the mid- to late-2000s. However, it was in the 2010s when Chinese government policies were much more focused on gaining global market share in innovation industries. The impacts on innovation for foreign nations would therefore likely be even higher in this period.

Fourth, with the exception of one study, the studies model the impact of import competition, but not the impact of lost exports (either to China or nations wherein China has gained market share), which in some cases might be greater.

Fifth, most studies examine the impact on product innovation and not on process innovation (e.g., innovation and improvements in production processes and technology). However, academic literature shows product design interacts with the production process.[48] Firms offshoring factories often reduces their ability to innovate.[49] Moreover, firms may focus less on process innovation when they move production to low-wage nations, because it is easier to simply use low-wage labor rather than invest in process innovation (e.g., robotics) in the higher-wage home country.[50] Investments in process innovation become less valuable the lower the workers' wages. And as the work of Fuchs and Kirchain has shown, investments in the next generation of product innovation may also be less valuable if the current product is able to maintain equal or superior cost performance because of low-wage production.[51]

Finally, none of the literature looks at global effects, in part because it assumes foreign innovators' gains in innovation compensate for the reduction in domestic firms' innovation. In addition, the data and modeling requirements for doing so are vastly more complex.

The next two sections review the literature of the effect of Chinese competition on process and product innovation.

Process Innovation

Process innovation refers to how companies produce a good or service. Globalization and trade can impact this. For example, opening up low-wage markets makes it easier for companies to shift or establish production there. Because labor is cheaper, it makes less economic sense to invest in automation. This is because the decision to install and run a robot is often based on the cost savings that can be achieved when a robot can perform a task instead of a human worker, and those cost savings are directly related to the compensation levels of manufacturing workers. When the price of labor is high, the return on investment from investing in labor-saving technology is higher. Often referred to as the "Webb" effect, the theory maintains a higher wage floor leads to higher levels of efficiency.[52] Indeed, one study on the effects of the minimum wage on employment concluded that "if the federal government raises the minimum wage, employers in some sectors may expedite the adoption of automated equipment and new technology to increase labor productivity."[53] Thus, it is not surprising countries with higher wages are generally more likely to adopt labor-saving technology. It should therefore come as no surprise high-wage Germany has a higher penetration rate of robots than does a nation such as India.[54]

As Bena and Simintzi wrote:

> [A] firm's production function is not a single technology, but rather represents the substitution possibilities across different production techniques. Each technique stems from an idea how to produce with a given mix of production factors. Jones argues that, for example, in order for firms to take advantage of producing using a higher capital-labor ratio they first need to invent new production techniques that are appropriate for that capital-labor ratio—firms need to innovate.[55]

They found that the 1999 bilateral trade agreement between the United States and China made investment in China more profitable and secure, but reduced process innovation investment in the United States by 25 percent over what it would have been absent the agreement. [56] They wrote, "This result suggests that a better access to cheap Chinese labor leads U.S. firms to rely relatively less on physical capital, which is consistent with the firms responding to the reduction in their effective labor costs by reducing investments in new capital goods that are typically introduced together with new cost-saving production methods."[57]

Another study by Kueng, Li, and Yang of effects on Canadian firms found the same result: "Canadian manufacturing firms systematically reduce innovation activities… This reduction in innovative activities is strongly driven by a drop in process innovation rather than product innovation."[58] Likewise, Kim found that Chinese competition reduces total factor productivity (TFP) growth within manufacturing firms in Canada. [59] This is to be expected given China reduced revenues and profitability, limiting firms' ability to invest in productivity-enhancing activities.

In conversations with corporate clients that had moved work from the United States to China, the Boston Consulting Group reported, "To leverage lower cost labor, some companies are further reducing their reliance on capital… they are doing this by redesigning their products to permit more manual assembly."[60] In other words, companies redesigned products that had been designed to be fabricated and assembled by machines in order to make assembly by manual labor easier. This reduced the labor productivity of the process. Similarly, in describing Chint, a leading Chinese electronics manufacturer that tried to automate but realized a labor-intensive process was cheaper, the McKinsey Global Institute wrote, "The company discovered that it cost four times as much to maintain the automated machinery as it cost to pay the workers that the machinery had replaced."[61]

This production cost advantage—some of it generated by unfair government policies—can also have negative impacts on product innovation. In a study of the optoelectronics industry, Fuchs and Kirchain discovered the ability to produce existing generations in East Asia (including China) with low-cost labor had caused emerging, next-generation designs to no longer be cost efficient, noting, "The emerging designs, however, have performance characteristics that may be valuable in the long term to the larger computing market and to pushing forward Moore's law."[62] In other words, low-cost production options can affect product design decisions, thereby boosting short-term consumer welfare at the cost of dynamic efficiency (innovation) and long-term consumer welfare.

One might argue these dynamics were just a process of global expansion and market opening, and this result was a net positive because of better factor allocation from free trade. But this is not the whole story. First, if countries manipulate the cost of production in order to keep it lower than market forces would otherwise generate, then there is likely to be misallocation of resources, with a negative net effect on global welfare. Companies would be expanding low-wage, low-productivity production at the expense of higher wage, higher productivity production more than they would have otherwise. And given China consistently keeps the dollar-denominated value of its labor lower than market forces would otherwise lead to, principally by manipulating the value of its currency (as well as by suppressing unions), Chinese labor costs less than it would without innovation mercantilism. One study estimated that, in 2003, Chinese currency was undervalued by 23 percent.[63] On top of that were an array of subsidies to Western firms to locate production in China, which further distorted market forces.[64] This resulted in the global capital-to-labor ratio being lower than without the distortions.

There is another dynamic in which Chinese mercantilist policies, especially direct and indirect subsidies, have harmed productivity by enabling less-productive Chinese firms to gain more market share than they otherwise would have against more productive foreign firms. For example, in the 2000s, the Chinese government massively subsidized its shipbuilding industry. According to Halouptsidi, Chinese government subsidies decreased the cost of production in Chinese shipyards by 13–20 percent, with the result being "substantial misallocation of production across countries—with Japan, in particular, losing significant market share... In the absence of the subsidies, China's market share would be cut to less than half, while Japan's share would increase by 70%."[65] The author found that Chinese shipyards are less efficient than their Japanese and South Korean counterparts.[66] Likewise, Barwick, Kalouptsidi, and Zahur found that these subsidies "created sizable distortions and led to increased industry fragmentation and idleness."[67]

If countries manipulate the cost of production, then there is likely to be misallocation of resources, with a negative net effect on global welfare.

There is a second factor that contributes to lower productivity: the negative impact on process technology R&D because of spillovers. Capital equipment markets have spillovers that can be a form of market failure. And to the extent trade—especially unfair trade—substitutes labor for capital, capital equipment innovation rates slow relative to what they would otherwise be. Research over the last two decades indicates companies capture only about half of the total societal return from their investment in new capital equipment. One of the earliest studies to find this was by Lawrence Summers and Brad DeLong.[68] Subsequent studies have found similar results. For instance, Jonathan Temple found externalities from capital investment.[69] Van Ark discovered the spillovers from investment in new capital equipment are larger than the benefits accrued by the investing firms.[70] Hitt and Tambe found the spillovers from firms' investments in

IT to be "significant and almost as large in size as the effects of their own IT investment."[71] In other words, firms capture on average only about half the total societal benefits from their investments in IT, suggesting the current level of IT investment is significantly less than would be societally optimal. Xavier Sala-i-Martin found that both equipment and non-equipment investment (e.g., buildings) are strongly and positively related to growth, but that equipment investment has about four times the effect on growth as non-equipment investment.[72] Ornaghi also found "statistically significant knowledge spillover associations for process and product innovation."[73] He asserted that these "knowledge spillovers play an important role in improving the quality of products, and to a lesser extent, in increasing the productivity of the firm."[74] At least one study has found firms invest more in product R&D when they invest more in process R&D, meaning that spurring process R&D also stimulates product R&D.[75] Cefis, Rosenkranz, and Weitzel observed that positive externalities in process R&D indicate relatively high technological spillovers in this type of innovation.[76]

There are a number of reasons firms are not able to capture all the benefits from their investments in capital equipment. One is investments in new machinery give workers knowledge about these new investments—and the workers in turn transmit this information to their next employers, leading them to also invest in new machinery. Indeed, users of new equipment learn what modifications need to be made and then transfer this experience to other firms through a host of means, including interfirm labor movement, trade shows, and professional-association meetings. In addition, some equipment—especially IT—has network effects wherein a single firm adopting the technology significantly benefits other firms. As Hitt and Tambe noted, "Firm-level investments in communications technologies can create benefits for business partners. Alternatively, investments in information technologies can produce knowledge that can spill over between firms."[77] This is not to say all kinds of corporate capital investment have all of these characteristics. When, say, a company buys office furniture or a car, or builds a new building, the suppliers (the makers of the furniture, car, or building) benefit but no spillovers are created because the equivalent number of jobs would have been created elsewhere in the economy from other spending. And when a firm buys new equipment or software, it is also not likely to capture all the benefits, as other firms are able to boost their own productivity because of it. To the extent China's artificially induced, low-cost production hurt more productive foreign establishments—as it did in shipbuilding, for example—or led to the transfer of more automated production from higher-wage nations to China (which ended up less automated), the negative effects were not just direct on the productivity of production processes, but indirect on capital investment innovation overall.

Product Innovation

There have been a number of studies examining the impact of trade on innovation, with most focusing on the impact of China, especially in the 2000s. Some studies that looked more broadly at trade with developing nations—particularly prior to 2000—found a positive effect on innovation in the United States. When looking at the impact of China in the 2000s, several studies found China had a positive impact on EU and U.S. innovation, although the lion's share concluded the opposite: China hurt innovation in the EU and United States. There may be several reasons for the conflicting findings, including different time periods of study, quantitative models, and datasets used.

A number of studies have found a positive effect. A 2017 paper by Chakravorty, Liu, and Tang found "a robust positive relationship between exposure to imports from China and innovation activities of U.S. manufacturing firms when we measure innovation by the number of citation-weighted patent applications."[78] This relationship, however, is strongest for firms in low-tech industries. Moreover, their model "generates an inverted-U shaped response to competition: at low levels of imitation, domestic firms make higher profits and a rise in imitation triggers innovation. However, when import penetration is high, the effect of innovation on profits is weak and imitation reduces innovation."[79] It is important to note this study only examined impacts through 2006, which was the year China restructured its economic strategy toward innovation and innovation industries. This is why, in their analysis, the most trade-impacted industries were dolls, stuffed toys, and footwear, with the industries gaining the most innovation from import competition from China being largely in the textiles and toy sectors.

However, most studies find a negative impact from China on innovation. Kim studied whether Chinese competition could help explain both the decline in business enterprise R&D and total factor productivity in Canada after 2000 (China was accepted into WTO in December 2001).[80] Kim used Canadian firm-level data to explore the impact of rising Chinese import competition on Canadian firm R&D. Chinese imports as a share of domestic production increased from around 2 percent in 2000 to around 8 percent in 2010.[81] The study found "increasing Chinese import competition reduced R&D" within Canadian firms. The effect was most pronounced in smaller firms. It was also negative for large Canadian firms, but significant at the 10 percent confidence level (in other words, the range of values within which there is a 90 percent certainty the true mean of the population is found). Kim discovered competition from China explained about 7 percent of the total decline in R&D expenditures in Canadian manufacturing between 2005 and 2010 (a decline of around $92 million CDN per year). Overall, the study estimated, on average, R&D expenditure growth within firms fell by 1.027 percentage points in response to a 1 percentage point increase in the Chinese import share in total domestic consumption. One reason for the decline in R&D is Chinese import competition reduces the profitability of Canadian manufacturing firms. It is important to note this was during a period when a larger share of Chinese competition was in less-R&D-intensive industries—and presumably, if the study had been able to focus on more recent data, the effects would have been considerably higher.

While increased competition would seemingly have resulted in reduced R&D in some sectors, it would have increased in others as export opportunities grew. But this did not happen to the extent theory predicted it, for two reasons. First, Canadian exports to China increased, but principally in natural resources sectors (e.g., agriculture and mining) that are significantly less R&D-intensive than manufacturing. And second, because China focused on running up large trade surpluses, the export opportunities for R&D-intensive industries were less than if had China run trade balances with the rest of the world.

In 1997, China's global trade balance in non-resource-based industries was $40.7 billion, or 4.2 percent of its gross domestic product (GDP). This figure more than tripled by 2007, when China's trade balance peaked at 13.8 percent of GDP. Since then, China's non-resource trade balance has risen by 50 percent, but has been outstripped by Chinese economic growth, causing the balance to fall to 7.6 percent of GDP in 2017. In contrast, China's non-resource trade balances with Canada and the United States have grown steadily as a portion of each nation's GDP over the same period, increasing nineteenfold from 0.1 to 1.0 percent, and sevenfold from 0.2 to 1.5 percent, respectively.[82]

Another study on the impacts on Canadian innovation found similar results. Keung, Li, and Yang found "the 4-percentage-point increase in Chinese import share between 1999 and 2005 led to the exit of 4.2% of the firms sampled in 1999 over that period, which is very large relative to the 17% overall exit rate of these firms."[83] Moreover, surviving firms had lower profits than otherwise would have been the case.[84] However, while they found a weak but still negative effect of Chinese import competition on product innovation, which, while not significant at the 0.05 level of confidence, is significant at the 0.10 level.

One study that has perhaps received the most attention is by Autor, Dorn, Hanson, Pisano, and Shu. In contrast to most other studies, their 2017 research examined the impact of Chinese competition on U.S. patents into the 2010s (specifically to 2013). They:

> document a robust, negative impact of rising Chinese competition on firm-level and technology class-level patent production. Accompanying this fall in innovation, global employment, sales, profitability, and R&D expenditure all decline within trade-exposed firms. [85]

They also found that "accelerating import competition from China during the 2000s can explain about 40% of the slowdown in patenting in 1999–2007 relative to 1991–1999."[86] On average, they found, firms reduce R&D investment when they belong to industries that are exposed to more import competition from China.

A number of other studies have found similar results for the U.S. economy. Akcigit, Ates, and Impullitti looked at the impact of China on U.S. innovation and found that "Even a relatively very advanced economy might experience a reduction in aggregate innovation, if it has an enough number of sectors that are getting discouraged by foreign competition."[87] They went on to note "foreign technological catching-up hurts U.S. welfare by stealing away business and profits of U.S. firms."[88] Hombert and Matray found similar results, observing, "[R]ising imports lead to slower sales growth and lower profitability for firms in import competing industries." However, this effect is significantly smaller for firms that have invested large amounts in R&D, thanks to more generous state R&D tax credit policies.[89]

Firms reduce R&D investment when they belong to industries that are exposed to more import competition from China.

At least one study of the United States argues that, on net, Chinese competition spurs innovation. Like most of the others researching impacts on North American innovation, Zu and Gong found, "On average, firms reduce R&D investment when they belong to industries that are exposed to more import competition from China."[90] They went on to note that a 10 percentage point increase in industry-level import competition (i.e., the share of U.S. consumption imported from China) would lead to a 6.4 percent drop in R&D investment, on average. The impact of import competition on R&D expenditure by high-tech firms is even larger, with a 10 percent increase in import competition leading to a 7.3 percent decrease in R&D expenditures on average."[91]

Zu and Gong also found that "import competition induces the reallocation of R&D towards firms that are more productive and firms that have more initial market power. This reallocation effect is large enough to offset the average negative effect when we aggregate the impact of import competition on all firms in the sample."[92] However, total effects are still negative, as, in 2007, the reallocation effect offset only 57 percent of the R&D reduction in exposed industries.

Given most other studies find a large net negative impact on U.S. innovation, Zu and Gong's finding is puzzling. One problem is they defined "competition" as the share of imports, rather than as a share of imports plus reduction in export share. In other words, the impact of China might be worse if U.S. firms also lose market share with exports, either to China or other nations to which China exports. More importantly, their research assumes innovation in services industries is equal to innovation in manufacturing. In particular, they found evidence that "rising import competition in manufacturing industries speeds up the structural transformation. In particular, researchers are reallocated from affected manufacturing industries to three service industries: business and repair services, financial services and personal services."[93] For them, these service sector industries "benefit from higher supply of researchers mobilized from import-struck manufacturing industries."[94] In other words, they argue Chinese competition hurts innovation in manufacturing, but spurs innovation in certain service sectors. But it's difficult to see how there is much innovation in the service sectors they identify, such as the repair sector (e.g., NAICS codes 8111, 8112, 8113, and 8114) or personal care services (e.g., NAICS code 8121) such as nail salons. And while there is certainly innovation in Wall Street, with companies hiring many of the best and brightest science, technology, engineering, and math (STEM) talent, it is dubious whether much of this leads to any net societal gain, as opposed to simply enabling some investors to win over others. Again, their study reflects the conventional view of trade based on allocative efficiency; by definition, any reallocation of resources (e.g., a computer Ph.D. leaving a high-tech manufacturer to take a job in a hedge fund) is welfare-maximizing. Indeed, they see these "shocks" as positive, providing a "cleansing effect," presumably cleaning out R&D-based manufacturing to make way for innovation-based hedge funds and nail salons.[95]

The impacts are more mixed for other regions of the world. For example, one study of the impact on China trade with South Korea found, "With a 10% increase in import share (percent) of Chinese products, a firm is expected to produce 1.58% more patent applications and 1.76% more patents granted. With a 10% increase in export share (percent) to China, a firm is expected to produce 1.17% more patent applications and 1.29% more patents granted."[96] It also found that when sectors are controlled for quality and price, there is no effect on lower quality or price sectors. One likely reason for this is Korea has run consistent trade surpluses with China—ones that actually grew after China joined WTO—in part because of stronger Korean national competitiveness policies and increased societal pressure on Korean firms to not outsource production to China.[97] So, on net, Korean firms have had more sales opportunity than have domestic U.S. firms.

In contrast, a study looking at Taiwan found increased opportunities to offshore production to mainland China reduced patenting by high-tech companies.[98] Similarly, a study of the impacts on Vietnam found exposure to competition from China had a small, but negative, impact on the innovation of manufacturing firms. The study concluded, "These results support the hypothesis that domestic firms do not need to innovate as cheap imported inputs allow them to invest less in innovation."[99]

Likewise, a study of offshoring of R&D and production on Japanese innovation found mixed effects. Yamashita and Yamauchi found that Japanese firms offshoring R&D to other developed nations has a positive effect on innovation in Japan due knowledge transfer (Japanese firms gain more access to knowledge and technology).[100] However, when the R&D is offshored to developing nations, such as China, the effect turns negative, possibly because the quality of the foreign R&D is not as strong, or domestic restrictions on knowledge transfer make it harder for firms to use these innovations in Japan. At the same time, Yamashita and Yamauchi found that offshoring production, presumably mostly to developing nations, reduces domestic R&D in part because there is synergy between production and R&D activities. In other words, as Pisano and Shi have argued, company R&D is often tightly linked to advanced production facilities, and when the two are geographically remote, innovation can be hindered.[101]

The evidence with regard to the impact on Europe is mixed. One highly cited study on the effect of Chinese trade on a number of northern European economies found Chinese trade stimulated innovation. Bloom, Draca, and Van Reenen studied the impact of Chinese trade on EU innovation from 2000 to 2007 and concluded, "China appeared to account for almost 15% of the increase in patenting, IT, and productivity."[102] They found, "Chinese import competition reduces employment and survival probabilities in low-tech firms."[103] In addition, "Firms with lower levels of patents or TFP shrink and exit much more rapidly than high-tech firms in response to Chinese competition." However, "Chinese import competition increases innovation *within* surviving firms," especially firms that are more high-tech (higher patenting rates). One key question the authors failed to answer, in part because it is methodologically difficult, is whether these firms that went out of business are less innovative than their Chinese counterparts.

Again, as with South Korea's, Europe's terms of trade with China—at least from 2000 to 2007—was more positive than the United States'. In this sense, innovation could have been spurred if it created a bigger market. For example, as Branstetter and his coauthors wrote, "Dauth et al. (2014) find that the China shock has no negative effect on German manufacturing employment, a result attributed to Germany's large persistent trade surplus in the manufacturing sector vis-a-vis China."[104]

Another possible reason for this finding is it was based on an examination of a period before China began competing and exporting more technology-oriented products in earnest. Finally, the authors hypothesized that because the EU market was exposed to less competition overall than the U.S. market, Europe was positioned farther to the left on the inverted-U relationship between competition and innovation—and greater import competition from China moves Europe up the left leg of the inverted U, whereas it moves the U.S. down the right leg.[105]

Another reason for this positive finding is the authors did not look at the entire EU economy, but rather at only 12 economies, many of which were highly innovative. However, it could very well be producers in less technologically advanced economies that compete with China more directly on cost factors were hurt. This is indeed what Branstetter, Kovak, Mauros, and Venancio found in a study of the impact of China on Portuguese manufacturing: The impact of China trade on the output of Portuguese manufacturers was negative. One reason for this is, while most studies focus on the direct effect of the rise of China's imports on the domestic labor markets of developed countries, their focus on export displacement stemming from increased competition from China in the export markets may be as—or more—important.[106] And they "strongly suspect our findings for Portugal reflect economic realities common to other Southern European countries."[107]

Moreover, another later study of the impact on Europe found opposite results from Bloom et al. that are consistent with the results of most studies of impacts on firms in the United States. For example, Campbell and Mau found:

> [T]he apparent positive impact of Chinese competition on European patenting [that Bloom et al. find] disappears once one controls for richer sectoral trends, the lagged level of patents, or switches to Chinese import penetration instead of the Chinese share of imports… Thus, we believe we have partially solved the puzzle of why the rise of China ostensibly had a negative impact on patents in the US (or, others have found no impact on R&D for the US), but a positive impact in Europe—the latter results appear to be spurious.[108]

Indeed, they found, "When controlling for lagged patents and outsourcing, and using Chinese penetration, one is more likely to get negative and significant coefficients."[109] They reached this finding in part because they used more robust methods, including more controls for spurious correlation, such as lagged patents trends and pretreatment levels.

If policymakers want to ensure robust rates of global innovation going forward, working to ensure China plays by the rules they agreed to when they joined WTO is a critical task.

Finally, there is evidence more open trade has spurred innovation in China. Bombardini, Li, and Wang looked at the period of 2000 to 2007, and found the long-term effect of a 1 percentage point decrease in import tariffs encouraged top firms to increase patent rates by 3.6 to 4.6 percentage points.[110]

CONCLUSION

Both the logic and scholarly evidence suggest China's innovation mercantilist policies have harmed innovation in other nations, particularly in North America and Europe. This is not to argue increased *market-based* globalization is innovation reducing; in fact, the evidence suggests the opposite to be true. But the nature of Chinese economic and trade policy is so distortive, it ends up harming more innovative companies in many foreign countries. As such, if policymakers want to ensure robust rates of global innovation going forward, working to ensure China plays by the rules they agreed to when they joined WTO is a critical task.

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ENDNOTES

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