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Abstract

This paper studies how Chinese firms responded to the 2007 U.S. "China Military Catch-All Rule," which restricted exports of dual-use products with military applications. By comparing sanctioned goods to those that were just excluded from the policy, we estimate firm-level effects on imports, R&D, and patenting. Treated firms sharply reduced imports of controlled products and increased innovation activity: R&D spending rose by 49.1%, patenting by 41.3%, and the number of active inventors by 30.4%. Patenting in related technologies increased by 65.1% and patents on other topics increased by 41.6%, indicating a broad innovation response rather than one narrowly focused on replacing restricted inputs. We also examine domestic suppliers of controlled goods and find that their innovation increased, but was concentrated in patent applications related to the restricted products, which more than quadrupled. Taken together, these results suggest that a key unintended consequence of export controls is their potential to accelerate innovation in the sanctioned economy.

JEL Classification: F13, F14, D22

Keywords: export controls, sanctions, innovation, China, geoeconomics

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1 Introduction

In recent years, escalating geopolitical rivalries have reshaped the global economy, with economic policies, especially trade sanctions, emerging as key instruments of conflict (Mohr and Trebesch, 2025; Gopinath et al., 2025; Clayton et al., 2025b). Export controls, a prominent form of sanction, restrict the sale of specific items to designated foreign destinations and generally aim to slow technological progress and limit production in security-related industries. Their use is widespread: as of 2023, the United States controlled exports to over one hundred countries,[1] and forty-two countries participated in the Wassenaar Arrangement, a multilateral regime restricting exports from conventional arms to dual-use technologies.

One major debate surrounding export controls is whether they inadvertently spur innovation in targeted countries. Proponents argue that this is not a major concern: past U.S. Commerce Secretary Gina Raimondo said Chinese technology is "years behind what we have in the United States" and that "export controls are working."[2] Critics counter that export controls can "forc[e] other ecosystems to grow up"[3] and "stimulate the growth of significant foreign competition."[4] Some analysts have even concluded that "[o]n net, American restrictions have accelerated China's innovation drive."[5]

This debate is central to policy, yet evidence remains limited due to several empirical challenges. First, export controls typically apply to a narrow set of specialized products, making it difficult to construct credible control groups and conduct econometric analysis. Second, countries subject to export controls, such as North Korea and Iran, often have limited data coverage, hindering efforts to establish policy exposure and identify firm responses. Third, technological progress in national-security-related domains is difficult to measure given its sensitivity.

[1] Bureau of Industry and Security (2023) "Commerce Country Chart."

[2] Gina Raimondo as quoted in Alexandra Alper, "US Commerce Secretary Downplays Chip in Advanced Huawei Phone," *Reuters*, April 21, 2024.

[3] René Haas as quoted in "Arm CEO Sides With Nvidia Against U.S. Export Limits on China," *SupplyChainBrain*, June 12, 2025.

[4] Cryptography's Role in Securing the Information Society. Washington, DC: National Academies Press, 1996), "Export Controls." DOI: 10.17226/5131.

[5] Dan Wang as quoted in Parikh, Tej. "China Can Outfox Trump's Tariffs," *Financial Times*, Jan. 19, 2025.

In this paper, we address these challenges by studying how innovation in Chinese firms evolved following the 2007 U.S. China Military Catch-All Rule, which restricted the export, re-export, and transfer of items with both civilian and military applications to China.[6] At the time, one U.S. official described it as "one of the most important changes to export control policy in many years."[7]

This setting offers several advantages for identifying the causal effect of export controls on innovation in a sanctioned country. First, the policy initially targeted 77 six-digit HS products, but an inter-agency review based on direct military relevance and U.S. export share subsequently excluded 18 of them. We use these left-out products as a natural control group for the targeted ones in a difference-in-differences framework, which we corroborate with a propensity score matching approach. Second, detailed firm-level data on imports, performance, and innovation in China allow us to identify directly-exposed firms and trace their import and innovation responses, as well as examine spillovers to upstream domestic suppliers of controlled goods. Third, Chinese patent text data allow us to measure the effects of export controls on national-security-related innovation as well as innovation in other areas.

Our analysis proceeds in stages. We begin by estimating the effect of export controls on imports of restricted products. Then, we document how firm innovation responded to the controls using firm-level R&D and patenting data. Finally, we assess whether and how innovation activity changed among upstream domestic suppliers of controlled goods. In the first and second stages, we compare firms that imported treated products before 2007 with firms that imported excluded products. In the third stage, we compare suppliers of restricted goods serving treated firms with suppliers of left-out goods to control group firms. We further validate our findings using propensity score matching and synthetic difference-in-differences estimators.

We find that the 2007 export controls had large and persistent effects on targeted trade flows. Relative to control firms, pre-period importers of controlled goods were 18 percentage points less likely to import them from the U.S. after 2007, and total imported value fell 89.5% relative to

[6] The policy also created a program for validating trusted end users of controlled items.

[7] Assistant Secretary of Commerce for Export Administration Christopher A. Padilla, The Future of U.S. Export Controls on Trade with China, States News Service, Jan. 29, 2007.

the pre-period mean. The probability of importing treated goods from any foreign source also decreased substantially, by about 10 percentage points, while the total value of controlled goods imported from the world fell by 55.4% relative to baseline, indicating that substitution to alternative foreign suppliers did not offset the loss of U.S. exports.

At the same time, affected firms significantly increased their innovation activity. Treated firms were 3.6 percentage points more likely to report any R&D expenditures and increased R&D spending by 49.1%. They also expanded patenting activity: the probability of having any patent application increased by 2.8 percentage points, and the number of total patent applications increased by 41.3% of the pre-period mean. Patent applications in controlled technologies and other technologies increased by 65.1% and 41.6% relative to baseline, respectively. The number of active inventors per firm rose by 30.4% of the pre-period mean. Event-study estimates show that these changes emerged quickly and grew over time, indicating that the export controls induced a sustained shift toward innovation rather than a short-lived response. Treated firms increased patenting not only in technologies related to restricted products but also in other areas, reflecting adaptation strategies that extended beyond simply replacing the controlled inputs. The innovation response was concentrated among non-state-owned firms.

We also document upstream spillovers. Domestic suppliers that sold controlled products to treated firms before 2007 were 4.4 percentage points more likely to apply for any patent related to controlled technologies, and the total number of related patent applications increased 361% relative to baseline. Other patent applications did not increase significantly among suppliers, indicating that while directly exposed firms innovated broadly to compensate for lost inputs, treated suppliers concentrated their innovation in the specific domains subject to export controls. This pattern suggests that upstream propagation is an important channel through which export controls can generate unintended technological progress in sanctioned domains.

This paper provides new causal evidence on the economic consequences of export controls for targeted countries, an area that a survey by Mohr and Trebesch (2025) identify as severely understudied. Most existing empirical work examines effects on issuing countries. For example, Crosignani et al. (2024) document that U.S. export controls contributed to financial and real decoupling from Chinese firms, with declines in stock returns, bank lending, profitability, and employment among U.S. suppliers. A notable exception is Alfaro et al. (2025), who study China's 2010 rare earth export quota cuts and find that they spurred alternative supply and innovation in rare-earth-intensive downstream sectors worldwide. We contribute to this literature by providing causal evidence that destination-specific export controls can increase innovation in the targeted economy. We find that firms cut off from imported inputs innovate more broadly, including in both controlled and non-controlled technologies, while upstream domestic suppliers of controlled products exhibit a concentrated surge in innovation in the sanctioned domains.[8,9]

We also contribute to the expanding literature on geoeconomics, and specifically on how trade policy is used for geopolitical ends. Our results provide evidence on a key margin, targets' innovative responses, that are essential for embedding export controls in strategic models of sanctions. In particular, our findings relate to Kooi (2024), who formalizes a "national security externality" in which policies such as export controls and friend-reshoring are chosen to raise domestic resilience and reduce an adversary's. The innovative response we document highlights that such models should account for the possibility that such policies can inadvertently increase the target's economic resilience. Becko and O'Connor (2024) develop a dynamic model of trade and geopolitics in which peacetime industrial and trade policies are chosen to shape leverage in future conflicts. Our evidence suggests that these forward-looking strategies must account for the possibility that

[8]Our results are consistent with evidence from Clayton et al. (2025a), who use text analysis of U.S. earnings-call transcripts and sell-side analyst reports to show that firms subject to export controls increase mentions of domestic investment and R&D. In a historical context, Juhász (2018) shows that a trade blockade imposed on France during the Napoleonic Wars spurred adoption of mechanized cotton spinning, which had persistent effects on industrial development. More broadly, our results align with Flynn et al. (2025), who find that greater foreign political risk, as measured by a country-level index, raises directed innovation in U.S. sectors and reduces reliance on imports from risky sources.

[9]Our work also relates to a vast empirical literature on sanctions, recently surveyed in Morgan et al. (2023) and Itskhoki and Ribakova (2024). Most closely, Egorov et al. (2025) combine customs and balance sheet data to document the negative impact of export bans on Russian imports and firms after the 2022 invasion of Ukraine, but without analyzing innovation responses. Nigmatulina (2021) shows a positive impact on sanctioned Russian firms following the 2014 annexation of Crimea, driven by government subsidies. Draca et al. (2019) and Ghasseminejad and Jahan-Parvar (2021) study sanctions on Iran, showing that they reduced stock returns and firm profitability, while Kim et al. (2023) documents declines in aggregate output and real income following trade sanctions on North Korea. More broadly, our paper connects to a longstanding political science literature on the effectiveness and incidence of sanctions (Hufbauer et al., 1990; Morgan and Schwebach, 1997; Pape, 1997; Baldwin, 1999).

export controls reshape not only adversaries' trade dependence but also their incentives to innovate. Finally, Clayton et al. (2024) study economic coercion, fragmentation, and anti-coercive policies in a general equilibrium framework. Our findings suggest an additional force behind fragmentation: when export controls induce innovation in a targeted economy, they may erode hegemonic leverage, thereby increasing incentives on both sides to decouple further.[10]

The remainder of the paper is organized as follows. Section 2 describes the policy background and institutional context of the 2007 China Rule. Section 3 outlines our empirical strategy and data sources. Section 4 presents the main results as well as robustness checks. Section 5 examines the response of domestic suppliers to treated firms. Section 6 concludes.

2 Background

In this section, we outline the broader context surrounding the 2007 China Rule and discuss the specifics of its implementation. Historically, the United States has at times restricted exports to geopolitical rivals of "dual-use" goods: products that have both military and civilian applications. The first major example of this policy took place in World War I, when the US banned exports of arms, transportation components, and other goods that could aid the enemy. During the Cold War, the US participated in the Coordinating Committee for the Control of Multinational Trade (CoCom), a multilateral organization that limited exports of strategic goods and technology to communist countries (Chapman, 2013).

In the 1990s, after the fall of the Soviet Union, the United States eased dual-use export controls. The period of liberalization endured until September 11, 2001, when the US underwent a significant policy shift, and national security became a top priority. During this period, the Bush administration emphasized the role of economic policies in protecting national security. U.S. leadership became increasingly concerned about China's rapidly expanding military capabilities and

[10]Clayton et al. (2025b) provide a more detailed overview of this literature. Some additional relevant work includes Clayton et al. (2023), Alekseev and Lin (2024), Liu and Yang (2024), Mayer et al. (2024), Pflueger and Yared (2024), and Becko et al. (2025).

announced that it would hedge against China's military buildup. It was against this backdrop that a new policy was announced.

The 2007 China Rule. On June 19th, 2007, the United States Bureau of Industry and Security (BIS) issued a new policy: "Revisions and Clarification of Export and Reexport Controls for the People's Republic of China (PRC)," commonly referred to as the "China Military Catch All Rule," or the "China Rule" (Padilla, 2007). The rule updated the Export Administration Regulations, which are the implementation mechanism of the Export Administration Act of 1979 (Diamond, 2008). Under this act, the executive branch has the authority to regulate foreign commerce, including creating lists of controlled products for export to particular destinations.

The purpose of the China Rule was to protect United States national security by restricting flows of products and technologies that could contribute to China's military capabilities. It focused on dual-use goods (those that had both civilian and military applications). The policy was motivated by US concerns about Chinese military expenditures, which had been rising steadily for several decades.

The policy placed restrictions on the export, re-export, or transfer of specific products "that would make a direct and significant contribution to China's military" and changed how export licenses for those products were granted. In Appendix Section A, we provide excerpts from the original policy document with more details. The policy's enforcement mechanism expanded the liability of US exporters, stating that they needed to obtain a license whenever they had or *should have had* "knowledge" that their products were destined for "military end-uses" in China. As a result, after the policy, US exporters needed to implement extensive due diligence about each transaction to China or risk harsh penalties, including fines and legal action (Corr, 2002).

In a draft rule disclosed in July 2006, 77 HS 6-digit products (26 physical goods under the Export Control Classification Number (ECCN) system) were slated for inclusion under export controls. However, addressing concerns voiced in public comments, BIS conducted a thorough military and economic impact review. This review employed three criteria to determine whether a product should be controlled. In order of their importance, the criteria were: the military applicability of each item, the extent of US exports of the item, and the availability of the item from other countries. After deliberation, 18 HS 6-digit products (9 ECCN goods) were removed from the list, which we refer to as the "left-out" products, resulting in 59 HS 6-digit products (17 ECCN goods classifications) that were subject to final export controls.[11] Between 2000 and 2006, treated products accounted for an average of 6.2% of China's imports from the U.S., while left-out products represented 4.2%. The two largest HS 2-digit categories among treated products were 85 (electrical machinery, equipment, and parts) and 84 (nuclear reactors, boilers, machinery, and parts), and the two largest HS 2-digit categories among left-out products were 84 (nuclear reactors, boilers, machinery, and parts) and 90 (optical and surgical instruments).[12] Appendix Tables A.1 and A.2 provide a complete list of treated HS 6-digit products, and Appendix Table A.3 does the same for left-out HS 6-digit products.

Experts anticipated that the policy would decrease Chinese imports of controlled products. One factor was firm uncertainty around whether they were in violation of the policy. US exporters, especially small and medium firms, had difficulty analyzing the complex ties between Chinese enterprises and the military. As a result, many firms avoided any transactions that might expose them to legal risk. Furthermore, though the Validated End-User (VEU) program theoretically allowed qualified Chinese firms to obtain pre-approval to buy restricted products, the requirements were extremely stringent and most Chinese firms could not meet them.

Overall, policymakers viewed the rule as "one of the most important changes to export control policy in many years."[13] There was, however, disagreement as to whether the policy would achieve its intended effects. Critics argued that China would eventually source controlled goods from other countries or manufacture them domestically. They also reasoned that the rule would drive adaptation and innovation in China (Diamond, 2008).

[11] While we focus on physical goods, the initial and final lists also contained 21 and 14 software and technology products, respectively.

[12] One prominent example of controlled products, semiconductors, falls under HS 85.

[13] Assistant Secretary of Commerce for Export Administration Christopher A. Padilla, The Future of U.S. Export Controls on Trade with China, States News Service, Jan. 29, 2007.

In Figure 1, we plot the share of China's imports from the U.S. accounted for by treated and left-out product categories.[14] We note two key patterns. First, the share of treated products declines after 2007. Second, imports of the treated group do not fall to zero. This is primarily due to two factors: (1) some Chinese firms were able to obtain exemptions under the VEU program, and (2) the crosswalk from ECCN to HS6 codes introduces some untreated products into the treated group.

3 Empirical Strategy and Data

We analyze whether the export controls affected imports and innovation among Chinese firms. We estimate the following specification using a firm-year-level dataset:

$$y_{fct} = \beta Treat_f \times \mathbb{I}_{t \geq 2007} + \theta_f + \theta_{ct} + \mathbf{X}_f \times \delta_t + \varepsilon_{fct}, \tag{1}$$

where f indexes firms, c indexes counties in China, and t indexes years. $Treat_f$ is a firm-level indicator that equals one if the firm imported any restricted HS6 products before 2007 and zero if it imported any left-out HS6 products (and no restricted products) before 2007.

Our firm-year-level outcome variables, y_{fct}, include three measures of imports and five measures of innovation. We consider imports of controlled goods from the United States, from non-U.S. countries, and from the world as a whole. Our five measures of innovation are: R&D spending, total patent applications, relevant patent applications (those related to controlled products), other patent applications (those unrelated to controlled products), and total active inventors (the number of inventors with at least one patent application in a given firm-year).

The specification includes firm fixed effects, θ_f, to accommodate average differences across firms and county-by-year fixed effects, θ_{ct}, to absorb differences in policies and economic performance across places over time. We also control for a vector of pre-period firm characteristics $\mathbf{X}_f$[15] interacted with year fixed effects to address the possibility that fast-growing or highly-innovative

[14] Section 3.1 describes the data used to construct this figure.

[15] The vector $\mathbf{X}_f$ includes average pre-2007 firm sales growth, R&D spending value, patent count, relevant patent count, and active inventor count.

firms were on different trajectories. We cluster standard errors at the firm level as that is the level of variation in $Treat_f$.

The coefficient β captures the difference in outcomes between firms that imported any exposed products and those that imported control products and no exposed products, before and after the sanctions. Ex ante, we expect the export controls to have generally harmed imports, implying $\beta < 0$ for outcomes such as imports from the United States. Conversely, if export controls spurred firm innovation, we would expect $\beta > 0$ for the innovation measures.

Analogous to the import results, we also estimate a year-by-year version of Equation 1 to assess pre-trends and dynamic effects. We interact the firm treatment variable with indicators for each year of the sample, $\mathbb{I}_{t=j}$, treating 2006 as the omitted group. Coefficients β_j capture the year-by-year difference in the outcome y_{fct} among treated and untreated firms.

$$y_{fct} = \sum_{\substack{j=2001 \\ j \neq 2006}}^{2013} \beta_j Treat_f \times \mathbb{I}_{t=j} + \theta_f + \theta_{ct} + \mathbf{X}_f \times \delta_t + \varepsilon_{fct}. \tag{2}$$

3.1 Data

Sanctioned Products. We obtain the list of sanctioned ECCN products from U.S. BIS. We match ECCN codes to six-digit Harmonized System (HS) codes using a correspondence table provided by the E.U. Council.[16] We match HS six-digit codes to four-digit Chinese Industrial Code (CIC4) industries using a crosswalk from Brandt et al. (2017).

Imports. We measure Chinese trade flows using transaction-level data from China Customs, which are available from 2000 to 2016. For all import and export transactions, we observe total value, quantity, HS eight-digit product code, and source or destination country. We also observe characteristics of the importing or exporting firm, including its name, location, and ownership category.

[16] Source: Directorate-General for Financial Stability, Financial Services and Capital Markets Union, "Export-Related Restrictions for Dual-Use Goods and Advanced Technologies," 2023. https://finance.ec.europa.eu/publications/export-related-restrictions-dual-use-goods-and-advanced-technologies_en

Innovation. We obtain firm-level R&D data from China's National Bureau of Statistics. The data were collected for the years 2001–2013, excluding 2004. We note that, following a bureaucratic reorganization, the R&D module was transferred from the *Annual Survey of Industrial Production* (ASIP) to the *Industrial Firm Innovation Activity Database* (IFIAD) in 2008. The questions remained the same and the data are comparable (Cao et al., 2024).

Patent data come from the China National Intellectual Property Administration (CNIPA), which contains the universe of patent applications filed annually in China. From this database, we construct several firm-level measures of innovation. *Total Patents* denotes the total number of invention and utility patent applications filed by a firm in a given year. *Related Patents* refers to the number of invention and utility patent applications pertaining to controlled products.[17] *Other Patents* captures the number of patent applications on all remaining topics. Finally, *Active Inventors* measures the number of unique inventors listed on a firm's patent applications in a given year.

Other Firm Outcomes. We obtain firm balance sheets and income statements from the *Annual Survey of Industrial Production* (ASIP), 1998–2013. The ASIP is conducted each year by the National Bureau of Statistics (NBS). These data cover large manufacturing firms with annual revenues above 5 million RMB (approximately 609,000 USD in 2000). We omit the 2010 survey from our sample due to documented data quality issues (Brandt et al., 2020). The data contain a rich set of variables related to firm production, including sales, profits, capital, employment, and intermediate inputs. To link firm outcomes to trade flows, we merge the Customs and ASIP data using firm names.[18] Given the temporal coverage of the Customs data and firm data, our final regression sample includes 2000 through 2013, excluding 2010.[19]

[17]We match International Patent Classification (IPC) codes to ECCN codes using a large language model. Appendix B provides details on this procedure.

[18]We match these datasets using firm names. To improve matching efficiency, we first clean firms' names as follows: (1) we delete spaces, punctuation marks, and other symbols; (2) we standardize all letters in firm and applicant names in capital form in English style; (3) we single out five high-frequency general terms by statistical analysis and drop them: "limited," "liability," "stock," "company," "factory;" and (4) we delete general terms for regions: "province," "autonomous region," "city," "district," "county." Then we match import data and patent data with ASIP data, year by year. The resulting merge covers 182,293 out of 791,574 unique ASIP firms and out of 629,424 unique Customs firms.

[19]Firm value-added and intermediate inputs are not reported in ASIP starting 2009. We calculate those variables following the process in Brandt et al. (2020) for 2011-2013. The necessary inputs for this calculation are not available

4 Results

Imports. We first analyze whether treated firms' imports of controlled goods declined relative to untreated firms. Subfigure 2a displays the year-by-year estimates for firm-level imports of controlled goods in treated relative to untreated firms. We observe a striking decline in treated imports at exactly 2007. We note that there is a slight upward pre-trend in treated imports, which could be due to anticipation among treated firms. However, these pre-trends would go against our observed treatment effect.

Table 1 reports the average treatment effects on import outcomes. Panel A reports extensive-margin responses, while Panel B reports the responses of the inverse hyperbolic sine of the outcomes, which also capture intensive-margin changes. The estimates in Table 1 indicate that treated firms were 18.2 percentage points less likely to import any treated goods, and imported 89.5% less value in treated imports.[20]

Were treated firms able to replace lost inputs, either through substitution or rerouting (Iyoha et al., 2024)? In Subfigure 2b, we display the analogous estimates for the outcome variable of importing any treated product from anywhere in the world. Column (3) of Table 1 shows that the likelihood of importing any controlled product from abroad dropped by 10.1 percentage points (Panel A), and the total value of such imports decreased by 55.4% (Panel B). These results suggest that firms were not able to completely replace inputs lost due to the policy by purchasing from the rest of the world. For completeness, we also perform these analyses at the HS 6-digit product, firm, and year level in Appendix Section D.

Innovation. Did affected firms adapt to export controls by innovating? We measure innovation using research and development (R&D) expenditures, total patent applications, total relevant patent applications, total applications in other areas, and the number of active inventors. Table 2 presents the results.

Column (1) shows that treated firms were 3.6 percentage points more likely to have positive

for 2009.

[20] Throughout the paper, we report magnitudes following calculations in Appendix Section C.

R&D expenditures, with a coefficient statistically significant at the $p < 0.01$ level. Panel B, column (1) shows that R&D spending grew by 49.1% relative to pre-period levels. Column (2) shows that treated firms were 2.8 percentage points more likely to have any patent, with a coefficient statistically significant at the $p < 0.01$ level, and that total patents increased by 41.3% relative to baseline. In columns (3) and (4), we separate patent applications into topics directly related to controlled technologies and other technologies. We find a 1.1 percentage point increase in having any patent applications related to controlled technologies and a 2.9 percentage point increase in having any patent applications in other technologies. The probability of having any active inventors increased by 2.3 percentage points (column (5)). The coefficients in Panel B correspond to increases of 65.1%, 41.6%, and 30.4% relative to baseline levels, respectively.

In Figure 3, we examine the dynamic response of R&D, patents, related patents, patents on other topics, and total active inventors. The omitted group is 2006, and we again note that data for R&D expenditures was not available in 2004. Subfigure 3a shows that the probability of having positive R&D expenditures increased sharply in the first two years after treatment and remained higher thereafter. We do not observe pre-trends in this variable. Similarly, Subfigure 3b shows that the probability of having any new patents increased after 2007 and remained higher for at least six years after treatment. We do not observe pre-trends. Next, we compare the response among patents on treated topics versus patents on other topics in Subfigures 3c and 3d. We observe an increase in both types, though the magnitude of the response is greater among patents on other topics. This result suggests that treated firms innovated in multiple dimensions, not just to replace their lost imports. Finally, in Subfigure 3e, we do not observe a large increase in active inventors.

Overall, we observe a marked increase in innovation activity in treated firms compared to control firms.

Firm Outcomes. We also test how export controls affected overall performance among treated firms. To do so, we estimate Equation 1 for the inverse hyperbolic sine of sales, profits, capital, workers, and intermediate inputs. Table A.4, columns (1) and (3) show that, in treated relative to control firms, sales and capital declined by 3.4% and 5.7% relative to baseline, respectively. Coefficients on other firm outcomes were not statistically significant.

4.1 Robustness

Matched Sample. One concern about our baseline specification is that importers of treated and left-out products were different in ways correlated with firm innovation and not addressed by our fixed effects and control variables. To address this possibility, we estimate treatment effects using a control group constructed via propensity score matching. We match treated and control firms one-to-one using nearest-neighbor matching without replacement, imposing a narrow caliper of 0.0001 to ensure close matches. The propensity score is estimated using a logistic regression of treatment status on a rich set of pre-treatment firm characteristics: pre-period mean of log sales, log capital, log employment, log materials, TFP, research and development expenditures, and patent count. We also match on the pre-period average growth rate of each of these variables and on two pre-period indicator variables: whether the firm had any research and development spending and whether the firm had any patents. We also include fixed effects for two-digit industry and year to account for sector and time-specific variation. We restrict the sample to the region of common support. Figure A.1 plots the percent standardized bias across each continuous pre-period covariate. The full sample shows the least balance; the treatment using left-out products improves balance substantially, and the matched sample decreases bias even further.

Table A.5 reports results for import outcomes, and Table A.6 presents corresponding results for innovation outcomes. We find a statistically significant decline in imports of controlled goods among treated firms relative to control firms. We also observe positive responses across all measures of innovation activity. However, the effect on R&D expenditures is no longer statistically significant, while all other innovation outcomes are significant at the 1% level.

Synthetic Difference-in-Differences. As an additional robustness check, we implement the synthetic difference-in-differences method of Arkhangelsky et al. (2021), which offers improved robustness to violations of parallel trends. Tables A.7 and A.8 report results for import and innovation outcomes, respectively. We continue to find declines in imports of controlled goods from both the U.S. and the rest of the world, though the effect on non-U.S. imports is no longer statistically distinguishable from zero. For innovation outcomes, the point estimates for both the extensive margin and the inverse hyperbolic sine transformation are positive and similar in magnitude to our baseline findings. However, statistical significance weakens: only the increase in related patents in Panel A remains significant, while only R&D expenditures, related patents, and active inventors remain statistically significant in Panel B, the inverse hyperbolic sine results. These lower levels of significance are likely due to the large reduction in sample size, as this method requires a fully balanced panel of firms. Re-estimating Tables 1 and 2 with a balanced panel of firms yields similar levels of precision.

Intellectual Property Infringement. One potential concern is that the observed increase in patent applications may reflect firms copying foreign technologies rather than engaging in genuine innovation. To examine this possibility, we estimate Equation 2 using two alternative outcome variables: (i) an indicator for whether any of a firm's patent applications from a given year were subsequently granted, and (ii) the inverse hyperbolic sine of the number of this measure.[21] Since 2008, China's Patent Law has explicitly defined "prior art" as "any technology known to the public domestically and/or abroad before the filing date of the patent application."[22] This definition implies that any application duplicating or closely resembling existing foreign patents would be rejected. Therefore, subsequently granted patents provide a measure of innovation that excludes potential instances of intellectual property theft. However, because patent applications can be rejected for many reasons, we are careful not to interpret the difference between filed and granted patents as a measure of IP theft.

Figure A.2 reports the coefficients of interest. For both measures of granted patents, we observe no pre-trends and an increase after 2007. These figures strongly suggest that our results are not

[21]The granted patent measure covers granted invention patents.

[22]Patent Law of the People's Republic of China. Article 22.

driven by IP infringement.

Additional Robustness. We next test whether potential omitted variables drive the innovation results. First, we consider whether SOEs and non-SOEs followed different innovation trajectories correlated with treatment. Appendix Tables A.9 and A.10, Panel A, report results controlling for ownership indicators interacted with year fixed effects. The baseline findings remain highly robust. Second, we examine whether market concentration within each four-digit industry could generate spurious results. We construct the Herfindahl-Hirschman Index (HHI) for each industry and interact it with year fixed effects. Appendix Tables A.9 and A.10, Panel B, show that the results are again robust.

We also consider the potential confounding role of China's WTO accession in 2001, which led to substantial changes in tariffs and trade flows. While year fixed effects capture the aggregate impact of WTO entry, differential effects across treated and untreated firms could still bias our estimates. To address this concern, Appendix Tables A.9 and A.10 report results with additional controls. Panel C adds total Chinese imports and exports by four-digit industry and year. Panel D includes Panel C controls and further adds Chinese imports and exports to the United States by four-digit industry and year. Panel E controls for Chinese tariffs on imported inputs and final goods as well as export rebates, also at the four-digit industry-year level. Across all specifications, the results remain highly robust.

4.2 Heterogeneity in the Innovation Response

We explore heterogeneity in the innovation response along four pre-period firm characteristics: ownership, exporting status, prior R&D investment, and prior patenting activity. Across these dimensions, the patterns point to differences in the breadth and intensity of the response, as well as to potential mechanisms underlying firms' innovative behavior.

State Ownership. To assess whether the innovation response was concentrated in state-owned enterprises or also present in the private sector, Appendix Table A.11 estimates Equation 1 separately by ownership. Columns (1) to (5) report results for SOEs and columns (6) to (10) for non-SOEs. The table shows that private firms drive the aggregate response, with large and statistically significant increases across our innovation measures. For SOEs, point estimates are generally positive but imprecisely estimated, likely driven by low power due to a very small sample.

Exporting Status. We next split firms by their pre-2007 exporting status. Appendix Table A.12 reports estimates of Equation 1 separately for exporters and non-exporters. Most firms in our sample are exporters, which is unsurprising given that both treated and control firms imported inputs prior to 2007 by construction. Among exporters, exposure to export controls is followed by statistically significant increases across all five innovation outcomes. Since patenting usually occurs when firms operate at or near the technological frontier, whereas R&D spending often serves broader purposes, this pattern is consistent with the interpretation that non-exporters are either catching up to the frontier or pursuing other forms of innovation, such as product design.

Pre-Period R&D Spending. Did firms that previously invest in R&D drive the response? Appendix Table A.13 reports estimates of Equation 1 separately for firms that had any R&D spending in the pre-period and those that did not. We observe an increase in both R&D and patenting activity across both groups of firms, though the magnitudes of the responses are comparable across groups. This suggests that not having prior R&D investments was not a barrier to later innovation.

Pre-Period Patent Applications. Did more firms with a history of patent applications exhibit a larger response in innovation? Appendix Table A.14 reports estimates of Equation 1 separately for firms that had any patent applications in the pre-period and those that did not. While we observe an increase in both R&D and patenting activity across both groups of firms, the response in total patent applications, relevant patent applications, other patent applications, and active inventors was larger among firms that had applied for patents before. This pattern suggests that there may be fixed costs in learning how to patent.

5 Domestic Suppliers

Do upstream domestic suppliers of restricted goods adjust their innovative activity in response to export controls? To examine this question empirically, we construct a matched sample of supplier firms. We identify firm-to-firm supplier relationships using the value-added tax (VAT) invoice dataset from the Chinese State Administration of Tax, which records all inter-firm transactions reported to the tax bureau. This dataset allows us to identify firms that have sold inputs to those in our baseline sample, along with the corresponding product codes.

A key limitation is that these data are only available beginning in 2014. We therefore use the 2014 supplier network and match it retroactively to our primary sample period of 2000–2013. Using the VAT data, we recover $368,144$ unique supplier-buyer pairs, where the buyers are firms that imported either a controlled or left-out HS6 product prior to 2007. Out of $10,382$ baseline firms, $7,207$ are successfully linked to upstream buyers in the VAT records. We then identify upstream suppliers for these matched firms. We match $92,792$ upstream manufacturing suppliers to firms in the ASIP dataset.

We then define treatment and control groups for the supplier analysis. A supplier is coded as treated if it meets two conditions: (1) it sells to a firm treated in the baseline (that is, it sells to a firm that imported a controlled HS6 product before 2007), and (2) it operates in a CIC4 industry corresponding to the controlled HS6 product. In Appendix Figure A.3, this group is labeled A1.

A supplier is assigned to the control group if it meets two alternative conditions: (1) it sells to a firm in the control group from the baseline (that is, it sells to a firm that imported a left-out HS6 product before 2007), and (2) it belongs to a CIC4 industry corresponding to a left-out HS6 product. This group is labeled B1 in Appendix Figure A.3.

Our supplier analysis sample thus comprises firms in groups A1 and B1. For the 89 firms that sell both treated products to a treated firm and left-out products to a control group firm (i.e., those in both A1 and B1), we assign them to the treated group (A1). The final sample includes 1,321 treated suppliers (A1) and 677 control suppliers (B1), for a total of 1,998 unique suppliers and 17,652 supplier-year observations.

Results. Table 3 reports the coefficient of interest from Equation 1 for the domestic supplier sample. While most outcomes are not statistically significant and have relatively small magnitudes, we observe a strong response in column (3). In Panel A, we find that the probability of filing any related patent increases by 4.4 percentage points among treated suppliers with $p < 0.01$. The coefficient in Panel B, column (3), implies that the number of related patents in treated firms increases by 0.07, an increase of 361% relative to baseline. We also observe a slight increase in the number of active inventors in Panel B, column (5). Figure 4 presents the time-varying treatment effects from Equation 2 on suppliers' innovation behavior. In line with Table 3, a clear response is evident only in Subfigure 4c, which shows a sustained increase in the probability of having any related patent application beginning in 2007 and continuing through the end of the sample period in 2013.

These findings suggest that export controls likely spurred innovation not only among exposed firms but also among their domestic suppliers of controlled products. The evidence suggests that directly affected firms responded to the loss of imported inputs by innovating across a broad range of domains, while domestic suppliers concentrated their innovation efforts in areas specifically related to the controlled products.

6 Conclusion

Export controls have become a defining feature of contemporary geoeconomic competition, yet systematic evidence on their consequences for targeted countries remains limited. This paper examines the 2007 U.S. "China Military Catch-All Rule" and provides causal evidence on how Chinese firms and their suppliers adjusted. We show that the controls sharply curtailed imports of targeted products, with limited substitution to other foreign suppliers. In response, directly affected firms increased R&D expenditures, patenting, and active inventors, while domestic suppliers more than quadrupled innovation in technologies related to restrictions. These findings reveal that export controls can unintentionally accelerate the very technological innovation they seek to suppress.

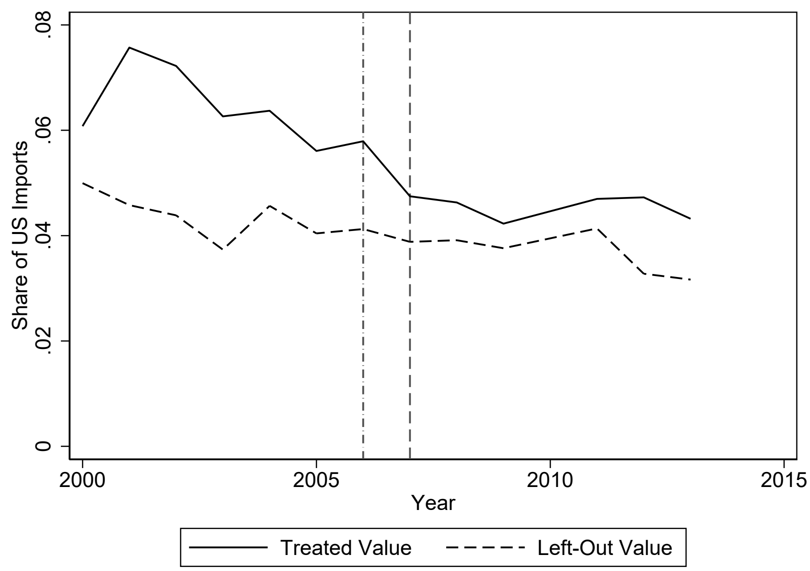
Our results highlight a core paradox of export controls: by cutting off immediate access to foreign technologies, they may catalyze adaptive innovation that diminishes the long-run advantage of the controlling country. This tradeoff underscores the need for policymakers to weigh carefully the strategic costs and benefits of export controls.

At the same time, our study points to important open questions. We document medium-run firm-level effects, but the durability of these innovation responses, and whether they translate into sustained technological upgrading and substantial productivity increases, remain to be examined. We also abstract from normative welfare considerations, such as whether our findings imply that export controls are overall ineffective and not worth pursuing or whether their benefits overweigh the costs of stimulating technological innovation in China.

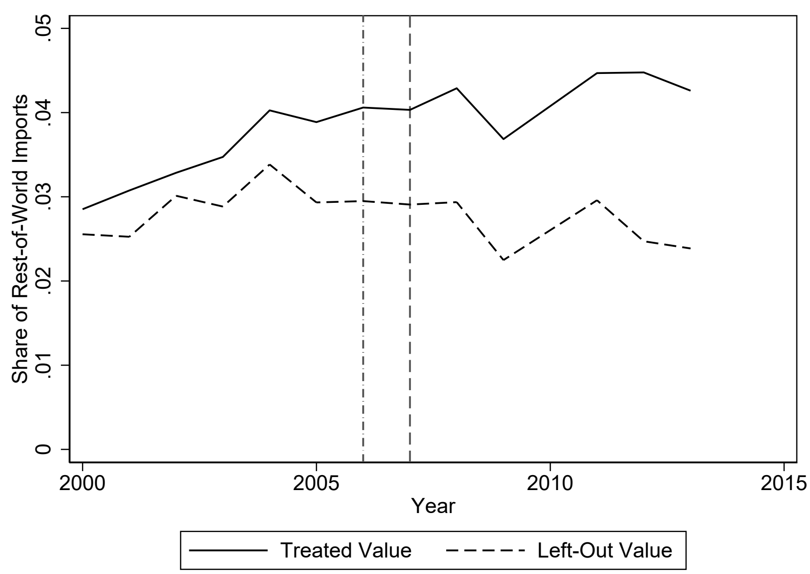
In sum, our analysis demonstrates that export controls can spur innovation in both relevant and broader domains in sanctioned countries. In doing so, we provide new evidence on the tradeoffs inherent in using economic policy for geo-strategic ends. As governments continue to expand the use of export restrictions, understanding the conditions under which they succeed or backfire will be central to both academic research and effective policy.

Figure 1: Treated and Left-Out Products' Share

(a) Share of China's Imports from US



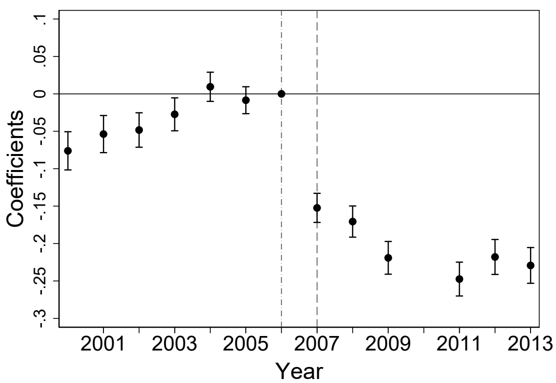
(b) Share of China's Imports from the Rest of the World



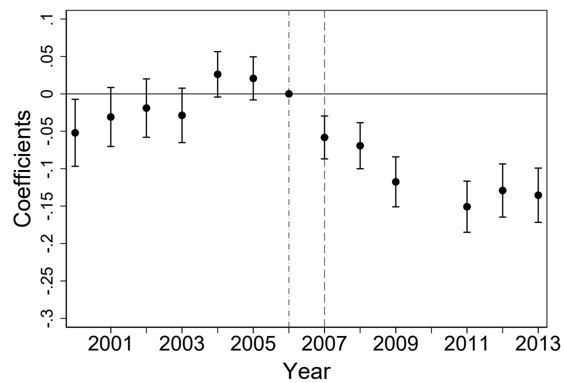
Notes: Panel (a) shows the shares of China's total import value from the US accounted for by treated and left-out products over time. Panel (b) presents the corresponding shares for China's imports from the rest of the world.

Figure 2: Import Response

(a) Firm Level - Any Treated Imports from the US

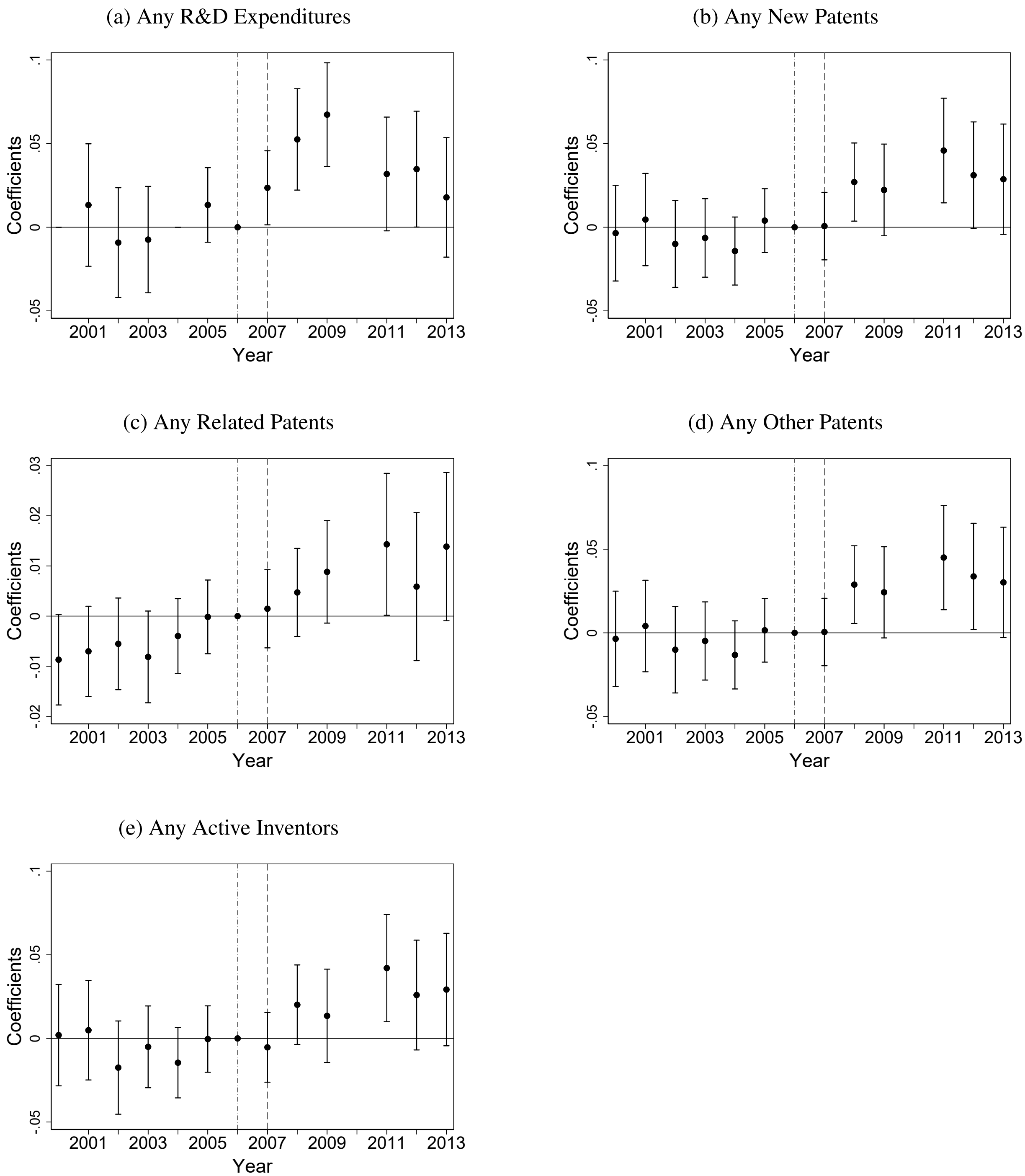


(b) Firm Level - Any Treated Imports from the World



Notes: These figures plot the year-by-year treatment coefficients from Equation 2. The specification includes firm fixed effects, county-by-year fixed effects, and interactions of pre-period firm characteristics with year fixed effects. The pre-period characteristics include average pre-2007 firm sales growth, R&D spending, patent counts, and inventor counts. Standard errors are clustered at the firm level. The bars represent 95% confidence intervals.

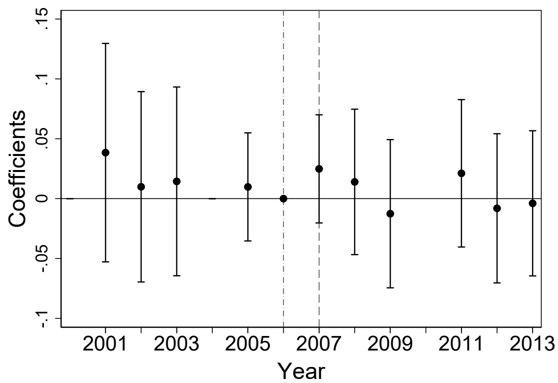
Figure 3: Firm Innovation



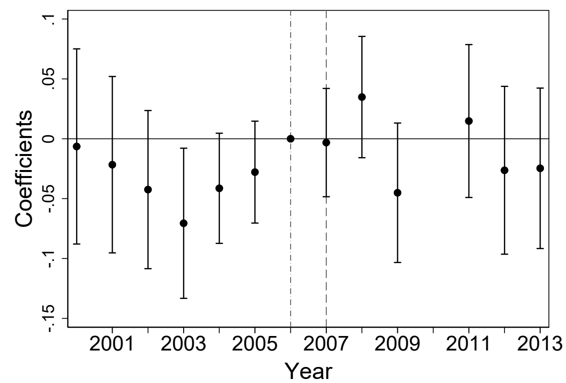
Notes: These figures plot the year-by-year treatment coefficients from Equation 2. The specification includes firm fixed effects, county-by-year fixed effects, and interactions of pre-period firm characteristics with year fixed effects. The pre-period characteristics include average pre-2007 firm sales growth, R&D spending, patent counts, and inventor counts. Standard errors are clustered at the firm level. The bars represent 95% confidence intervals.

Figure 4: Domestic Supplier Innovation

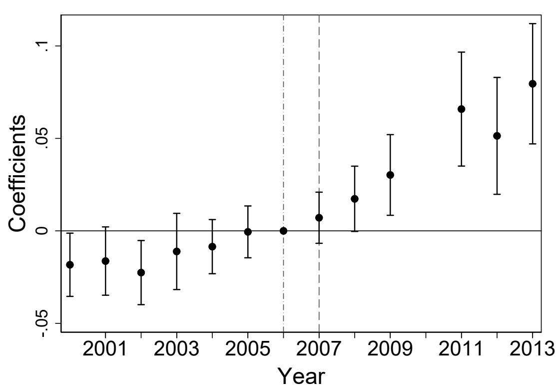
(a) Any R&D Expenditures



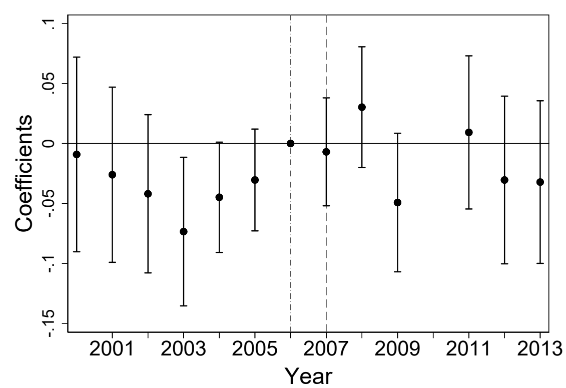
(b) Any New Patents



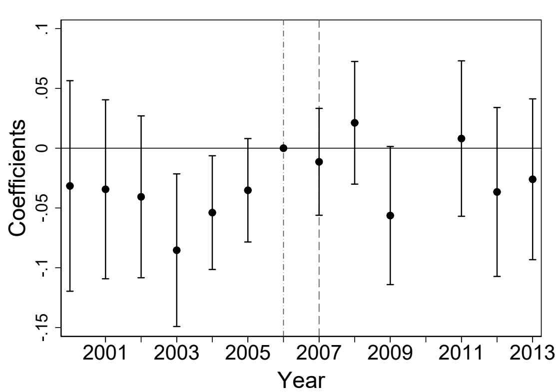
(c) Any Related Patents



(d) Any Other Patents



(e) Any Active Inventors



Notes: These figures plot the year-by-year treatment coefficients from Equation 2 for the domestic supplier sample. The specification includes firm fixed effects, county-by-year fixed effects, and interactions of pre-period firm characteristics with year fixed effects. The pre-period characteristics include average pre-2007 firm sales growth, R&D spending, patent counts, and inventor counts. Standard errors are clustered at the firm level. The bars represent 95% confidence intervals.

Table 1: Firm Imports

	(1)	(2)	(3)
	Imports of Controlled Goods from:		
	U.S.	Non-U.S.	World
	Panel A: I(Outcome > 0)		
Pre-2007 Mean	*0.27*	*0.46*	*0.53*
Treat x Post-2007	-0.182***	-0.038***	-0.101***
	(0.006)	(0.010)	(0.011)
Observations	73,092	73,092	73,092
R-squared	0.452	0.551	0.519
	Panel B: Asinh(Outcome)		
Pre-2007 Mean	*3.69*	*7.68*	*8.03*
Treat x Post-2007	-2.200***	-0.076	-0.808***
	(0.082)	(0.157)	(0.154)
Observations	54,852	50,059	55,162
R-squared	0.573	0.660	0.663

Notes: Observations are at the firm-year level. All regressions include firm fixed effects, county-by-year fixed effects, and continuous pre-period average sales, R&D spending, patent count, relevant patent count, and active inventors, each interacted with year fixed effects. Standard errors are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

Table 2: Firm Innovation

	(1)	(2)	(3)	(4)	(5)
	R&D Expenditures	Total Patents	Related Patents	Other Patents	Active Inventors
			Panel A: I(Outcome > 0)		
Pre-2007 Mean	*0.32*	*0.12*	*0.02*	*0.12*	*0.14*
Treat x Post-2007	0.036***	0.028***	0.011***	0.029***	0.023***
	(0.011)	(0.008)	(0.003)	(0.008)	(0.009)
Observations	62,353	73,092	73,092	73,092	73,092
R-squared	0.613	0.559	0.505	0.558	0.564
			Panel B: Asinh(Outcome)		
Pre-2007 Mean	*2.43*	*0.24*	*0.04*	*0.23*	*0.31*
Treat x Post-2007	0.395***	0.096***	0.026***	0.093***	0.090***
	(0.096)	(0.022)	(0.007)	(0.022)	(0.024)
Observations	62,353	73,092	73,092	73,092	73,092
R-squared	0.672	0.667	0.688	0.659	0.690

Notes: Observations are at the firm-year level. All regressions include firm fixed effects, county-by-year fixed effects, and continuous pre-period average sales, R&D spending, patent count, relevant patent count, and active inventors, each interacted with year fixed effects. Standard errors are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

Table 3: Firm Innovation - Suppliers

	(1)	(2)	(3)	(4)	(5)
	R&D Expenditures	Total Patents	Related Patents	Other Patents	Active Inventors
	Panel A: I(Outcome > 0)				
Pre-2007 Mean	*0.36*	*0.14*	*0.02*	*0.14*	*0.15*
Treat x Post-2007	-0.002	0.022	0.044***	0.019	0.020
	(0.020)	(0.017)	(0.007)	(0.017)	(0.017)
Observations	15,444	17,652	17,652	17,652	17,652
R-squared	0.665	0.586	0.526	0.581	0.594
	Panel B: Asinh(Outcome)				
Pre-2007 Mean	*2.51*	*0.24*	*0.02*	*0.23*	*0.30*
Treat x Post-2007	0.107	0.039	0.072***	0.018	0.073*
	(0.160)	(0.042)	(0.012)	(0.042)	(0.043)
Observations	15,444	17,652	17,652	17,652	17,652
R-squared	0.727	0.651	0.618	0.642	0.677

Notes: Observations are at the firm-year level. All regressions include firm fixed effects, county-by-year fixed effects, and continuous pre-period average sales, R&D spending, patent count, relevant patent count, and active inventors, each interacted with year fixed effects. Standard errors are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

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Online Appendix

A Excerpts from the 2007 China Rule

In this appendix, we present excerpts from the final version of the China Rule (Padilla, 2007) for reference. The passage below provides a summary of the rule itself.

> In this final rule, the Bureau of Industry and Security (BIS) amends the Export Administration Regulations (EAR) to revise and clarify US licensing requirements and licensing policy on exports and reexports of items to the People's Republic of China (PRC). BIS published a revised policy and related amendments in proposed form in the Federal Register with a request for comments.
>
> This final rule establishes a control, based on knowledge of a "military end-use," on exports and reexports to the PRC of certain items on the Commerce Control List (CCL) that otherwise do not require a license to the PRC. It also includes a revision to the license application review policy for items destined for the PRC that are controlled on the CCL for reasons of national security and revises the license review policy for items controlled for reasons of chemical and biological weapons proliferation, nuclear nonproliferation, and missile technology for export to the PRC, requiring that applications involving such items be reviewed in conjunction with the revised national security licensing policy.
>
> This rule also creates a new authorization for "validated end-users" to which specified items may be exported or reexported without a license. Validated end-users will be placed on a list in the EAR after review and approval by the United States Government. The process for such review is also set forth in this final rule.
>
> This rule also revises the circumstances in which End-User Statements, issued by the PRC Ministry of Commerce (MOFCOM), must be obtained, requiring them for trans-

> actions that both require a license to the PRC for any reason and (for most exports) exceed a total value of $50,000.
>
> This final rule also includes other minor corrections and conforming amendments.

The next passage explains the intended purpose of the rule as well as major events during the rule's proposal and revision process.

> It is the policy of the United States Government to facilitate US exports to legitimate civilian end-users in the People's Republic of China (PRC), while preventing exports that would enhance the military capability of the PRC. Consistent with this policy, the Bureau of Industry and Security (BIS) is amending the Export Administration Regulations (EAR) by revising and clarifying United States licensing requirements and licensing policy on exports and reexports of goods and technology to the PRC. As the PRC has increased its participation in the global economy, bilateral trade has grown rapidly, and the PRC has emerged as a major market for US exports and investment. This greatly expanded economic relationship is beneficial for both nations, and has increased the prosperity of both the American and Chinese people. The United States therefore seeks to encourage and facilitate exports to legitimate civil end-users in the PRC. At the same time, the United States has a longstanding policy of not permitting exports that would make a direct and significant contribution to the PRC's military capability. Moreover, the United States has an interest in restricting exports of certain dual-use products and technologies that would not otherwise need an export license, if those items are destined for a "military end-use" in the PRC. BIS is therefore amending the EAR to revise and clarify US licensing requirements and licensing policy on exports and reexports of items to the PRC, and to establish a new authorization that is intended to facilitate exports to validated civilian end-users in the PRC. On July 6, 2006, BIS published a proposed rule and requested public comments (71 FR 38313). On October 19, 2006, the original comment period deadline of November 3, 2006 was extended until December 4, 2006 (71 FR 61692). The detailed rationale for the

proposed rule's provisions is provided in the preamble to the proposed rule and is not repeated here. In general, however, this rule proposes certain revisions and clarifications to licensing requirements and policies with regard to the PRC to more precisely reflect US foreign policy and national security interests.

This passage then details the three major components of the policy: updated licensing requirements, the Validated End-User program, and updated end-user statement requirements.

Revision of Licensing Review Policy and License Requirements

To strengthen efforts to prevent US exports to the PRC that would enhance the PRC's military capabilities, this rule revises the licensing review policy for items controlled on the Commerce Control List for reasons of national security. Specifically, this rule amends section 742.4(b)(7) to make clear that the overall policy of the United States for exports to the PRC of these items is to approve exports for civil end-uses but generally to deny exports that will make a direct and significant contribution to Chinese military capabilities. BIS makes further revisions to the EAR to clarify that it will review license applications to export or reexport to the PRC items controlled for chemical and biological weapons proliferation, nuclear nonproliferation, and missile technology under sections 742.2, 742.3 and 742.5, respectively, of the EAR, in accordance with the licensing policies in both paragraph (b) of the applicable section and with the revised licensing policy in paragraph 742.4(b)(7) of the EAR, which provides a presumption of denial for license applications to export, reexport, or transfer items that would make a direct and significant contribution to the PRC's military capabilities such as, but not limited to, the major weapons systems described in new Supplement No. 7 to Part 742 of the EAR. This rule also implements a new control on exports to the PRC of certain CCL items that otherwise do not require a license to the PRC when the exporter has knowledge, as defined in section 772.1 of the EAR, that such items are destined for "military end-use" in the PRC or is informed that such items are destined for such an end-use. The list of items subject to this "military end-use" restriction covers approximately 20 products and associated technologies, as described in the entries of 31 full or partial Export Control Classification Numbers (ECCNs). The list was based on a review of public comments and a careful interagency review of items listed on the CCL that currently do not require a license for export to the PRC but have the potential to advance the military capabilities of the PRC. Applications to export, reexport, or transfer items controlled pursuant to the "military end-use" control will be reviewed on a case-by-case basis to determine whether the export, reexport, or transfer will make a material contribution to the military capabilities of the PRC and would result in advancing the country's military activities contrary to the national security interests of the United States. Other end-use controls in part 744 of the EAR continue to apply.

New Authorization Validated End-User (VEU)

To facilitate legitimate exports to civilian end-users, BIS establishes in this rule a new authorization Validated End-User. The authorization will allow the export, reexport, and transfer of eligible items to specified end-users in an eligible destination, initially the PRC. Validated end-users will be those entities that meet a number of criteria, including a demonstrated record of engaging only in civil end-use activities. This rule outlines clear procedures to request Validated End-User authorization, the procedures and timelines to be used by an interagency committee established to consider such requests, and the criteria for evaluating requests.

Revision of End-User Statement Requirements

To strengthen implementation of the April 2004 end-use visit understanding between the Vice Minister of Commerce of the PRC and the US Under Secretary of Commerce for Industry and Security, this rule requires exporters to obtain PRC End-User Statements from the Ministry of Commerce of the PRC for all exports of items on the CCL requiring a license to the PRC over a specific value, which for most exports will be a new, higher threshold of $50,000. BIS anticipates that this change will facilitate BIS's ability to conduct enduse checks on exports or reexports of controlled goods and technologies to the PRC, consistent with the existing enduse visit understanding with the Government of the PRC, without resulting in an overall annual increase in the number of such statements required from US exporters. The facilitation of end-use checks should, in turn, facilitate increased US exports to the PRC.

B Data Appendix

IPC to HS 6-digit Crosswalk Construction. To connect innovation data with trade and export control data, we build a crosswalk between three coding systems: IPC (International Patent Classification), HS6 (six-digit Harmonized System trade codes), and ECCN (Export Control Classification Numbers). The process unfolds in several steps.

Step 1: Improve IPC descriptions. The original IPC labels are often short and vague, so we first expand them into clearer descriptions. For example, we expand the IPC labels to distinguish between phrases like "hand cultivators with a single blade" and "hand cultivators with two or more blades." This ensures that subtle but important technological differences are preserved.

Step 2: Create text embeddings. We convert these enriched IPC descriptions into machine-readable vectors using PatentBERT, a language model trained specifically for patent text.[23] This allows us to compare them systematically to product descriptions from trade and export control data.

Step 3: Match IPCs to HS6 and ECCNs. We then take known matches between HS6 codes and ECCNs, along with their joint descriptions, and compare them against the enriched IPC descriptions. Each match received a similarity score on a scale of 0 to 10, with 10 being a perfect match. We discard all matches with similarity score below 6.

[23] https://arxiv.org/abs/1906.02124

Step 4: Verify quality. Finally, we manually review all suggested matches. We manually classify each match as either correct or incorrect and retain only the correct matches.

The end result is a three-way crosswalk between IPCs, HS6 codes, and ECCNs. This dataset makes it possible to link export controls, patents, and trade flows in a consistent way.

C Magnitudes

To compute magnitudes from coefficients when the outcome variable is transformed using the inverse hyperbolic sine function, defined as

$$\text{asinh}(y) = \log\left(y + \sqrt{y^2+1}\right),$$

consider a value x that represents $\text{asinh}(y)$. In this case,

$$y = \frac{e^x - e^{-x}}{2}.$$

To interpret the coefficient β in percentage terms of y, we apply the hyperbolic sine function:

$$\frac{\left(\frac{e^{\bar{x}+\hat{\beta}} - e^{-\bar{x}-\hat{\beta}}}{2}\right) - \bar{x}}{\bar{x}},$$

where $\hat{\beta}$ is the estimated coefficient.

D Product-Firm Level Import Analysis

One concern about using Equation 1 to estimate the response of Chinese imports of controlled imports is that different product categories may be exposed to different shocks over time. As the baseline estimates take place at the firm level, we cannot control for such shocks. As a result, we perform a related analysis at the HS 6-digit product-firm-year level here. We estimate:

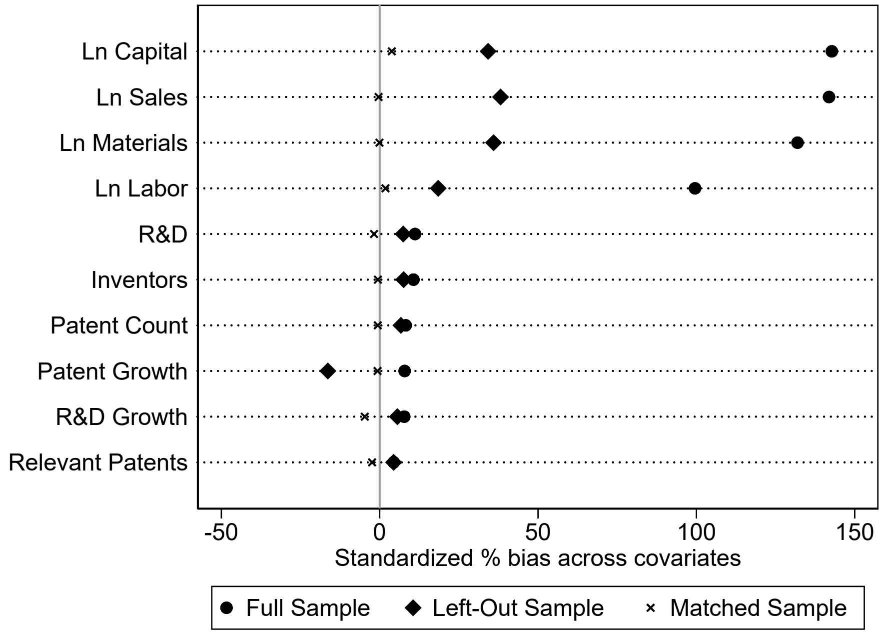
$$y_{f,hs6,t} = \beta Treat_{hs6} \times \mathbb{I}_{t \geq 2007} + \theta_f + \theta_{hs6} + \theta_{hs4,t} + \varepsilon_{f,hs6,t}, \tag{3}$$

where f indexes firms, $hs6$ indexes six-digit HS products, $hs4$ indexes four-digit HS products, and t indexes years. Each observation is at the firm, six-digit product, and year level. $Treat_{hs6}$ is an indicator that equals one if the six-digit HS product was ever subject to an export control and zero if it was initially listed as a controlled item but removed during deliberations. $\mathbb{I}_{t \geq 2007}$ is an indicator that equals one if the year is 2007 or later and zero otherwise.

The specification controls for firm fixed effects, θ_f, six-digit HS product fixed effects, θ_{hs6}, and four-digit HS product-by-year fixed effects, $\theta_{hs4,t}$. The firm fixed effects absorb average differences in imports across firms, so that we rely on differences in imports across products within a given firm and year. The six-digit HS product fixed effects address the possibility that some six-digit products are always imported more. Finally, the four-digit HS product-by-year fixed effects ensure that we control for differences in imports over time by broad product group. We cluster standard errors at the six-digit HS level (77 clusters), leading to relatively low statistical power.

Subfigures A.4a and A.4b present year-by-year estimates of Equation 3. We find no evidence of pre-trends in the likelihood of importing treated versus untreated goods from the U.S. Prior to 2007, trends are flat; following 2007, imports of treated goods decline and remain lower through 2013. A similar pattern holds for imports from the rest of the world. Appendix Table A.15, reports coefficients from estimating Equation 3. Across both the extensive margin (Panel A) and the inverse hyperbolic sine of imports (Panel B), the point estimates are consistently negative. Only three coefficients reach significance at the 10% level, Panel A, column (3); Panel B, columns (1) and (3), a result consistent with limited statistical power due to the small number of clusters.

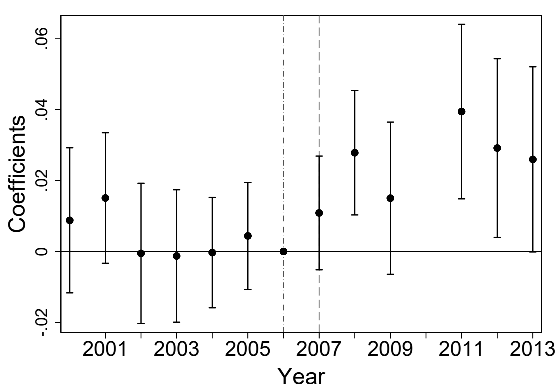
Figure A.1: Balance Over Pre-Period Observables



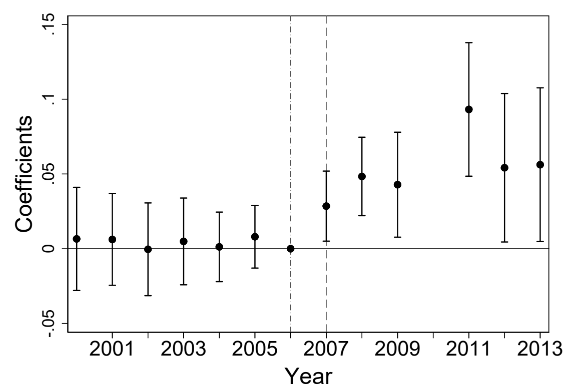
Notes: This figure plots the percent standardized bias across each continuous pre-period covariate for the full sample, the baseline left-out control group sample, and the matched sample.

Figure A.2: Firm Innovation - Subsequently-Granted Patents

(a) Any New Invention Patents, Granted



(b) Asinh(New Invention Patents, Granted)



Notes: These figures plot the year-by-year treatment coefficients from Equation 2. The specification includes firm fixed effects, county-by-year fixed effects, and interactions of pre-period firm characteristics with year fixed effects. The pre-period characteristics include average pre-2007 firm sales growth, R&D spending, patent counts, and inventor counts. Standard errors are clustered at the firm level. The bars represent 95% confidence intervals.

Figure A.3: Supplier Sample Construction

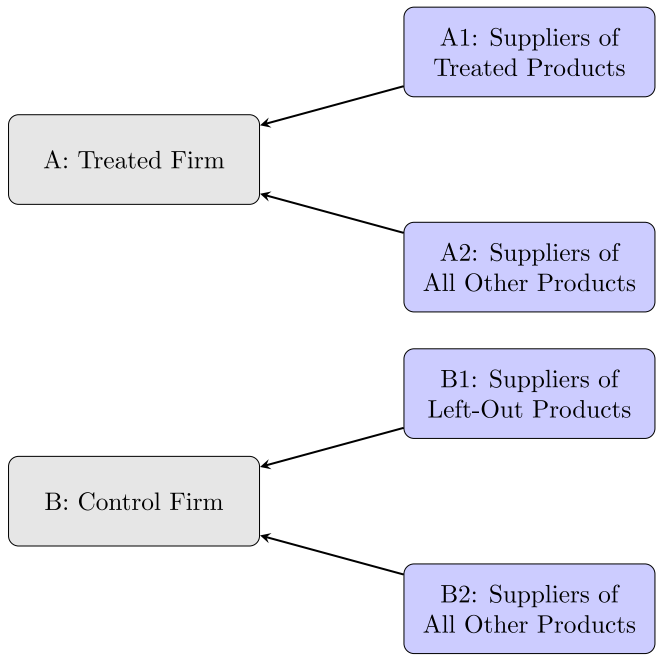
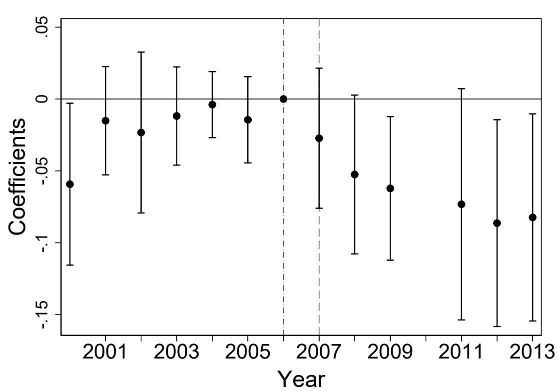
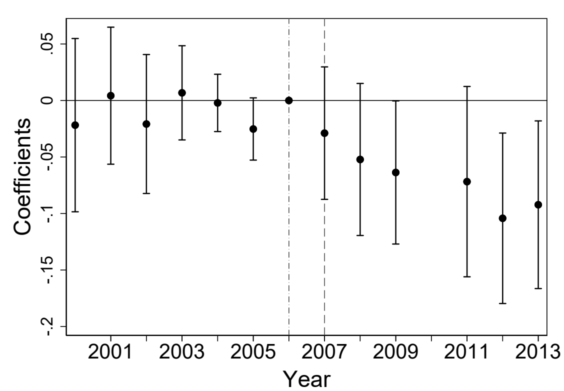


Figure A.4: Import Response, Product-Firm Level

(a) Any Treated Imports from the US



(b) Any Treated Imports from the World



Notes: The specification controls for firm fixed effects, six-digit HS product fixed effects, and four-digit HS product-by-year fixed effects. Standard errors are clustered at the six-digit HS level (77 clusters). The bars represent 95% confidence intervals.

Table A.1: List of Treated Products

HS6	Percent of Imports from US*	HS6 Product Description
284430	.001%	Uranium; depleted in U235 thorium their compounds alloys dispersions (including cermets) ceramic products and mixtures containing uranium depleted in U235 thorium; compounds of these products
381900	.003%	Hydraulic fluids; for brakes and other prepared liquids for hydraulic transmission not containing or containing less than 70% by weight of petroleum oils or oils obtained from bituminous minerals
540210	.009%	Yarn; (not sewing thread) high tenacity yarn of nylon or other polyamides (including synthetic monofilament of less than 67 decitex) not put up for retail sale
550110	.008%	Fibres; synthetic filament tow of nylon or other polyamides
550310	.039%	Fibres; synthetic staple fibres of nylon or other polyamides not carded combed or otherwise processed for spinning
681510	.002%	Stone articles and other mineral substances non-electrical articles of graphite or other carbon
681599	.007%	Stone articles and articles of other mineral substances; n.e.s. or included in heading no. 6815
841111	.086%	Turbo-jets; of a thrust not exceeding 25kN
841112	1.056%	Turbo-jets; of a thrust exceeding 25kN
841121	.014%	Turbo-propellers; of a power not exceeding 1100kW
841122	.066%	Turbo-propellers; of a power exceeding 1100kW
841191	.142%	Turbines; parts of turbo-jets and turbo-propellers
845710	.038%	Machining centres; for working metal
845720	.031%	Machines; unit construction machines (single station) for working metal
845730	.035%	Metal machines; multi-station transfer machines for working metal
845811	.032%	Lathes; for removing metal horizontal numerically controlled
845819	.006%	Lathes; for removing metal horizontal other than numerically controlled
845891	.028%	Lathes; for removing metal numerically controlled other than horizontal lathes
845899	.005%	Lathes; for removing metal other than horizontal or numerically controlled lathes
845910	.020%	Machine-tools; way-type unit head machines for drilling boring milling threading or tapping by removing metal other than lathes of heading no. 8458
845931	.022%	Machine-tools; for boring-milling by removing metal numerically controlled
845951	.005%	Machine-tools; for milling by removing metal knee-type numerically controlled
845961	.033%	Machine-tools; for milling by removing metal (not knee-type) numerically controlled
846011	.014%	Machine-tools; flat-surface grinding machines in which positioning in any one axis can be set up to an accuracy of 0.01mm or better numerically controlled
846019	.006%	Machine-tools; flat-surface grinding machines in which positioning in any one axis can be set up to an accuracy of 0.01mm or better other than numerically controlled
846021	.035%	Machine-tools; grinding machines (other than flat-surface) in which positioning in any one axis can be set up to at least an accuracy of 0.01mm numerically controlled
846029	.011%	Machine-tools; grinding machines (other than flat-surface) in which positioning in any one axis can be set up to at least an accuracy of 0.01mm other than numerically controlled
847130	.002%	Data processing machines; portable digital and automatic weighing not more than 10kg consisting of at least a central processing unit a keyboard and a display
847141	.033%	Data processing machines; digital automatic (not portable analogue or hybrid) comprising in the same housing at least a central processing unit an input and output unit whether or not combined
847149	.066%	Data processing machines; digital automatic (not portable analogue or hybrid) presented in the form of systems n.e.s. in item no. 8471.41
847150	.022%	Digital processing units; other than those of subheadings 8471.41 and 8471.49 whether or not containing in the same housing one or two of the following types of unit storage units input units or output units
847180	.017%	Data processing machines; automatic units thereof n.e.s. in heading no. 8471
848210	.002%	Ball bearings
848280	.002%	Bearings; n.e.s. in heading no. 8482 including combined ball/roller

Notes: *Imports of a given HS 6-digit product times 100 divided by total Chinese imports from the U.S. 2000-2007 average.

Table A.2: List of Treated Products - Continued

HS6	Percent of Imports from US*	HS6 Product Description
851730	.034%	Line telephony or telegraphy apparatus; telephonic or telegraphic switching apparatus
851750	.057%	Line telephony or telegraphy apparatus; n.e.s. in heading no. 8517 for carrier-current line systems or for digital line systems
851790	.054%	Line telephony or telegraphy apparatus; electrical parts of the apparatus of heading no. 8517
851830	.001%	Headphones earphones and combined microphone\/speaker sets
852510	.029%	Transmission apparatus; for radio-telephony radio-telegraphy radio-broadcasting or television whether or not incorporating reception or sound recording and reproducing apparatus
852520	.048%	Transmission apparatus; for radio-telephony radio-telegraphy radio-broadcasting or television with reception apparatus with or without sound recording or reproducing apparatus
852691	.018%	Radio navigational aid apparatus
852790	.012%	Reception apparatus; for radio-telephony radio-telegraphy or radio-broadcasting whether or not combined in the same housing n.e.s. in heading no. 8527
852990	.054%	Reception and transmission apparatus; for use with the apparatus of heading no. 8525 to 8528 excluding aerials and aerial reflectors
900110	.065%	Optical fibres optical fibre bundles and cables; excluding those of heading no. 8544
900630	.006%	Cameras photographic (excluding cinematographic); specially designed for underwater use aerial survey medical or surgical examination of internal organs; comparison cameras for forensic or criminological use
901320	.012%	Lasers; other than laser diodes
901410	.001%	Navigational instruments and appliances; direction finding compasses
901420	.017%	Navigational instruments and appliances; for aeronautical or space navigation (excluding compasses)
901490	.005%	Navigational instruments and appliances; parts and accessories
902219	.012%	Apparatus based on the use of x-rays including radiography or radiotherapy apparatus; for other than medical surgical dental or veterinary uses
902229	.011%	Apparatus based on the use of alpha beta or gamma radiations including radiography or radiotherapy apparatus; (for other than medical surgical dental or veterinary uses)
902230	.022%	X-ray tubes
902290	.021%	Apparatus based on use of x-rays and similar; parts and accessories (x-ray generators tubes high tension generators control panels and desks screens examination or treatment tables chairs and like
902920	.001%	Meters; speed indicators and tachometers; stroboscopes
903020	.005%	Cathode-ray oscilloscopes and cathode-ray oscillographs
903082	.045%	Instruments and apparatus; for measuring or checking semiconductor wafers or devices
903149	.009%	Optical instruments and appliances; for measuring or checking n.e.s. in chapter 90
903180	.011%	Instruments appliances and machines; for measuring or checking n.e.s. in chapter 90
940540	.002%	Lamps and light fittings; electric n.e.s. in heading no. 9405

Notes: *Imports of a given HS 6-digit product times 100 divided by total Chinese imports from the U.S. 2000-2007 average.

Table A.3: List of Left-Out Products

HS6	Percent of Imports from US*	HS6 Product Description
382200	.011%	Reagents; diagnostic or laboratory reagents on a backing and prepared diagnostic or laboratory reagents whether or not on a backing other than those of heading no. 3002 or 3006
700220	.031%	Glass; unworked in rods
842199	.005%	Machinery; parts for filtering or purifying liquids or gases
844519	.048%	Textile machinery; n.e.s. in heading no. 8445 for preparing ile fibres
845180	.012%	Machinery; for wringing dressing finishing coating or impregnating ile yarns fabrics or made up ile articles; for applying paste to base fabric used in manufacture of floor coverings
846140	.040%	Machine-tools; gear cutting gear grinding or gear finishing machines working by removing metal sintered metal carbides or cermets
846420	.046%	Machine-tools; grinding or polishing machines for working stone ceramics concrete asbestos-cement or like mineral materials or for cold working glass
847780	.017%	Machinery; for working rubber or plastics n.e.s. in heading no. 8477
847989	.036%	Machines and mechanical appliances; n.e.s. in item no. 8479.8 having individual functions
903010	.004%	Instruments and apparatus; for measuring or detecting ionising radiations
903031	.001%	Multimeters; for measuring or checking voltage current resistance or power without a recording device
903039	.003%	Instruments and apparatus; for measuring or checking voltage current resistance or power without a recording device (excluding multimeters)
903040	.015%	Instruments and apparatus; specially designed for telecommunications (eg cross-talk meters gain measuring instruments distortion factor meters psophometers)
903083	.009%	Instruments and apparatus; for measuring or detecting alpha beta gamma x-ray cosmic or other ionising radiations with a recording device
903089	.008%	Instruments and apparatus; for measuring or detecting alpha beta gamma x-ray cosmic or other ionising radiations without a recording device
903090	.009%	Instruments apparatus for measuring checking electrical quantities not meters of heading no. 9028; parts and accessories for measuring or detecting alpha beta gamma x-ray cosmic and other radiations
903120	.016%	Test benches
903141	.042%	Optical instruments and appliances; for inspecting semiconductor wafers or devices or for inspecting photomasks or reticles used in manufacturing semiconductor devices n.e.s. in chapter 90

Notes: *Imports of a given HS 6-digit product times 100 divided by total Chinese imports from the U.S. 2000-2007 average.

Table A.4: Firm Performance

	(1) Asinh(Sales)	(2) Asinh(Profits)	(3) Asinh(Capital)	(4) Asinh(Workers)	(5) Asinh(Inter. Inputs)
Pre-2007 Mean	*12.47*	*5.84*	*11.26*	*6.60*	*12.14*
Treat x Post-2007	-0.035*	0.247	-0.059**	-0.015	-0.007
	(0.019)	(0.189)	(0.024)	(0.019)	(0.023)
Observations	73,092	73,089	73,092	73,092	67,069
R-squared	0.935	0.472	0.921	0.875	0.898

Notes: Observations are at the firm-year level. All regressions include firm fixed effects, county-by-year fixed effects, and continuous pre-period average sales, R&D spending, patent count, relevant patent count, and active inventors, each interacted with year fixed effects. Standard errors are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

Table A.5: Firm Imports - Matched Sample

	(1)	(2)	(3)
	Imports of Controlled Goods from:		
	U.S.	Non-U.S.	World
	Panel A: I(Outcome > 0)		
Pre-2007 Mean	*0.07*	*0.16*	*0.17*
Treat x Post-2007	-0.145***	-0.107***	-0.152***
	(0.014)	(0.019)	(0.020)
Observations	30,340	30,340	30,340
R-squared	0.572	0.634	0.635
	Panel B: Asinh(Outcome)		
Pre-2007 Mean	*4.19*	*6.79*	*6.96*
Treat x Post-2007	-3.281***	-0.896**	-1.715***
	(0.372)	(0.372)	(0.354)
Observations	4,594	7,340	7,832
R-squared	0.684	0.719	0.720

Notes: Observations are at the firm-year level. All regressions include firm fixed effects, county-by-year fixed effects, and continuous pre-period average sales, R&D spending, patent count, relevant patent count, and active inventors, each interacted with year fixed effects. Standard errors are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

Table A.6: Firm Innovation - Matched Sample

	(1) R&D Expenditures	(2) Total Patents	(3) Related Patents	(4) Other Patents	(5) Active Inventors
	Panel A: I(Outcome > 0)				
Pre-2007 Mean	*0.83*	*0.59*	*0.05*	*0.58*	*0.62*
Treat x Post-2007	0.022	0.053***	0.067***	0.057***	0.049***
	(0.017)	(0.018)	(0.013)	(0.019)	(0.018)
Observations	25,762	30,340	30,340	30,340	30,340
R-squared	0.439	0.424	0.567	0.424	0.430
	Panel B: Asinh(Outcome)				
Pre-2007 Mean	*6.46*	*1.08*	*0.09*	*1.06*	*1.45*
Treat x Post-2007	0.095	0.329***	0.181***	0.315***	0.342***
	(0.167)	(0.063)	(0.033)	(0.062)	(0.066)
Observations	25,762	30,340	30,340	30,340	30,340
R-squared	0.625	0.661	0.744	0.655	0.651

Notes: Observations are at the firm-year level and are from the merged Customs-ASIP sample. The data cover 2000-2013, except 2010. All regressions include firm fixed effects, county-by-year fixed effects, and industry-specific time trends. Standard errors are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

Table A.7: Firm Imports - Synthetic Difference-in-Differences

	(1)	(2)	(3)
	Imports of Controlled Goods from:		
	U.S.	Non-U.S.	World
	Panel A: I(Outcome > 0)		
Treat x Post-2007	-0.142***	-0.021	-0.075***
	(0.009)	(0.019)	(0.019)
Observations	25,441	25,441	25,441
	Panel B: Asinh(Outcome)		
Treat x Post-2007	-1.784***	0.411	-0.131
	(0.211)	(0.310)	(0.362)
Observations	7,306	9,048	9,620

Notes: This table reports treatment effects estimated using the Synthetic Difference-in-Differences (SDID) estimator, following Arkhangelsky et al. (2021). Observations are at the firm-year level. We restrict the sample to fully balanced panels for each outcome. Standard errors are obtained via block bootstrap as implemented by the `sdid` Stata command. *** p<0.01, ** p<0.05, * p<0.1.

Table A.8: Firm Innovation - Synthetic Difference-in-Differences

	(1)	(2)	(3)	(4)	(5)
	R&D Expenditures	Total Patents	Related Patents	Other Patents	Inventors
	Panel A: I(Outcome > 0)				
Treat x Post-2007	0.023	0.015	0.012**	0.014	0.012
	(0.018)	(0.016)	(0.006)	(0.016)	(0.014)
Observations	25,223	25,441	25,441	25,441	25,441
	Panel B: Asinh(Outcome)				
Treat x Post-2007	0.320**	0.047	0.028*	0.039	0.074*
	(0.125)	(0.039)	(0.016)	(0.041)	(0.044)
Observations	25,223	25,441	25,441	25,441	25,441

Notes: This table reports treatment effects estimated using the Synthetic Difference-in-Differences (SDID) estimator, following Arkhangelsky et al. (2021). Observations are at the firm-year level. We restrict the sample to fully balanced panels for each outcome. Standard errors are obtained via block bootstrap as implemented by the sdid Stata command. *** p<0.01, ** p<0.05, * p<0.1.

Table A.9: Firm Innovation - Robustness to Additional Controls

	(1)	(2)	(3)	(4)	(5)
	I(Outcome > 0)				
	R&D Expenditures	Total Patents	Related Patents	Other Patents	Active Inventors
	Panel A: Ownership x Year FE				
Pre-2007 Mean	*0.32*	*0.12*	*0.02*	*0.12*	*0.14*
Treat x Post-2007	0.035***	0.027***	0.011***	0.029***	0.023***
	(0.011)	(0.008)	(0.003)	(0.008)	(0.009)
Observations	62,353	73,092	73,092	73,092	73,092
R-squared	0.613	0.560	0.506	0.558	0.564
	Panel B: Pre-2007 Industry HHI x Year FE				
Pre-2007 Mean	*0.32*	*0.12*	*0.02*	*0.12*	*0.14*
Treat x Post-2007	0.036***	0.027***	0.010***	0.029***	0.023***
	(0.011)	(0.008)	(0.003)	(0.008)	(0.009)
Observations	62,353	73,092	73,092	73,092	73,092
R-squared	0.613	0.560	0.506	0.558	0.565
	Panel C: Chinese Exports and Imports to World				
Pre-2007 Mean	*0.32*	*0.12*	*0.02*	*0.12*	*0.14*
Treat x Post-2007	0.035***	0.026***	0.009***	0.027***	0.022**
	(0.011)	(0.008)	(0.003)	(0.008)	(0.009)
Observations	62,353	73,092	73,092	73,092	73,092
R-squared	0.613	0.560	0.507	0.558	0.565
	Panel D: Total Chinese Exports and Imports to World and U.S.				
Pre-2007 Mean	*0.32*	*0.12*	*0.02*	*0.12*	*0.14*
Treat x Post-2007	0.036***	0.027***	0.010***	0.029***	0.023***
	(0.011)	(0.008)	(0.003)	(0.008)	(0.009)
Observations	62,353	73,092	73,092	73,092	73,092
R-squared	0.613	0.560	0.507	0.558	0.564
	Panel E: Chinese Import Tariffs and Export Rebates				
Pre-2007 Mean	*0.32*	*0.12*	*0.02*	*0.12*	*0.14*
Treat x Post-2007	0.035***	0.027***	0.011***	0.028***	0.023***
	(0.011)	(0.008)	(0.003)	(0.008)	(0.009)
Observations	62,337	73,073	73,073	73,073	73,073
R-squared	0.613	0.560	0.506	0.558	0.565

Notes: Observations are at the firm-year level. All regressions include firm fixed effects, county-by-year fixed effects, and continuous pre-period average sales, R&D spending, patent count, relevant patent count, and active inventors, each interacted with year fixed effects. Standard errors are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

Table A.10: Firm Innovation - Robustness to Additional Controls, Continued

	(1)	(2)	(3)	(4)	(5)
	Asinh(Outcome)				
	R&D Expenditures	Total Patents	Related Patents	Other Patents	Active Inventors
	Panel A: Ownership x Year FE				
Pre-2007 Mean	*2.43*	*0.24*	*0.04*	*0.23*	*0.31*
Treat x Post-2007	0.398***	0.097***	0.027***	0.094***	0.091***
	(0.096)	(0.022)	(0.007)	(0.022)	(0.024)
Observations	62,353	73,092	73,092	73,092	73,092
R-squared	0.672	0.667	0.689	0.659	0.690
	Panel B: Pre-2007 Industry HHI x Year FE				
Pre-2007 Mean	*2.43*	*0.24*	*0.04*	*0.23*	*0.31*
Treat x Post-2007	0.395***	0.093***	0.024***	0.091***	0.088***
	(0.097)	(0.022)	(0.007)	(0.022)	(0.024)
Observations	62,353	73,092	73,092	73,092	73,092
R-squared	0.672	0.667	0.689	0.659	0.690
	Panel C: Chinese Exports and Imports to World				
Pre-2007 Mean	*2.43*	*0.24*	*0.04*	*0.23*	*0.31*
Treat x Post-2007	0.377***	0.090***	0.020***	0.088***	0.084***
	(0.096)	(0.022)	(0.007)	(0.022)	(0.024)
Observations	62,353	73,092	73,092	73,092	73,092
R-squared	0.672	0.667	0.691	0.660	0.690
	Panel D: Total Chinese Exports and Imports to World and U.S.				
Pre-2007 Mean	*2.43*	*0.24*	*0.04*	*0.23*	*0.31*
Treat x Post-2007	0.392***	0.093***	0.022***	0.091***	0.088***
	(0.096)	(0.022)	(0.007)	(0.022)	(0.024)
Observations	62,353	73,092	73,092	73,092	73,092
R-squared	0.672	0.667	0.691	0.659	0.690
	Panel E: Chinese Import Tariffs and Export Rebates				
Pre-2007 Mean	*2.44*	*0.24*	*0.04*	*0.23*	*0.31*
Treat x Post-2007	0.393***	0.093***	0.025***	0.091***	0.088***
	(0.096)	(0.022)	(0.007)	(0.022)	(0.024)
Observations	62,337	73,073	73,073	73,073	73,073
R-squared	0.672	0.667	0.689	0.660	0.690

Notes: Observations are at the firm-year level. All regressions include firm fixed effects, county-by-year fixed effects, and continuous pre-period average sales, R&D spending, patent count, relevant patent count, and active inventors, each interacted with year fixed effects. Standard errors are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

Table A.11: Firm Innovation - Heterogeneity by Ownership

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	R&D Expenditures	Total Patents	Related Patents	Other Patents	Active Inventors	R&D Expenditures	Total Patents	Related Patents	Other Patents	Active Inventors
	State-Owned Enterprises					Private Firms				
	Panel A: I(Outcome > 0)									
Pre-2007 Mean	*0.64*	*0.31*	*0.03*	*0.30*	*0.33*	*0.30*	*0.11*	*0.02*	*0.11*	*0.13*
Treat x Post-2007	0.007	0.021	0.020	0.025	-0.016	0.037***	0.031***	0.009***	0.032***	0.027***
	(0.133)	(0.125)	(0.060)	(0.124)	(0.122)	(0.011)	(0.008)	(0.003)	(0.008)	(0.009)
Observations	769	972	972	972	972	60,064	70,311	70,311	70,311	70,311
R-squared	0.802	0.809	0.706	0.807	0.818	0.605	0.552	0.504	0.551	0.558
	Panel B: Asinh(Outcome)									
Pre-2007 Mean	*5.40*	*0.58*	*0.04*	*0.57*	*0.87*	*2.29*	*0.22*	*0.03*	*0.21*	*0.29*
Treat x Post-2007	0.140	-0.033	0.018	-0.038	-0.079	0.411***	0.098***	0.023***	0.095***	0.096***
	(1.165)	(0.379)	(0.067)	(0.379)	(0.434)	(0.098)	(0.023)	(0.008)	(0.022)	(0.024)
Observations	769	972	972	972	972	60,064	70,311	70,311	70,311	70,311
R-squared	0.856	0.848	0.781	0.847	0.850	0.662	0.661	0.691	0.653	0.683

Notes: Observations are at the firm-year level. All regressions include firm fixed effects, county-by-year fixed effects, and continuous pre-period average sales, R&D spending, patent count, relevant patent count, and active inventors, each interacted with year fixed effects. Standard errors are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

Table A.12: Firm Innovation - Heterogeneity by Pre-Period Exporting Status

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	R&D Expenditures	Total Patents	Related Patents	Other Patents	Active Inventors	R&D Expenditures	Total Patents	Related Patents	Other Patents	Active Inventors
	Ever Exported in Pre-Period					Never Exported in Pre-Period				
	Panel A: I(Outcome > 0)									
Pre-2007 Mean	*0.32*	*0.12*	*0.02*	*0.12*	*0.14*	*0.31*	*0.11*	*0.02*	*0.10*	*0.12*
Treat x Post-2007	0.031***	0.029***	0.011***	0.030***	0.026***	0.097***	0.002	-0.003	0.002	-0.001
	(0.012)	(0.009)	(0.003)	(0.009)	(0.009)	(0.033)	(0.028)	(0.010)	(0.028)	(0.027)
Observations	54,023	63,343	63,343	63,343	63,343	6,527	7,652	7,652	7,652	7,652
R-squared	0.613	0.565	0.519	0.564	0.570	0.689	0.606	0.527	0.606	0.613
	Panel B: Asinh(Outcome)									
Pre-2007 Mean	*2.45*	*0.24*	*0.04*	*0.23*	*0.32*	*2.31*	*0.18*	*0.03*	*0.17*	*0.25*
Treat x Post-2007	0.365***	0.103***	0.025***	0.100***	0.101***	0.729***	0.020	0.008	0.022	-0.000
	(0.105)	(0.024)	(0.008)	(0.024)	(0.025)	(0.279)	(0.070)	(0.018)	(0.068)	(0.080)
Observations	54,023	63,343	63,343	63,343	63,343	6,527	7,652	7,652	7,652	7,652
R-squared	0.672	0.674	0.694	0.668	0.699	0.733	0.679	0.754	0.665	0.707

Notes: Observations are at the firm-year level. All regressions include firm fixed effects, county-by-year fixed effects, and continuous pre-period average sales, R&D spending, patent count, relevant patent count, and active inventors, each interacted with year fixed effects. Standard errors are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

Table A.13: Firm Innovation - Heterogeneity by Pre-Period R&D Spending

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	R&D Expenditures	Total Patents	Related Patents	Other Patents	Active Inventors	R&D Expenditures	Total Patents	Related Patents	Other Patents	Active Inventors
	Positive R&D Spending in Pre-Period					No R&D Spending in Pre-Period				
	Panel A: I(Outcome > 0)									
Pre-2007 Mean	*0.63*	*0.20*	*0.03*	*0.19*	*0.23*	*0.00*	*0.04*	*0.00*	*0.04*	*0.05*
Treat x Post-2007	0.040**	0.016	0.013**	0.018	0.011	0.039***	0.023**	0.005**	0.022**	0.022**
	(0.018)	(0.015)	(0.006)	(0.015)	(0.016)	(0.012)	(0.009)	(0.003)	(0.009)	(0.009)
Observations	29,699	34,878	34,878	34,878	34,878	30,602	35,820	35,820	35,820	35,820
R-squared	0.481	0.576	0.528	0.576	0.578	0.584	0.477	0.470	0.476	0.484
	Panel B: Asinh(Outcome)									
Pre-2007 Mean	*4.84*	*0.41*	*0.06*	*0.39*	*0.54*	*0.00*	*0.07*	*0.01*	*0.06*	*0.08*
Treat x Post-2007	0.288*	0.059	0.032**	0.057	0.048	0.438***	0.070***	0.010**	0.067***	0.076***
	(0.161)	(0.043)	(0.016)	(0.042)	(0.046)	(0.115)	(0.020)	(0.004)	(0.020)	(0.021)
Observations	29,699	34,878	34,878	34,878	34,878	30,602	35,820	35,820	35,820	35,820
R-squared	0.596	0.698	0.703	0.692	0.709	0.600	0.549	0.681	0.540	0.581

Notes: Observations are at the firm-year level. All regressions include firm fixed effects, county-by-year fixed effects, and continuous pre-period average sales, R&D spending, patent count, relevant patent count, and active inventors, each interacted with year fixed effects. Standard errors are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

Table A.14: Firm Innovation - Heterogeneity by Pre-Period Patent Activity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	R&D Expenditures	Total Patents	Related Patents	Other Patents	Active Inventors	R&D Expenditures	Total Patents	Related Patents	Other Patents	Active Inventors
	Applied for Patent in Pre-Period					Did Not Apply for Patent in Pre-Period				
	Panel A: I(Outcome > 0)									
Pre-2007 Mean	*0.57*	*0.44*	*0.07*	*0.43*	*0.48*	*0.21*	*0.00*	*0.00*	*0.00*	*0.01*
Treat x Post-2007	0.046*	0.059**	0.022**	0.061**	0.056**	0.038***	0.015*	0.005*	0.016*	0.015*
	(0.025)	(0.024)	(0.011)	(0.024)	(0.024)	(0.012)	(0.008)	(0.003)	(0.008)	(0.009)
Observations	15,378	18,055	18,055	18,055	18,055	44,814	52,503	52,503	52,503	52,503
R-squared	0.590	0.473	0.574	0.477	0.474	0.571	0.429	0.322	0.426	0.435
	Panel B: Asinh(Outcome)									
Pre-2007 Mean	*4.70*	*0.87*	*0.14*	*0.83*	*1.10*	*1.53*	*0.00*	*0.00*	*0.00*	*0.02*
Treat x Post-2007	0.431*	0.161**	0.061**	0.153**	0.182**	0.415***	0.060***	0.011*	0.059***	0.053**
	(0.222)	(0.070)	(0.025)	(0.069)	(0.074)	(0.108)	(0.020)	(0.006)	(0.020)	(0.021)
Observations	15,378	18,055	18,055	18,055	18,055	44,814	52,503	52,503	52,503	52,503
R-squared	0.683	0.701	0.752	0.693	0.702	0.614	0.434	0.346	0.431	0.458

Notes: Observations are at the firm-year level. All regressions include firm fixed effects, county-by-year fixed effects, and continuous pre-period average sales, R&D spending, patent count, relevant patent count, and active inventors, each interacted with year fixed effects. Standard errors are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

Table A.15: Product-Firm Imports

	(1)	(2)	(3)
	Imports of Controlled Goods from:		
	U.S.	Non-U.S.	World
	Panel A: I(Outcome > 0)		
Pre-2007 Mean	*0.24*	*0.60*	*0.40*
Treat x Post-2007	-0.050	-0.025	-0.059*
	(0.031)	(0.024)	(0.035)
Observations	311,282	311,282	311,282
R-squared	0.127	0.209	0.207
	Panel B: Asinh(Outcome)		
Pre-2007 Mean	*2.36*	*4.43*	*4.20*
Treat x Post-2007	-0.536*	-0.503	-0.699*
	(0.306)	(0.382)	(0.369)
Observations	311,282	208,770	311,282
R-squared	0.136	0.236	0.236

Notes: Observations are at the HS 6-digit product-firm-year level. All regressions control for firm fixed effects, HS 4-digit product by year fixed effects, and HS 6-digit product fixed effects. Standard errors are clustered at the HS 6-digit product level. *** p<0.01, ** p<0.05, * p<0.1.