

The Surprisingly Swift Decline of U.S. Manufacturing Employment*

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Abstract

This paper links the sharp drop in U.S. manufacturing employment after 2000 to a change in U.S. trade policy that eliminated potential tariff increases on Chinese imports. Industries where the threat of tariff hikes declines the most experience more severe employment losses and larger increases in the value of imports from China and the number of firms engaged in U.S.-China trade. Results are robust to other potential explanations of employment loss, and there is no similar reaction in the EU, which did not experience a change in policy. (JEL F13, F16, F61, F66, J23)

Keywords: Manufacturing; Trade Policy; Uncertainty; Offshoring; Supply Chains; Employment; China; World Trade Organization; Normal Trade Relations; MFN

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1 Introduction

U.S. manufacturing employment fluctuated around 18 million workers between 1965 and 2000 before plunging 18 percent from March 2001 to March 2007. In this paper, we find a link between this sharp decline and the U.S. granting of Permanent Normal Trade Relations (PNTR) to China, which was passed by Congress in October 2000 and became effective upon China’s accession to the WTO at the end of 2001.¹

Conferral of PNTR was unique in that it did not change the import tariff rates the United States actually applied to Chinese goods over this period. U.S. imports from China had been subject to the relatively low NTR tariff rates reserved for WTO members since 1980.² But for China, these low rates required annual renewals that were uncertain and politically contentious. Without renewal, U.S. import tariffs on Chinese goods would have jumped to the higher non-NTR tariff rates assigned to non-market economies, which were originally established under the Smoot-Hawley Tariff Act of 1930. PNTR removed the uncertainty associated with these annual renewals by permanently setting U.S. duties on Chinese imports at NTR levels.

Eliminating the possibility of sudden tariff spikes on Chinese imports may have affected U.S. employment through several channels. First, it increased the incentive for U.S. firms to incur the sunk costs associated with shifting operations to China or establishing a relationship with an existing Chinese producer.³ Second, it similarly provided Chinese producers with greater incentives to invest in entering or expanding into the U.S. market, increasing competition for U.S. producers. Finally, for U.S. producers, it boosted the attractiveness of investments in capital- or skill-intensive production technologies or less labor-intensive mixes of products that are more consistent with U.S. comparative advantage. Intuition for these channels of adjustment can be derived from the large literature on investment under uncertainty, where firms are

¹Though this paper focuses on the impact of a particular U.S. trade policy, it relates to a substantial body of research documenting a negative relationship between import competition and U.S. manufacturing employment, including Freeman and Katz (1991), Revenga (1992), Sachs and Shatz (1994) and Bernard et al. (2006), as well as studies linking Chinese imports to employment outcomes by Autor et al. (2014), Bloom et al. (2015), Ebenstein et al. (2011), Groizard, Ranjan and Rodriguez-Lopez (2012), Mion and Zhu (2013) and Utar and Torres Ruiz (2013).

²Normal Trade Relations is a U.S. term for the familiar principle of Most Favored Nation.

³A *New York Times* article reporting on the passage of PNTR noted the link to uncertainty: “U.S. companies expect to benefit from billions of dollars in new business and an end to years of uncertainty in which they had put off major decisions about investing in China” (Knowlton 2000). Section 2.1 below and Section A of the online appendix contain additional anecdotes describing the effect of PNTR-related uncertainty on U.S. and Chinese firms’ behavior.

more likely to undertake irreversible investments as the ambiguity surrounding their expected profit decreases.⁴

We quantify the transition from annual to permanent normal trade relations via the “NTR gap,” defined as the difference between the non-NTR rates to which tariffs would have risen if annual renewal had failed (which average 37 percent in 1999) and the NTR tariff rates that were locked in by PNTR (which average 4 percent across industries in 1999). Importantly, the NTR gap exhibits substantial variation across industries: in 1999, its mean and standard deviation are 33 and 14 percentage points. Larger responses are expected in industries with higher NTR gaps.

Our generalized difference-in-differences identification strategy exploits this cross-sectional variation in the NTR gap to test whether employment in manufacturing industries with higher NTR gaps (first difference) is lower after the change in policy relative to employment in the pre-PNTR era (second difference). One attractive feature of this approach is its ability to isolate the role of the change in policy. While industries with high and low gaps are not identical, comparing outcomes within industries over time isolates the differential impact of China’s change in NTR status.

Regression results reveal a negative relationship between the change in U.S. policy and subsequent employment in manufacturing that is both statistically and economically significant. The baseline specification implies that moving an industry from an NTR gap at the 25th percentile of the observed distribution to the 75th percentile increases the implied relative loss of employment by 0.08 log points.

The relationship between PNTR and U.S. manufacturing employment remains statistically and economically significant after controlling for policy changes in China that may be spuriously correlated with the NTR gap, including a reduction in import tariffs, the phasing out of export licensing requirements and production subsidies, and the elimination of barriers to foreign investment. Furthermore, the results are robust to controlling for other U.S. economic developments contemporaneous with PNTR,

⁴The effect of uncertainty on investment can be positive or negative depending upon a range of firm and market characteristics, including adjustment costs, product market competition and production technology. The negative association between PNTR and employment found here is consistent with a range of theoretical (e.g., Rob and Vettas 2003) and empirical (e.g., Guiso and Pirigi 1999, Bloom et al. 2007) applications. A theoretical framework closely related to our setting is Pindyck (1993), which shows that uncertainty over input costs increases the value of waiting before undertaking sunk investments. For example, using this framework, Schwartz and Zozaya-Gorostiza (2003) show that input cost uncertainty lowers incentives to invest in new information technology. Handley (2014) and Handley and Limao (2014a, 2014b) show that reduction in destination-country trade policy uncertainty is associated with increased entry into exporting.

such as the bursting of the 1990s information technology bubble, the expiration of the global Multi-Fibre Arrangement governing Chinese textile and clothing export quotas, and declining union membership in the United States. To further verify that the U.S. reaction can be attributed to the change in U.S. policy, we compare U.S. employment before and after PNTR to that in the European Union, which gave China the equivalent of PNTR much earlier, in 1980. We find no relationship between the U.S. NTR gap and EU manufacturing employment after the U.S. granting of PNTR to China.

We use data from a range of sources to explore the potential mechanisms behind the U.S. response. Using U.S. trade data, we find that PNTR is associated with relative increases in the value of U.S. imports from China as well as the relative number of U.S. importers, Chinese exporters and U.S.-China importer-exporter pairs. These outcomes demonstrate that U.S. imports from China surge in the high-NTR gap products most affected by PNTR, suggesting that the decline in U.S. employment is due in part to substitution of Chinese imports for U.S. output. They also offer a deeper understanding of the impact of reducing uncertainty in international trade. That is, while our finding of a positive association between the NTR gap and Chinese exporters is consistent with existing models of trade policy uncertainty, the surge in U.S. importers and U.S.-importer and Chinese-exporter pairs found here highlights a rich set of potential responses among firms in the importing country, e.g., within-firm offshoring. Toward that end, we show using Chinese microdata that relative Chinese exports to the United States increase significantly among foreign-owned Chinese firms, an outcome that is consistent with within-firm relocation of U.S. production to China.⁵

Insight into possible mechanisms explaining employment loss also comes from examining U.S. outcomes at the plant level. Comparison of plant employment and plant death regressions reveal that some plants were able to adapt to the change in U.S. policy rather than die. Further analysis of surviving plants' factor usage shows that PNTR was associated with increased capital intensity, a reaction that is consistent with two mechanisms of trade-induced adaptation: changes in product composition (as in Khandelwal 2010) and adoption of labor-saving technologies (as in Bloom, Draca and Van Reenen 2015), with the latter suggesting that PNTR may be associated with employment reductions beyond those attributable to replacement of U.S. production by Chinese imports. Finally, we find that employment among continuing plants and plant

⁵In research independent from that conducted here, Handley and Limao (2014a) note that their framework could be used to examine a link between PNTR and China's export boom, and Handley and Limao (2014b) demonstrate such a link using product-level trade data.

survival respond negatively to exposure to PNTR in downstream (customer) industries, providing indirect evidence of the sort of trade-induced supply-chain disruptions modeled by Baldwin and Venables (2013).

The paper proceeds as follows: Section 2 describes our data, Section 3 describes our empirical strategy and main results, Sections 4 and 5 present additional results, and Section 6 concludes. An online appendix provides additional empirical results as well as information about dataset construction and sources.

2 Data

2.1 Measuring the Effect of PNTR: The NTR Gap

2.1.1 Policy Background

U.S. imports from non-market economies such as China are subject to relatively high tariff rates originally set under the Smoot-Hawley Tariff Act of 1930. These rates, known as “non-NTR” or “column 2” tariffs, are often substantially larger than the “NTR” or “column 1” rates the United States offers fellow members of the World Trade Organization (WTO). However, the U.S. Trade Act of 1974 allows the President of the United States to grant NTR tariff rates to non-market economies on an annually renewable basis subject to approval by the U.S. Congress, and U.S. Presidents began granting such waivers to China annually starting in 1980.

While these waivers kept the tariff rates applied to Chinese goods low, the need for annual approval by Congress created uncertainty about whether the low tariffs would continue, particularly after the Tiananmen Square incident in 1989. In fact, the U.S. House of Representatives introduced and voted on legislation to revoke China’s temporary NTR status every year from 1990 to 2001. These votes even succeeded in 1990, 1991 and 1992, but China’s status was not overturned because the U.S. Senate failed to sustain the House votes. From 1990 to 2001, the average House vote against annual NTR renewal was 38 percent.⁶

Anecdotal evidence indicates that Congressional threats to withdraw China’s NTR status were taken seriously. Media reports, Congressional testimony and government reports make clear that firms viewed renewal of China’s NTR status as uncertain, and that this uncertainty suppressed investment needed to source goods from China.

⁶Table A.2 of the online appendix summarizes the House votes by year.

Indeed, in a 1994 report by the U.S. General Accounting Office, U.S. firms “cited uncertainty surrounding the annual renewal of China’s most-favored-nation trade status as the single most important issue affecting U.S. trade relations with China” and indicated that “uncertainty over whether the U.S. government will withdraw or place further conditions on the renewal of China’s most-favored-nation trade status affects the ability of U.S. companies to do business in China” (U.S. GAO 1994). These findings echoed a letter to President Clinton from the CEOs of 340 firms, including General Motors, IBM, Boeing, McDonnell Douglas and Caterpillar, in which they stated that “[t]he persistent threat of MFN withdrawal does little more than create an unstable and excessively risky environment for U.S. companies considering trade and investment in China, and leaves China’s booming economy to our competitors” (Rowley 1993). Moreover, the anecdotes underscore the idea that uncertainty can have a chilling effect on investment even if the probability of rescinding NTR is low. Testifying before the House Ways and Means Committee, a representative from Mattel asserted that “[w]hile the risk that the United States would withdraw NTR status from China may be small, if it did occur the consequences would be catastrophic for U.S. toy companies given the 70 percent non-MFN U.S. rate of duty applicable to toys” (St. Maxens 2000).⁷ After passage of PNTR, the Congressional Commission created to track its effects reported that: “In the months since the enactment of Permanent Normal Trade Relations (PNTR) legislation with China there has been an escalation of production shifts out of the U.S. and into China...[B]etween October 1, 2000 and April 30, 2001 more than eighty corporations announced their intentions to shift production to China, with the number of announced production shifts increasing each month from two per month in October to November to nineteen per month by April” (U.S. Trade Deficit Review Commission 2001).

Uncertainty associated with annual renewals of China’s NTR status is also apparent in a simplified version of the well-known Baker, Bloom and Davis (2013) policy uncertainty index, which we calculate to relate specifically to China’s NTR renewals. In constructing this index, a research assistant searched the database Proquest for articles that contain the words “China,” “uncertain” or “uncertainty,” and “most favored nation” or “normal trade relations,” for the years 1989 to 2013. The search was limited to articles in *The Wall Street Journal*, *The New York Times*, and *The Washington Post*, and irrelevant articles were manually screened from the search results.⁸ As in

⁷Additional anecdotes are provided in Section A of the online appendix.

⁸A list of the articles included in the index as well as those that were screened out manually is available from the authors upon request.

Baker, Bloom and Davis (2013), article counts are summed by year and then divided by the total number of articles produced by the three newspapers. The resulting index is displayed in Figure 1. As shown in the figure, the policy uncertainty index spikes in periods of tension in U.S.-China relations, with the highest levels observed in the early 1990s after Tiananmen Square and in 2000 during the debate over PNTR.⁹ After passage of PNTR in 2000, the index goes essentially to zero indicating that uncertainty regarding China’s NTR status was effectively resolved.

The U.S. Congress passed a bill granting PNTR status to China in October 2000 following the November 1999 agreement between the United States and China governing China’s eventual entry into WTO. PNTR became effective upon China’s accession to the WTO in December 2001, and was implemented on January 1, 2002.¹⁰ The baseline analysis in Section 3 treats years from 2001 forward as being “post-PNTR.” Alternate specifications in Section 3.2 relax this assumption by allowing the relationship between the NTR gap to differ in each year.

The change in China’s PNTR status had two effects. First, it ended the uncertainty associated with annual renewals of China’s NTR status, thereby eliminating any option value of waiting for U.S. or Chinese firms seeking to incur sunk costs associated with greater U.S.-China trade.¹¹ Second, it led to a substantial reduction in *expected* U.S. import tariffs on Chinese goods. We discuss channels through which the change in policy affected U.S. manufacturing employment in Section 5.

2.1.2 Calculating the NTR Gap

We quantify the impact of PNTR on industry i as the difference between the non-NTR rate to which tariffs would have risen if annual renewal had failed and the NTR tariff rate that was locked in by PNTR,

$$NTR\ Gap_i = Non\ NTR\ Rate_i - NTR\ Rate_i, \tag{1}$$

⁹Additional peaks occur around the time of China’s transfer of missile technology to Pakistan (1993) and the Taiwan Straits Missile Crisis (1996).

¹⁰While each of these milestones likely contributed to the overall reduction in policy uncertainty, both the anecdotal evidence and the policy uncertainty index described above indicate that passage of PNTR in 2000 played a key role in the elimination of uncertainty for U.S. firms.

¹¹To our knowledge, no other U.S. trade policy generates similar uncertainty with respect to China. For example, while the the Omnibus Trade and Competitiveness Act of 1988 requires the U.S. Treasury Secretary to provide semiannual reports indicating whether any major trading partner of the United States is manipulating its currency, such a designation only requires the Secretary to initiate negotiations to have the exchange rate adjusted “promptly” (Treasury 2012).

and we expect industries with larger NTR gaps to be more affected by the change in U.S. policy. One attractive feature of this measure is its plausible exogeneity to employment after 2000. Eighty-nine percent of the variation in the NTR gap across industries arises from variation in non-NTR rates, set 70 years prior to passage of PNTR. This feature of non-NTR rates effectively rules out reverse causality that would arise if non-NTR rates could be set to protect industries with declining employment. Furthermore, to the extent that NTR tariffs were set to protect industries with declining employment prior to PNTR, these *higher* NTR rates would result in *lower* NTR gaps, biasing our results away from finding an effect of PNTR.

We compute NTR gaps using *ad valorem* equivalent NTR and non-NTR tariff rates from 1989 to 2001 provided by Feenstra, Romalis and Schott (2002). Both types of tariffs are set at the eight-digit Harmonized System (HS) level, also referred to as “tariff lines.” We compute industry-level NTR gaps using concordances provided by the U.S. Bureau of Economic Analysis (BEA); the gap for industry i is the average NTR gap across the eight-digit HS tariff lines belonging to that industry. Further detail on the construction of NTR gaps is provided in Section B.1 of the online appendix.

We use the NTR gaps for 1999 – the year before passage of PNTR in the United States – in our regression analysis, but note that our results are robust to using the NTR gaps from any available year. Furthermore, the baseline empirical specification explicitly controls for industries’ NTR *rates*. In 1999, the average NTR gap across industries is 0.33 with a standard deviation of 0.14. The corresponding statistics are 0.04 and 0.07 for the NTR rate and 0.37 and 0.16 for the non-NTR rate.

2.2 U.S. Manufacturing Employment

Our principal source of data is the U.S. Census Bureau’s Longitudinal Business Database (LBD), assembled and maintained by Jarmin and Miranda (2002). These data track the employment and major industry of virtually every establishment with employment in the non-farm private U.S. economy annually as of March 12.¹² In these data, “establishments” correspond to facilities in a given geographic location, such as a manufacturing plant or retail outlet, and their major industry is defined at the four-digit

¹²The LBD definition of employment includes both full- and part-time workers; in Section 5.3 we show that our main employment results are robust to examining production hours instead of employment. While the use of staffing services by manufacturing firms was increasing during the 2000s, Dey, Houseman and Polivka (2012) show that this trend does not account for the steep decline in manufacturing employment after 2000.

Standard Industrial Classification (SIC) or six-digit North American Industry Classification System (NAICS) level. Longitudinal identifiers in the LBD allow establishments to be followed over time.

The long time horizon considered in this paper presents two complications for analyzing the evolution of manufacturing employment. The first complication is that the industry classification scheme used to track establishments' major industries changes from the SIC to the NAICS in 1997 and to subsequent versions of NAICS in 2002 to 2007. Because we need time-consistent industry definitions to track employment over our sample period, we use the algorithm developed in Pierce and Schott (2012) to create "families" of four-digit SIC and six-digit NAICS codes that are linked through the SIC and NAICS industry classification systems. Further detail on the creation of time-consistent industry codes is provided in Section B.3 of the online appendix. Unless otherwise noted, all references to "industry" in this paper refer to these families.

The second complication is that some activities (e.g., logging and publishing) are reclassified out of "manufacturing" in the SIC to NAICS transition and, moreover, some plants are sometimes classified within manufacturing and sometimes outside manufacturing. We construct a "constant manufacturing sample" that excludes any families that contain SIC or NAICS industries that are ever classified outside manufacturing. In addition, we exclude any plants that are ever classified outside manufacturing. Use of this constant manufacturing sample ensures that our results are not driven by any changes in classification system, and we note that qualitatively identical results can also be obtained using the simple NAICS manufacturing definition in the publicly available NBER-CES Manufacturing Industry Database from Becker, Gray and Marvakov (2013).¹³ Moreover, neither of these drops has a material impact on the general trend of manufacturing employment over the past several decades.¹⁴

While the loss of U.S. manufacturing employment after 2000 is dramatic, we note that it is *not* accompanied by a similarly steep decline in value added. Indeed, as illustrated in Figure 2, real value added in U.S. manufacturing, as measured by the BEA, continues to increase after 2000, though at a slower rate (2.8 percent) compared with the average from 1948 to 2000 (3.7 percent).¹⁵

¹³The results are also robust to use of a beta version of time-consistent NAICS codes developed for the LBD by Teresa Fort and Shawn Klimek.

¹⁴Section B.3 of the online appendix compares annual employment in our "constant" manufacturing sample against the manufacturing employment series available publicly from the U.S. Bureau of Labor Statistics. Both display a stark drop in employment after 2000.

¹⁵Houseman, Kurz, Lengermann and Mandel (2011) argue that gains in manufacturing value-added

2.3 Data for Alternate Explanations

As shown below, we consider a wide array of alternate explanations for the observed decline in U.S. manufacturing employment. To be plausible, these alternate explanations must explain why the decline in employment coincides with the timing of PNTR and why it is concentrated in industries most affected by the policy change. Descriptions and sources of the data used to capture these explanations are presented in Section D of the online appendix. Here, we provide a brief overview of the three classes of alternate explanations we consider: a decline in the U.S. competitiveness of labor-intensive goods, policy changes in China, and other notable macroeconomic events in the United States.

U.S. manufacturing employment may have fallen after 2000 due to a decline in the competitiveness of U.S. labor-intensive industries for some reason other than the change in U.S. trade policy, such as a general movement towards offshoring encouraged by the 2001 recession or a positive productivity shock in labor-abundant China.¹⁶ We control for these explanations by including measures of industry capital and skill intensity in our specification and by allowing the impact of these industry factor intensities to vary before and after PNTR.

As part of its accession to the WTO, China agreed to institute a number of policy changes which could have influenced U.S. manufacturing employment, including liberalization of its import tariff rates, export licensing rules, production subsidies and barriers to foreign investment. We control for these policy changes using data on Chinese import tariffs from Brandt, Van Biesbroeck, Wang, and Wang (2012), data on export licensing requirements from Bai, Krishna, and Ma (2012), and data on production subsidies from China's National Bureau of Statistics. Because China's reduction of barriers to foreign investment may have affected industries differently based on the nature of contracting in their industry, we also include Nunn's (2007) measure of the proportion of intermediate inputs that require relationship-specific investments.

Finally, the granting of PNTR to China overlaps with several notable events in the United States. The first was the abolishment of import quotas on some textile and clothing imports in 2002 and 2005 under the global Multi-Fibre Arrangement (MFA).

in the later years of Figure 2 may be overstated as purchases of low-cost foreign materials are not fully captured in input price indexes.

¹⁶We show in Section E of the online appendix that China's TFP growth is uncorrelated with the NTR gap. Furthermore, we demonstrate in Section 4 that the EU does not experience a similar decline in manufacturing employment in high NTR gap industries after 2000.

The second was the bursting of the U.S. tech “bubble” and the subsequent recovery. A third is a steady decline in unionization in the manufacturing sector. We control for the potential impact of these events using data on U.S. textile and clothing quotas from Khandelwal, Schott and Wei (2013), definitions of advanced technology products posted on the U.S. Census Bureau’s website, and industry-level unionization rates from Hirsch and Macpherson (2003).

Table A.1 of the online appendix summarizes the relationships between the NTR gap and the industry-level control variables we employ in the baseline specification, described in greater detail below. The strongest relationship among these variables is a negative relationship with capital intensity ($R^2 = 0.23$).

3 PNTR and U.S. Manufacturing Employment

3.1 Baseline Specification

We examine the link between PNTR and U.S. manufacturing employment using a generalized OLS difference-in-differences (DID) specification that examines whether employment losses in industries with higher NTR gaps (first difference) are larger after the imposition of PNTR (second difference). Industry fixed effects capture the impact of any time-invariant industry characteristics, and year fixed effects account for aggregate shocks that affect all industries equally. The sample includes annual industry-level data from 1990 to 2007.

We estimate the following equation:

$$\begin{aligned} \ln(Emp_{it}) &= \theta Post - PNTR_t \times NTR\ Gap_i + & (2) \\ &\gamma Post - PNTR_t \times \mathbf{X}_i + \lambda \mathbf{X}_{it} + \\ &\delta_t + \delta_i + \alpha + \varepsilon_{it}, \end{aligned}$$

where the dependent variable is the log level of employment in industry i in year t . The first term on the right hand side is the DID term of interest, an interaction of the NTR gap and an indicator for the post-PNTR period, i.e., years from 2001 forward. The second term on the right hand side is an interaction of the post-PNTR dummy variable and time-invariant industry characteristics, such as initial industry capital and skill intensity or the degree to which industries encompass high-technology products.

This term allows for the possibility that the relationship between employment and these characteristics changes in the post-PNTR period. The third term on the right-hand side of equation 2 captures the impact of time-varying industry characteristics, such as exposure to MFA quota reductions, union membership and the NTR tariff rate.¹⁷ δ_i , δ_t and α represent industry and year fixed effects and the constant. Regressions are weighted by initial industry employment.

Results are reported in Table 1 with robust standard errors clustered by industry. The first column includes only the DID term and the necessary fixed effects, while the second column adds industry initial factor intensities. The third column includes all covariates capturing the effect of the alternate explanations discussed in Section 2.3 and represents the “baseline” specification to which we refer throughout the remainder of the paper.

As indicated in the first row of Table 1, estimates of θ are negative and statistically significant in all specifications, indicating that the imposition of PNTR coincides with lower manufacturing employment. Moving across the columns from left to right shows that the estimate for θ decreases in absolute value as additional covariates are added, but remains statistically significant at conventional levels.

The estimated effects are also economically significant. The difference-in-differences coefficient in the baseline specification in column 3 indicates that moving an industry from an NTR gap at the 25th (0.23) to the 75th percentile (0.40) of the observed distribution increases the implied relative loss of employment by -0.08 ($=-0.47*(0.40-0.23)$) log points. We also perform a two-step calculation of the implied impact of PNTR that takes into account the employment weights of industries across the distribution of NTR gaps. First, for each industry i , we multiply θ by the industry’s NTR gap. This yields an implied effect of PNTR (versus the pre-period) on employment for each industry *relative to* a hypothetical industry with a zero NTR gap. Second, we average the implied relative effects for all manufacturing industries, using initial industry employment as weights. As reported in the final row of the third column of the table, the baseline specification implies a *relative* decline in manufacturing employment of -0.15 log points.¹⁸

¹⁷NTR tariff rates from Feenstra et al. (2002) are unavailable after 2001 and so are assumed constant after that year. As discussed in section I of the online appendix, we obtain nearly identical results using analogously computed “revealed” tariff rates from public U.S. trade available after 2001 but use the Feenstra et al. (2002) measures because they are available for a larger set of industries.

¹⁸Though our difference-in-differences identification strategy precludes estimation of the overall share of employment lost to the change in U.S. policy, we note that several prominent studies of the

The remaining rows of the third column of Table 1 display a positive and statistically significant relationship between employment and industries' initial skill intensity (defined as the ratio of non-production workers to total employment), and negative and statistically significant relationships between employment and industries' exposure to tariff reductions in China and MFA quota reductions. The positive coefficient for skill intensity indicates that skill-intensive industries more in line with U.S. comparative advantage do relatively well in terms of employment after 2001. The negative point estimate on exposure to Chinese import tariffs reveals that U.S. employment rises in industries where Chinese import tariffs decline. The negative coefficient for $MFA\ Exposure_{it}$ indicates that textile and clothing industries more exposed to the elimination of quotas experience greater employment loss.¹⁹

3.2 Alternate Specifications

This section assesses the timing and linearity assumptions inherent in the baseline specification. We find that the timing of the downturn in U.S. manufacturing employment corresponds closely with implementation of PNTR and that the implied impact of PNTR is similar across linear and non-linear specifications.²⁰

impact of trade liberalization on manufacturing employment have found large effects. Autor, Dorn and Hanson (2014), using an alternate means of identification, find that depending on assumptions used to isolate the Chinese supply shock, Chinese import penetration explains 26 to 55 percent of the overall decline in U.S. manufacturing employment from 2000 to 2007, or -5 to -11 percentage points of the overall -20 percent decline. In a different setting, Treffer (2004) finds that the Canada-U.S. Free Trade Agreement reduced Canadian manufacturing employment by 12 percent among industries in the top tercile of import tariff declines, i.e. those with an average reduction of -10 percent. Moreover, the growth in Chinese exports to the U.S. during our sample period dwarfs that of U.S. exports to Canada during the period studied by Treffer (2004). According to the U.S. International Trade Commission website, Chinese exports to the United States grew by \$223 billion from 2000 to 2007 (from \$100 billion to \$323 billion), while U.S. exports to Canada grew by \$44 billion between 1989 and 1996 (from \$75 billion to \$119 billion), in nominal terms.

¹⁹Following Brambilla et al. (2009), we measure the extent to which industries' quotas were binding under the MFA as the import-weighted average fill rate of the textile and clothing products that were under quota, where fill rates are defined as the actual imports divided by allowable imports under the the quota. Industries containing textile and clothing products with higher fill rates faced more binding quotas and are therefore more likely to experience employment reductions when quotas are eliminated. Fill rates are set to zero for unbound products.

²⁰In addition to the alternate specifications pursued here, results in Section I of the online appendix show that the baseline estimates are robust to different methods for controlling for the business cycle, different measures of the NTR tariff rate, and instrumenting the NTR gap with the non-NTR tariff rate.

3.2.1 Timing

For the decline in manufacturing employment to be attributable to PNTR, our policy measure, the NTR gap, should be correlated with employment after PNTR, but not before. To determine whether there is a relationship between the NTR gap and employment in the years before 2001, we replace the *Post – PNTR* indicator used in equation 2 with interactions of the NTR Gap and the full set of year dummies,

$$\ln(Emp_{it}) = \sum_{y=1991}^{2007} (\theta_y 1\{y = t\} \times NTR\ Gap_i) + \sum_{y=1991}^{2007} (\beta_y 1\{y = t\} \times \mathbf{X}_i) \quad (3) \\ + \lambda \mathbf{X}_{it} + \delta_t + \delta_i + \alpha + \varepsilon_{it}.$$

As above, we estimate equation 3 both with and without the industry controls.

Results for the difference-in-differences coefficients, θ_y , are reported in Table 2 and displayed visually along with their 90 percent confidence intervals in Figure 3. Coefficient estimates for the remaining covariates are omitted to conserve space. As indicated in both the table and the figure, point estimates are statistically insignificant at conventional levels until after 2001, at which time they become statistically significant and increasingly negative.²¹ This pattern is consistent with the parallel trends assumption inherent in our difference-in-differences analysis, lending further support for the baseline empirical strategy.

3.2.2 Linearity

The baseline specification assumes a linear relationship between employment and the NTR Gap. Here, we explore non-linear specifications to determine whether the NTR gap has less of an effect on firms' employment decisions beyond some threshold level or, alternatively, whether the effect of the NTR gap grows disproportionately as it increases with higher values of the NTR gap.

We consider two non-linear specifications. The first augments Equation 2 with the interaction of the square of the NTR gap with the $1\{post - PNTR_t\}$ dummy. The second constrains the relationship between employment and the NTR gap to be a two-segment spline.²² Results are reported in Table 3, where the first column reproduces

²¹Results are similar for an event study version of this specification that compares outcomes across years for industries in the top versus bottom quintiles of the NTR gap distribution.

²²The spline is estimated using a constrained OLS regressions that restricts the post-PNTR rela-

the baseline specification (column 3 of Table 1) to facilitate comparison. P-values testing the joint significance of the difference-in-differences coefficients in the quadratic specification and implied economic significance, computed using the two-step procedure as noted above, are reported in the final two rows of the table. In addition, Figure A.3 in the online appendix plots the relationship between the DID terms and log employment implied by each specification over the range of NTR gaps observed in the data.

As indicated in both the table and the figure, the results provide some support for the idea that employment loss accelerates with the NTR gap. On the other hand, column 2 of Table 1 reveals that while the coefficients for the NTR gap terms in the quadratic specification are jointly statistically significant at conventional levels, the square term is not itself statistically significant. In terms of economic significance, the nonlinear specifications yield economic impacts comparable to that implied by the baseline linear specification. The quadratic specification yields a relative decline in manufacturing employment of -0.12 log points and the spline specification yields a relative decline of -0.16 log points, compared to -0.15 log points in the baseline linear specification.

4 The United States versus the EU

Comparison of outcomes in the United States versus the European Union provides an alternate test of the idea that PNTR drives the employment decline in the United States. In contrast to the United States, the European Union granted permanent most-favored-nation status to China in 1980 (Casarini 2006). As a result, there was little change in either the actual or expected EU tariffs on Chinese goods when the U.S. granted PNTR to China in 2000, and imports from China were not subject to the annual potential tariff increases present in the United States.²³ Comparing the United

tionship between employment and the NTR gap to be two successive line segments starting at the origin and joined at a “knot.” We grid over NTR gap knots in increments of 0.05 and report the specification that minimizes the Akaike Information Criterion (AIC), reported in the penultimate row of Table 3. Minimization of Schwarz’s Bayesian Information Criterion yields identical results.

²³China was a Generalized System of Preferences (GSP) beneficiary in the EU before and after its accession to the WTO. According to European Commission (2003), Chinese import tariffs under the EU GSP program did not change when it joined the WTO. The EU renews GSP every decade and conducts annual revisions to their rates. These changes are generally made on a product-by-product rather than country-by-country basis, suggesting that they are not biased towards China. Nevertheless, we note that the majority of the EU’s GSP rate changes in recent years involve products in which Chinese exporters are active.

States and the EU therefore helps determine whether U.S. NTR gaps are spuriously correlated with other factors that may have affected employment in both the United States and EU, such as technological change, policy changes in China related to its entry to the WTO, or positive Chinese productivity shocks.

Our comparison makes use of data from United Nations' UNIDO dataset, which tracks employment by country and four-digit International Standard Industrial Classification (ISIC) industries from 1997 to 2005.²⁴ We estimate a triple difference-in-differences specification that examines employment for industries with varying NTR gaps (first difference) after the imposition of PNTR (second difference) and across the United States and the EU (third difference):

$$\begin{aligned} \ln(\text{Emp}_{ict}) &= \theta \text{Post} - \text{PNTR}_t * \text{NTR Gap}_i * 1\{c = US\}_c & (4) \\ &+ \gamma_1 \text{Post} - \text{PNTR}_t * \text{NTR Gap}_i + \gamma_2' \chi_{ict} \\ &+ \delta_i + \delta_t + \alpha + \varepsilon_{ict}. \end{aligned}$$

The dependent variable is log employment for four-digit ISIC industry i in $c \in US, EU$ in year t . θ is the coefficient for the triple-difference term of interest. χ_{hct} represents the full set of interactions of $\text{Post} - \text{PNTR}_t$, NTR Gap_i , and $1\{c = U.S.\}$ required to identify θ . As above, δ_i and δ_t are industry and year fixed effects, and α is the regression constant.

Results are reported in the first column of Table 4, with robust standard errors clustered by industry. As shown in the first row of the table, θ is negative and statistically significant, indicating that PNTR is associated with a relative decline in manufacturing employment in the United States versus the EU. Moreover, the lack of statistical significance for γ_1 in row 2, which measures the impact of PNTR common to the United States and the EU, indicates that the negative relationship between PNTR and employment is specific to the United States. Separate difference-in-difference specifications for the United States and the EU (columns 2 and 3) provide complementary evidence: PNTR is associated with statistically significant employment declines in the United States but not the EU.

²⁴The four-digit ISIC industries across which employment is reported are more aggregated than either the SIC or NAICS industries across which U.S. employment data is reported in the LBD. We aggregate NTR gaps to the six-digit HS level and then map them to the four-digit ISIC level using publicly available concordances from the World Bank. See section F of the online appendix for additional information regarding the UNIDO data.

The results in Table 4 are evidence against the idea that post-PNTR employment loss in the United States is due to an unobserved shock affecting manufacturing employment globally, or a shock in China that affects its exports to the U.S. and EU equally. They also confirm the relationship between employment and the NTR gap for the United States using an entirely different dataset and industrial classification system for employment.

5 Potential Mechanisms

PNTR may have caused a decline in U.S. manufacturing employment via several mechanisms, including: (1) encouraging U.S. firms to start sourcing inputs or final goods from Chinese rather than domestic suppliers; (2) persuading Chinese firms to expand into the U.S. market; (3) motivating U.S. manufacturers either to invest in labor-saving production techniques or to produce more skill- and capital-intensive products that are more in line with U.S. comparative advantage; and (4) inducing U.S. firms to shift all or part of their operations offshore, perhaps in conjunction with other firms in their supply chain. In this section we provide evidence consistent with all of these mechanisms.

5.1 U.S. Imports

Given that PNTR entailed a change in U.S. trade policy *vis-a-vis* China, we examine whether it was associated with changes in U.S. imports from China using customs data from the U.S. Census Bureau's Longitudinal Foreign Trade Transaction Database (LFTTD). As described in greater detail in Bernard, Jensen and Schott (2009), the LFTTD tracks all U.S. international trade transactions by U.S. firms beginning in 1992. For each import transaction we observe the product traded, the U.S. dollar value and quantity shipped, the shipment date and the origin country. The data also contain codes identifying both the U.S. importer and the foreign supplier of the imported product.

Our generalized triple DID specification compares products with varying NTR gaps (first difference) before and after PNTR (second difference) and across source countries

(third difference) for the years 1992 to 2007:

$$O_{hct} = \theta 1\{c = China\}_c \times Post - PNTR_t \times NTR Gap_h + \quad (5)$$

$$\gamma' \chi_{hct} + \lambda' \mathbf{X}_{hct} + \delta_h + \delta_c + \delta_t + \alpha + \varepsilon_{hct}.$$

The left-hand side variable represents the log level of one of several dimensions of U.S. import outcomes aggregated to the eight-digit HS product by source country by year level.²⁵ These dimensions are import value, the number of U.S. firms importing product h from country c in year t , the number of country c firms exporting product h to the United States in year t , and the number of importer-exporter pairs engaged in U.S. imports of product h from country c in year t . The first term on the right-hand side is the primary term of interest: a triple interaction of an indicator for China, an indicator for the post-PNTR period, and the NTR gap for product h . Its coefficient, θ , captures the impact of the change in U.S. policy. χ_{hct} represents all other interactions of the NTR gap, the post-PNTR indicator and the China indicator needed to identify θ ; the coefficients for these terms are suppressed below for ease of displaying results. \mathbf{X}_{hct} represents two control variables: the U.S. exchange rate *vis-a-vis* country c (foreign country per U.S. dollar) and the U.S. revealed import tariff for product h from country c in year t , computed as the ratio of duties collected to dutiable value using publicly available U.S. trade data. δ_h , δ_c and δ_t represent product, country and year fixed effects that control for unobserved time-invariant country and product attributes as well as aggregate macroeconomic shocks that are common to each year. α is the regression constant.²⁶

Results are reported in Table 5, with robust standard errors clustered by product. Estimates of θ are positive and statistically significant for all four dimensions of U.S. importing. As indicated in the bottom row of the table, these estimates imply that PNTR raises the relative import value of the affected products by 0.17 log points *vis a vis* imports of those products from other sources after the change in U.S. policy. The analogous responses for the number of U.S. importers, the number of Chinese exporters

²⁵As with SIC and NAICS industries, the eight-digit HS product codes are linked to time-invariant families using the concordance from Pierce and Schott (2012).

²⁶Although this specification omits observations where the left-hand side variable is equal to zero, we note that similar results are obtained in a previous version of this paper (Pierce and Schott 2013) when examining changes in those variables normalized as suggested by Davis, Haltiwanger and Schuh (1996).

and the number of importer-exporter pairs are 0.15, 0.17 and 0.17 log points.²⁷

These results demonstrate that U.S. import value from China surges in the high-NTR-gap products most affected by PNTR, suggesting that the decline in U.S. employment is due in part to substitution of Chinese imports for U.S. output.²⁸ Moreover, the relative increases in both the number of U.S. importers and the number of Chinese exporters are consistent with U.S. and Chinese firms being more willing to undertake irrecoverable investment in establishing bilateral trade relationships after PNTR, in line with the broad literature on investment under uncertainty. Relative to the existing literature on trade policy uncertainty (Handley 2014, Handley and Limao 2014a 2014b), which focuses on exporting, the results with respect to U.S. importers highlight the potential importance of reactions to uncertainty by firms in the importing country.²⁹ We pursue these reactions further in the next section.

5.2 Chinese Exports

In this section, we examine whether PNTR is associated with changes in the pattern of Chinese exports using firm-level customs data from China’s National Bureau of Statistics provided by Khandelwal et al. (2013).³⁰ One advantage of these Chinese export data *vis a vis* the U.S. import data examined in the previous section is the ability to classify Chinese exporters as domestic versus foreign-owned. As a result, they can shed light on whether China’s surge in high-NTR-gap exports may be due to offshoring by foreign firms versus market expansion by Chinese firms.³¹

Following Khandelwal et al. (2013), we use the ownership codes to classify firms into three groups: state-owned enterprises (SOEs), privately owned domestic firms

²⁷While standard errors in the reported results are clustered at the product level, we note that they are robust to clustering at the country-product level.

²⁸Our findings relate to Harrison and McMillan (2011), who show that offshore employment in low-wage countries is a substitute for domestic employment among U.S. manufacturers.

²⁹Handley and Limao (2014b) discusses welfare implications of eliminating trade policy uncertainty for the importing country, via the price index, but does not consider adjustments by firms in the importing country, such as offshoring.

³⁰The Chinese data track China’s exports by firm, product, destination, country, and year from 2000 to 2005. For each firm-product-destination-year observation, we observe the nominal value of exports shipped as well as codes for the ultimate ownership of the firm and the type of export shipment.

³¹Translated anecdotes from Chinese language news accounts provided in Section A of the online appendix offer support for both of these channels. For example, Shanghai Securities News noted in 1999 that if China’s accession to the WTO led to PNTR being granted: “[T]his will help to build confidence among investors at home and abroad, especially among United States investors, because currently, China faces the issue every year of maintaining Most Favored Nation trading status (Shanghai Securities News 1999).”

(“domestic”) and privately owned foreign firms (“foreign”).³² We decompose overall exports into “general” versus “processing & assembling” (“P&A”), where the latter refer to goods produced with intermediate inputs imported tariff-free on the condition that they not be sold domestically.³³

We examine the effect of PNTR on total Chinese exports using the same DID specification used for the U.S. import data above, but with two differences. First we replace the indicator for China as a source of imports with an indicator for the United States as a destination for exports. Second, we aggregate the Chinese data to the six-digit HS level in order to assign NTR gaps, as U.S. and Chinese product codes are not consistent at more disaggregated levels.

Results are reported in Table 6, with robust standard errors clustered by product. The top panel examines total, general and P&A exports by all firms. The bottom panel reports results for total exports by each ownership category. Estimates in the top panel of the table reveal that PNTR is associated with statistically significant relative increases in export value for both types of exports. The bottom panel demonstrates that these increases are experienced in all three types of firms, though coefficients are larger for privately owned firms.³⁴

Though it is not possible to identify the country origin of foreign firms in the Chinese data, the relative growth of foreign-firm exports may reflect relocation of U.S. production to China within U.S. firms after the change in U.S. policy. The PNTR-related export growth of domestically-owned Chinese firms, on the other hand, is consistent with both greater arm’s-length offshoring by U.S. firms and efforts by Chinese firms to expand into the U.S. market.

5.3 Changes in U.S. Factor Intensity

PNTR may have induced firms facing increased import competition from China to adjust their production processes. We use quinquennial data collected in the U.S. Census of Manufactures (CM) to analyze the relationship between PNTR and factor usage. We perform this analysis at both the industry *and* plant level to determine

³²SOEs include collectives, and foreign firms include joint ventures.

³³General and P&A exports account for more than 95 percent of exports in each year of the sample. Other export categories are omitted. Across the years for which the data are available, general exports represent approximately 43 percent of total exports.

³⁴PNTR is also associated with a statistically and economically significant increase in foreign-owned firms’ P&A exports to the United States.

the extent to which changes in factor intensity are driven by entry and exit versus continuing plants.³⁵

For years ending in “2” and “7”, the CM contains a range of plant characteristics, including total employment, a breakdown of total employment into production and non-production workers, production worker hours and capital.³⁶ As in Section 3 we define skill intensity as the ratio of non-production workers to total employment and capital intensity as the ratio of capital to total employment. Our analysis makes use of the same generalized difference-in-differences specification defined in equation 2, with one important difference: because the CM tracks establishments’ attributes only every five years, the pre-PNTR period is defined as 1992 and 1997 and the post-PNTR period is defined as 2002 and 2007.

The industry-level results, reported in Table 7 reflect adjustments in factor intensity both within and across plants. As indicated in Columns 1 and 2 of the table, PNTR is associated with statistically and economically significant increases in both industry skill intensity and industry capital intensity. The gain in skill intensity arises from heterogeneous responses for the two types of workers tracked in our data. While we find negative and statistically significant relationships between employment and the NTR gap for both non-production (column 3) and production workers (column 4), the implied impact of PNTR for production workers is more than one and a half times that for non-production workers.³⁷ Likewise, the gains in capital intensity arise from statistically significant declines in total employment (column 5), compared to a statistically insignificant response for capital (column 6).³⁸

Estimates from the plant-level regressions are reported in Table 8, with robust standard errors clustered for plants’ major industry. These regressions differ from the industry-level regressions in two ways. First, they make use of plant-level NTR gaps, defined as the weighted-average NTR gap across all of the industries in which the plant

³⁵Holmes and Stevens (2013) show that increased import competition from China can have heterogeneous effects among plants within an industry, with the biggest negative effect observed at large plants producing standardized goods. Small plants producing specialty goods are less affected.

³⁶Real book value is deflated using industry-level investment price indexes from Becker, Gray and Marvakov 2013.

³⁷Results in column 7 show that the PNTR-related decline in production hours is similar in magnitude to that for total employment, ruling out the possibility that the decline in employment resulted from a contraction on the extensive margin (the number of employees) that was offset by an expansion on the intensive margin (the number of hours per worker).

³⁸Results for total employment in column 5 are similar in terms of both statistical and economic significance to those reported in the baseline specification in Section 3, despite use of a different dataset.

is active in 1997. Second, they contain plant fixed effects as well as plant-level control variables such as age and total factor productivity in addition to the industry-level control variables used in the baseline specification.³⁹

Results in the first two columns of Table 8 indicate that while PNTR is not associated with changes in skill intensity for continuing plants, it is associated with capital deepening. Indeed, as noted in the final row of column 2, the implied economic impact of PNTR on plant capital intensity is a relative increase of 0.09 log points. This relative capital deepening within plants is consistent with two mechanisms of employment loss: trade-induced technological change, as in Bloom, Draca and Van Reenen (2015), and trade-induced product upgrading, as in Bernard et al. (2006), Khandelwal (2010), and Schott (2003, 2008), with the former suggesting that PNTR may be associated with employment reductions beyond those attributable to replacement of U.S. production by Chinese imports.⁴⁰

5.4 Input-Output Linkages

This section examines whether PNTR affected U.S. manufacturing plants indirectly via their supply chains, i.e., via the suppliers from which their inputs are purchased or the customers to which their output is sold. Plants benefiting from greater access to lower-priced Chinese inputs, for example, might expand operations and therefore employment, while plants whose major customers disappear due to greater competition from Chinese producers in high-gap industries might shrink (or exit). Alternatively, if proximity to suppliers and customers is an important determinant of the location of manufacturing activity, as found by Ellison, Glaeser and Kerr (2010), higher exposure to PNTR along any point of the supply chain may induce several or more links of a supply chain to co-offshore, as in the procurement model of Baldwin and Venables (2013).

We examine the transmission of PNTR through input-output linkages by computing

³⁹We follow Foster et al. (2008) in measuring TFP as the log of deflated revenue minus the log of inputs, weighted by the average cost share for each input across industries (see Section B.4 of the online appendix for more detail). We note that productivity measures constructed from revenue information may be biased due to unobserved establishment-level variation in prices, which can be affected by changes in trade policy (Pierce 2011 and De Loecker et al. 2012).

⁴⁰We provide anecdotal evidence supporting these mechanisms in Section A.3 of the online appendix. For example: “To beat the Chinese and other foreign competitors threatening [their] business, [the owners] invested several million dollars to double the production capacity of their plastic-part plant, PM Mold, with the latest in robotics and automation equipment. Now, [it] can make twice as many parts – and better ones at that – without adding to [its] work force (Neikirk 2002).”

plant-level up- and downstream NTR gaps and including them in the baseline plant-level regression. As we do not have information on the industries from which individual plants buy and to which they sell, we compute plants' up- and downstream NTR gaps using industry-level information from U.S. input-output tables. We calculate the upstream NTR gap for a plant in six-digit NAICS industry i ($NTR\ Gap_i^{Upstream}$) as the weighted average NTR gap across all six-digit NAICS industries used to produce i , employing IO coefficients from the BEA's 1997 total requirements table as weights. As plants often produce a range of goods within the same sector (Bernard et al. 2010), we set the weights for any six-digit NAICS input within i 's three-digit NAICS root to zero. Industry i 's downstream NTR Gap ($NTR\ Gap_i^{Downstream}$) is computed analogously. Using the concordances referenced in Section 2, we then map these NAICS-based up- and downstream NTR gaps to the major industry of each plant.⁴¹

We analyze the potential supply chain effects of PNTR on both the employment of continuing plants (intensive margin) and plant survival (extensive margin) by estimating the following equation,

$$\begin{aligned}
O_{pt} = & \sum_m \theta_d^m Post - PNTR_t \times NTR\ Gap_p^m & (6) \\
& + \gamma Post - PNTR_t \times \mathbf{X}_i + \lambda \times \mathbf{X}_{it} + \mu \mathbf{X}_{pt} \\
& + \delta_t + \delta_p + \alpha + \varepsilon_{pt},
\end{aligned}$$

where O_{pt} represents either log employment of continuing plant p in year t or an indicator variable that takes a value of 1 if the plant dies between year t and year $t+1$ and 0 otherwise. $NTR\ Gap_p^m$ represents the NTR gap for $m = \{Own, Upstream, Downstream\}$; for each dependent variable, we report estimates for specifications that both exclude and include the up- and downstream NTR gaps. All specifications use the annual plant-level data available from the LBD.

⁴¹Several caveats are worth pointing out. First, these up- and downstream gaps are based on industry-level IO relationships and therefore do not take into account the substantial heterogeneity across plants in the industries from which they source inputs and to which they sell outputs. In particular, some plants may produce inputs that other plants source from an upstream industry. Second, the own, upstream (mean and standard deviation of 0.11 and 0.04) and downstream (0.11, 0.08) gaps are highly related, with correlations of 0.46 and 0.24 for own versus upstream and own versus downstream, respectively. These high correlations may reduce the precision of our estimates by inflating the associated standard errors. Finally, supply chain linkages need not be uni-directional, as it is possible for plants in one industry to both purchase inputs from and sell outputs to plants in another industry.

Results in the first two columns of Table 9 indicate that the effect of PNTR on continuing plants' employment can be transmitted along supply chains. In the specification excluding input-output linkages, the coefficient estimate for plants' own NTR gap on employment is negative and statistically significant, and yields an economic magnitude, -0.12 log points, in line with those reported above. When input-output linkages are included in the regression, both the own and downstream NTR gaps are negative and statistically significant, indicating that plants experience relative declines in employment both when they are more exposed to PNTR and when their customers are more exposed. In terms of economic significance, the impact of PNTR implied by the results in column 2 is a relative -0.14 log point decline in employment in the post-PNTR period. Of this decline, the own and downstream NTR gaps contribute roughly equally.⁴²

The third and fourth columns of Table 9 report results for a linear probability estimation of plant death. As indicated in the table, the coefficients on plants' own NTR gap are positive and statistically significant in both specifications, indicating that higher direct exposure to PNTR is associated with a higher probability of plant death. As in the employment regression, the coefficient on the downstream NTR gap is statistically significant, with its positive sign indicating that plants are also more likely to die when their customers are more affected by PNTR. The coefficient for the upstream NTR gap is statistically insignificant at conventional levels.

These results are noteworthy for two reasons. First, they show that PNTR affects U.S. manufacturing employment along both the intensive and extensive margins, i.e., by reducing employment among continuing firms and by inducing plant exit.⁴³ Second, as in the procurement model of Baldwin and Venables (2013), they highlight the potential role of supply chains in propagating the effects of changes in trade policy.

6 Conclusion

This paper finds a relationship between the sharp decline in U.S. manufacturing employment after 2000 and the United States' conferral of permanent normal trade rela-

⁴²Computation of economic significance excludes the impact of the statistically insignificant coefficient for the upstream NTR gap.

⁴³The working version of this paper, Pierce and Schott (2013), shows that anemic job creation accounts for approximately one quarter of the overall estimated impact of PNTR, with the remainder due to exaggerated job destruction. These trends provide a partial explanation for the post-2000 shift in job creation and destruction rates discussed in Faberman (2008).

tions on China, a policy that is notable for eliminating the possibility of future tariff increases – and the uncertainty with which they were associated – rather than reducing the tariffs actually applied to Chinese goods.

We measure the effect of PNTR as the gap between the the high non-NTR rates to which tariffs would have risen if annual renewal had failed and the lower NTR tariff rates that were locked in by PNTR. Using a generalized difference-in-differences specification, we show that industries with higher NTR gaps experience larger employment declines, along with disproportionate increases in U.S. imports from China, the number of U.S. firms importing from China and the number of Chinese firms exporting to the United States, including both domestic and foreign-owned Chinese firms. These results are robust to inclusion of variables proxying for a wide range of alternate explanations for the observed trends in employment and trade. Moreover, we demonstrate that the pattern of employment losses in the United States – which experienced the policy change – are not present in the European Union, which had granted China the equivalent of PNTR status in 1980. Additional analysis of the mechanisms by which the change in policy affected U.S. manufacturers reveals reallocation within high-gap industries towards less labor-intensive plants, increases in the capital intensity of the most affected plants, and magnification of the effects of PNTR via downstream customers.

Having established a link between the change in trade policy and U.S. employment outcomes, this research raises several important, but challenging questions. To what extent can PNTR explain the diverging trends of value-added and employment in the U.S. manufacturing sector? What impact did PNTR have on U.S. prices and consumption patterns? To what extent did U.S. firms change the composition of their output in response to PNTR, and how large were the associated transition costs? We hope to bring additional data to bear on these questions in future research.

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	$\ln(\text{Emp}_{i,t})$	$\ln(\text{Emp}_{i,t})$	$\ln(\text{Emp}_{i,t})$
Post x NTR Gap _i	-0.714 ***	-0.601 ***	-0.469 ***
	0.193	0.191	0.147
Post x $\ln(K/\text{Emp}_{i,1990})$		0.037	-0.016
		0.031	0.025
Post x $\ln(NP/\text{Emp}_{i,1990})$		0.081	0.132 ***
		0.054	0.053
Post x Contract Intensity _i			-0.181
			0.112
Post x Δ China Import Tariffs _i			-0.244 *
			0.140
Post x Δ China Subsidies _i			0.063
			0.088
Post x Δ China Licensing _i			-0.238
			0.164
Post x 1{Advanced Technology _i }			-0.036
			0.045
MFA Exposure _{i,t}			-0.342 ***
			0.060
NTR _{i,t}			-0.455
			0.670
U.S. Union Membership _{i,t}			-0.123
			0.203
Observations	5,706	5,706	5,706
R2	0.98	0.98	0.99
Fixed Effects	i,t	i,t	i,t
Employment Weighted	Yes	Yes	Yes
Implied Impact of PNTR	-0.229	-0.193	-0.151

Notes: Table reports results of OLS generalized difference-in-differences regressions. The dependent variable is the log of industry-year employment and the independent variable representing the effect of PNTR is the interaction of the NTR gap and a post-PNTR indicator. Additional controls include time-varying variables -- MFA exposure, NTR tariff rates, union membership rates -- as well as interactions of the post-PNTR indicator with time-invariant controls including the log of 1990 capital and skill intensity, contract intensity (Nunn 2007), changes in Chinese import tariffs, changes in Chinese production subsidies, changes in Chinese export licensing requirements and an indicator for whether the industry produces advanced technology products. Data span 1990 to 2007. Robust standard errors adjusted for clustering at the industry (i) level are displayed below each coefficient. Estimates for the year (t) and industry fixed effects as well as the constant are suppressed. Observations are weighted by initial industry employment. Final row reports the predicted relative change in the dependent variable implied by the difference-in-differences coefficient. Superscripts ***, ** and * represent statistical significance at the 1, 5 and 10 percent levels.

Table 1: Baseline Results (LBD)

	ln(Emp _{it})	ln(Emp _{it})	ln(Emp _{it})
1{year=1991} x NTR Gap _i	-0.056	-0.050	-0.060
	0.050	0.059	0.047
1{year=1992} x NTR Gap _i	-0.021	-0.031	-0.016
	0.063	0.073	0.075
1{year=1993} x NTR Gap _i	0.011	0.022	0.062
	0.080	0.090	0.085
1{year=1994} x NTR Gap _i	-0.001	0.036	0.083
	0.103	0.109	0.102
1{year=1995} x NTR Gap _i	0.008	0.059	0.072
	0.124	0.132	0.128
1{year=1996} x NTR Gap _i	-0.013	0.068	0.083
	0.142	0.160	0.154
1{year=1997} x NTR Gap _i	-0.034	0.032	0.049
	0.147	0.158	0.154
1{year=1998} x NTR Gap _i	-0.046	0.033	0.031
	0.157	0.174	0.175
1{year=1999} x NTR Gap _i	-0.142	-0.063	-0.071
	0.181	0.197	0.198
1{year=2000} x NTR Gap _i	-0.207	-0.078	-0.082
	0.209	0.219	0.219
1{year=2001} x NTR Gap _i	-0.296	-0.157	-0.149
	0.224	0.245	0.236
1{year=2002} x NTR Gap _i	-0.581 ***	-0.427 *	-0.396 *
	0.246	0.260	0.237
1{year=2003} x NTR Gap _i	-0.691 ***	-0.487 *	-0.447 *
	0.260	0.274	0.241
1{year=2004} x NTR Gap _i	-0.830 ***	-0.652 **	-0.431 **
	0.274	0.287	0.207
1{year=2005} x NTR Gap _i	-0.905 ***	-0.758 ***	-0.536 ***
	0.285	0.296	0.217
1{year=2006} x NTR Gap _i	-0.953 ***	-0.809 ***	-0.601 ***
	0.297	0.315	0.238
1{year=2007} x NTR Gap _i	-1.057 ***	-0.900 ***	-0.682 ***
	0.314	0.339	0.259
Observations	5706	5706	5706
R2	0.98	0.99	0.99
Employment Weighted	Yes	Yes	Yes
Fixed Effects	i,t	i,t	i,t
Other Covariates Included?	No	Yes	Yes

Notes: Each column displays the results of an industry-level OLS generalized difference-in-differences regression of the log employment on industry (i) and year (t) fixed effects, interactions of year dummies and the NTR Gap. Regression reported in second column includes but does not display interactions of year dummies with industries' initial capital and skill intensity. Regression reported in third column also includes but does not display time-varying variables -- MFA exposure, NTR tariff rates, union membership rates -- as well as interactions of the post-PNTR indicator with time-invariant controls including the log of 1990 capital and skill intensity, contract intensity (Nunn 2007), changes in Chinese import tariffs, changes in Chinese production subsidies, changes in Chinese export licensing requirements and an indicator for whether the industry produces advanced technology products. Data span 1990 to 2007. Observations are weighted by initial industry employment. Robust standard errors adjusted for clustering at the industry level are displayed below each coefficient. Superscripts ***, ** and * represent statistical significance at the 1, 5 and 10 percent levels.

Table 2: PNTR and U.S. Manufacturing Employment (LBD)

	$\ln(\text{Emp}_{i,t})$	$\ln(\text{Emp}_{i,t})$	$\ln(\text{Emp}_{i,t})$
Post x NTR Gap _i	-0.469 ***	-0.244	
	0.147	0.429	
Post x NTR Gap _i ²		-0.346	
		0.636	
Post x NTR Gap _i (Slope 1)			-0.460
			0.513
Post x NTR Gap _i (Intercept 2)			0.551
			0.630
Post x NTR Gap _i (Slope 2)			-1.683
			1.054
Post x $\ln(K/\text{Emp}_{i,1990})$	-0.016	-0.015	0.414 **
	0.025	0.025	0.204
Post x $\ln(\text{NP}/\text{Emp}_{i,1990})$	0.132 ***	0.130 ***	-0.511 *
	0.053	0.053	0.283
Post x Contract Intensity _i	-0.181	-0.184	1.306 *
	0.112	0.114	0.738
Post x Δ China Import Tariffs _i	-0.244 *	-0.269 *	-0.557
	0.140	0.144	0.489
Post x Δ China Subsidies _i	0.063	0.073	-1.650 ***
	0.088	0.092	0.691
Post x Δ China Licensing _i	-0.238	-0.237	-1.319 **
	0.164	0.166	0.658
Post x 1(Advanced Technology _i)	-0.036	-0.036	0.018
	0.045	0.045	0.146
MFA Exposure _{i,t}	-0.342 ***	-0.342 ***	-0.541 ***
	0.060	0.061	0.198
NTR _{i,t}	-0.455	-0.430	24.346 *
	0.670	0.672	13.226
U.S. Union Membership _{i,t}	-0.123	-0.110	15.049 *
	0.203	0.199	7.792
Observations	5,706	5,706	5,706
R2	0.99	0.99	
Fixed Effects	i,t	i,t	i,t
Employment Weighted	Yes	Yes	Yes
Joint Significance P-Value		0.008	0.011
Constrained Estimation?	No	No	Yes
Knot	.	.	0.45
AIC	.	.	13810
Implied Impact of PNTR	-0.151	-0.120	-0.158

Notes: Table reports results of OLS generalized difference-in-differences regressions of log industry employment on nonlinear versions of the interaction of the NTR gap with an indicator with the post-PNTR period. Additional controls include time-varying variables -- MFA exposure, NTR tariff rates, union membership rates -- as well as interactions of the post-PNTR indicator with time-invariant controls including the log of 1990 capital and skill intensity, contract intensity (Nunn 2007), changes in Chinese import tariffs, changes in Chinese production subsidies, changes in Chinese export licensing requirements and an indicator for whether the industry produces advanced technology products. Data span 1990 to 2007. Robust standard errors adjusted for clustering at the industry (i) level are displayed below each coefficient. Estimates for the year (t) and industry fixed effects as well as the constant are suppressed. Observations are weighted by initial industry employment. "Joint Significance" reports the p-value of a test of joint significance of the linear and polynomial NTR gap terms in column two and the intercept and slope terms in column three. Penultimate row reports the Akaike Information Criterion (AIC) for the two-segment spline estimated in the final column. Final row reports the predicted relative change in the dependent variable implied by the difference-in-differences coefficient. Superscripts ***, ** and * represent statistical significance at the 1, 5 and 10 percent levels.

Table 3: Non-Linear Specifications (LBD)

	$\ln(\text{Emp}_{it})$	$\ln(\text{Emp}_{it})$	$\ln(\text{Emp}_{it})$
Post x NTR Gap _{i,1999} X 1{c=US}	-0.641 ***		
	-0.247		
Post x NTR Gap _{i,1999}		0.016	-0.649 ***
		-0.112	-0.270
Observations	1664	999	832
R2	0.997	0.994	0.982
Fixed Effects	ct, ci, it	i,t	i,t
Employment Weighted	Yes	Yes	Yes

Notes: First column displays results of a country-industry-level OLS generalized triple differences regression of the log of employment on a triple interaction of an indicator for the post-PNTR period, the NTR gap and an indicator for if the country is the U.S. The second and third columns display results of industry-level generalized difference-in-differences regression regressions for the EU and U.S., respectively. Data span 1998 to 2005, and data for EU members are aggregated to the EU level. Estimates for country x year (ct), country x industry (ci) and industry x year (it) fixed effects (for column 1), and industry and year fixed effects (for columns 2 and 3), as well as the regression constant are not reported. Robust standard errors adjusted for clustering at the country x industry-level (for column 1) and industry-level (for columns 2 and 3) are displayed below each coefficient. Observations are weighted by 1998 employment. Superscript *** denotes statistical significance at the 1 percent level.

Table 4: Employment in the United States versus EU (UNIDO)

	$\ln(\text{Value}_{ict})$	$\ln(\text{Importers}_{ict})$	$\ln(\text{Exporters}_{ict})$	$\ln(\text{Pairs}_{ict})$
1{c=China} x Post x NTR Gap _h	0.502 ***	0.437 ***	0.517 ***	0.509 ***
	0.122	0.062	0.071	0.074
$\ln(\text{Exchange Rate}_{ct})$	0.017 **	0.047 ***	0.042 ***	0.041 ***
	0.008	0.003	0.004	0.004
$\ln(\text{NTR}_{ct})$	0.107 ***	0.078 ***	0.089 ***	0.096 ***
	0.018	0.007	0.008	0.008
Observations	1,436,526	1,436,526	1,436,526	1,436,526
R2	0.38	0.49	0.48	0.47
Fixed Effects	hc,ct,ht	hc,ct,ht	hc,ct,ht	hc,ct,ht
Implied Impact of PNTR	0.17	0.14	0.17	0.17

Notes: Table displays results of product-country-year level OLS generalized triple difference-in-differences regression of noted dependent variable on interaction of China country indicator, post-PNTR indicator and NTR gap, along with country (c) x year (t), country x product (h) and product x year fixed effects and the NTR tariff rate. Data span 1992 to 2007. Robust standard errors adjusted for clustering at the product x country level are displayed below each coefficient. Estimates for the fixed effects and constant are suppressed. Final row reports the predicted relative change in the dependent variable implied by the triple differences coefficient. Superscripts ***, ** and * represent statistical significance at the 1, 5 and 10 percent levels.

Table 5: PNTR and U.S. Imports (LFTTD)

All Trade				
	All Firms	SOE	Domestic	Foreign
	ln(V _{ict})	ln(V _{ict})	ln(V _{ict})	ln(V _{ict})
1(c=US) x Post x NTR Gap _{it}	0.214 *	0.187	0.815 *	1.018 ***
	0.126	0.138	0.473	0.207
Observations	1,159,132	972,780	473,590	510,839
R2	0.84	0.75	0.71	0.76
Fixed Effects	hc,ht,ct	hc,ht,ct	hc,ht,ct	hc,ht,ct

General Trade				
	All Firms	SOE	Domestic	Foreign
	ln(V _{ict})	ln(V _{ict})	ln(V _{ict})	ln(V _{ict})
1(c=US) x Post x NTR Gap _{it}	0.357 ***	0.333 **	0.728	0.919 ***
	0.129	0.150	0.475	0.226
Observations	1,112,173	945,902	467,854	419,451
R2	0.82	0.81	0.81	0.79
Fixed Effects	hc,ht,ct	hc,ht,ct	hc,ht,ct	hc,ht,ct

Processing & Assembly Trade				
	All Firms	SOE	Domestic	Foreign
	ln(V _{ict})	ln(V _{ict})	ln(V _{ict})	ln(V _{ict})
1(c=US) x Post x NTR Gap _{it}	0.287	0.185	1.802	0.707 ***
	0.176	0.211	2.086	0.209
Observations	344,604	182,274	39,444	275,940
R2	0.86	0.85	0.85	0.85
Fixed Effects	hc,ht,ct	hc,ht,ct	hc,ht,ct	hc,ht,ct

Notes: Table displays results of product-country-year level OLS generalized triple difference-in-differences regression of log Chinese export value on interaction of US country indicator, post-PNTR indicator and NTR gap, along with country (c) x year (t), country x product (h) and product x year fixed effects and the NTR tariff rate. Data span 2000 to 2005. Robust standard errors adjusted for clustering at the product x country level are displayed below each coefficient. Estimates for the fixed effects and constant are suppressed. Superscripts ***, ** and * represent statistical significance at the 1, 5 and 10 percent levels.

Table 6: PNTR and Chinese Exports (Chinese Data)

	ln(NP/Emp _{it})	ln(K/Emp _{it})	ln(NProd _{it})	ln(Prod _{it})	ln(Emp _{it})	ln(K _{it})	ln(Hours _{it})
Post x NTR Gap _{it}	0.159 ***	0.556 ***	-0.324 *	-0.531 ***	-0.481 **	-0.097	-0.567 ***
	0.062	0.157	0.186	0.222	0.218	0.230	0.228
Post x ln(K/Emp _{it,1990})	-0.049 ***		-0.031	0.019	0.006	-0.082 **	0.010
	0.018		0.031	0.042	0.039	0.041	0.041
Post x ln(NP/Emp _{it,1990})		-0.021	0.075	0.217 ***	0.181 **	0.200 ***	0.223 ***
		0.054	0.077	0.079	0.079	0.083	0.081
Post x Contract Intensity _{it}	0.134 ***	0.172	-0.017	-0.299 *	-0.201	-0.193	-0.322 *
	0.045	0.130	0.159	0.178	0.169	0.158	0.179
Post x ΔChina Import Tariffs _{it}	0.127 *	-0.213	-0.142	-0.467 **	-0.332	-0.507 ***	-0.495 **
	0.066	0.159	0.206	0.217	0.213	0.212	0.228
Post x ΔChina Subsidies _{it}	0.061	0.298 ***	0.140	0.015	0.070	0.401 ***	-0.017
	0.054	0.085	0.106	0.133	0.121	0.129	0.143
Post x ΔChina Licensing _{it}	-0.051	0.065	-0.314	-0.222	-0.265	-0.095	-0.156
	0.071	0.138	0.232	0.250	0.235	0.229	0.262
Post x 1{Advanced Technology _{it} }	-0.044 **	-0.015	-0.010	-0.040	-0.018	-0.021	-0.043
	0.019	0.055	0.068	0.075	0.070	0.070	0.074
MFA Exposure _{it}	0.072	0.048	-0.274 ***	-0.352 ***	-0.335 ***	-0.306 ***	-0.344 ***
	0.060	0.117	0.080	0.132	0.117	0.103	0.132
NTR _{it}	-0.108	0.182	-1.246	-0.696	-1.094	-0.709	-0.781
	0.494	0.959	1.114	1.406	1.280	1.147	1.417
U.S. Union Membership _{it}	0.298 **	0.241	0.170	-0.292	-0.158	-0.113	-0.273
	0.148	0.263	0.376	0.347	0.359	0.354	0.362
Observations	1,280	1,280	1,280	1,280	1,280	1,280	1,280
R2	0.97	0.97	0.98	0.98	0.98	0.98	0.98
Fixed Effects	i,t	i,t	i,t	i,t	i,t	i,t	i,t
Employment Weighted	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Implied Impact of PNTR	0.051	0.178	-0.104	-0.170	-0.154	-0.031	-0.182

Notes: Table reports results of industry-year level OLS generalized difference-in-differences regression of noted industry outcome on the interaction of the NTR gap and a post-PNTR indicator. Additional controls include time-varying variables -- MFA exposure, NTR tariff rates, union membership rates -- as well as interactions of the post-PNTR indicator with time-invariant controls including the log of 1990 capital and skill intensity (Nunn 2007), changes in Chinese import tariffs, changes in Chinese production subsidies, changes in Chinese export licensing requirements and an indicator for whether the industry produces advanced technology products. NProd, Prod, Hours and K represent non-production workers, production workers, production hours and the real book value of capital. Data are from the CM and for census years 1992, 1997, 2002 and 2007. Robust standard errors adjusted for clustering at the industry level are displayed below each coefficient. Estimates for the year (t) and industry (i) fixed effects as well as the constant are suppressed. Observations are weighted by initial industry employment. Final row reports the predicted relative change in the dependent variable implied by the difference-in-differences coefficient. Superscripts ***, ** and * represent statistical significance at the 1, 5 and 10 percent levels.

Table 7: Other Industry Outcomes (CM)

	$\ln(\text{NP}/\text{Emp}_{i,t})$	$\ln(\text{K}/\text{Emp}_{i,t})$	$\ln(\text{NProd}_{i,t})$	$\ln(\text{Prod}_{i,t})$	$\ln(\text{Emp}_{i,t})$	$\ln(\text{K}_{i,t})$	$\ln(\text{Hours}_{i,t})$
Post x NTR Gap _p	0.003 0.082	0.295 ** 0.139	-0.240 * 0.123	-0.280 ** 0.142	-0.276 *** 0.112	-0.419 0.268	-0.312 ** 0.139
Post x $\ln(\text{K}/\text{Emp}_{p,1990})$	-0.039 *** 0.006		-0.027 ** 0.013	-0.008 0.014	-0.009 0.012	-0.254 *** 0.023	-0.017 0.013
Post x $\ln(\text{NP}/\text{Emp}_{p,1990})$		0.013 0.021	-0.290 *** 0.024	0.109 *** 0.020	0.016 0.018	0.070 *** 0.028	0.106 *** 0.020
Age _p	0.022 0.017	0.092 *** 0.026	0.197 *** 0.031	0.213 *** 0.030	0.195 *** 0.025	0.244 *** 0.027	0.216 *** 0.027
TFP _p	-0.042 *** 0.012	-0.073 *** 0.021	-0.007 0.012	0.032 0.022	0.031 * 0.017	-0.037 0.025	0.046 ** 0.023
Post x Contract Intensity _i	0.034 0.058	0.114 0.097	0.064 0.117	-0.214 * 0.128	-0.094 0.102	-0.369 ** 0.168	-0.251 ** 0.123
Post x Δ China Import Tariffs _i	0.236 *** 0.079	-0.166 0.168	0.222 0.165	-0.388 ** 0.190	-0.229 0.144	-0.294 0.288	-0.436 *** 0.164
Post x Δ China Subsidies _i	0.014 0.052	0.239 ** 0.103	0.150 0.097	0.141 0.123	0.103 0.086	0.453 *** 0.174	0.103 0.111
Post x Δ China Licensing _i	0.180 *** 0.072	0.155 0.170	-0.210 0.201	-0.550 ** 0.252	-0.387 ** 0.188	0.064 0.267	-0.460 ** 0.214
Post x 1{Advanced Technology _i }	-0.048 *** 0.020	-0.015 0.054	0.051 0.043	-0.130 ** 0.063	-0.057 0.048	-0.013 0.079	-0.107 * 0.063
MFA Exposure _{i,t}	0.085 0.058	0.081 0.066	-0.139 0.089	-0.191 * 0.100	-0.185 * 0.095	-0.184 0.116	-0.201 ** 0.101
NTR _{i,t}	-0.849 0.582	-0.949 0.681	0.015 0.844	1.827 1.220	0.868 0.903	0.904 1.080	1.666 1.208
U.S. Union Membership _{i,t}	0.268 * 0.145	-0.009 0.240	0.591 *** 0.237	0.179 0.252	0.304 0.223	-0.262 0.263	0.109 0.259
Observations	257,503	257,503	257,503	257,503	257,503	257,503	257,503
R2	0.78	0.73	0.93	0.93	0.95	0.91	0.92
Fixed Effects	p,t	p,t	p,t	p,t	p,t	p,t	p,t
Employment Weighted	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Implied Impact of PNTR	0.001	0.094	-0.077	-0.089	-0.088	-0.134	-0.100

Notes: Table reports results of plant-year level OLS generalized difference-in-differences regression of noted plant outcome on the interaction of the NTR gap and a post-PNTR indicator. Additional controls include time-varying variables -- MFA exposure, NTR tariff rates, union membership rates, plant age, plant TFP (index method) -- as well as interactions of the post-PNTR indicator with time-invariant controls including the log of capital and skill intensity in the first year the plant is observed, contract intensity (Nunn 2007), changes in Chinese import tariffs, changes in Chinese production subsidies, changes in Chinese export licensing requirements and an indicator for whether the industry produces advanced technology products. NProd, Prod, Hours and K represent non-production workers, production workers, production hours and the real book value of capital. Data are from the CM and for census years 1992, 1997, 2002 and 2007. Robust standard errors adjusted for clustering at the level of the plants' major industries are displayed below each coefficient. Estimates for the year (t) and plant (p) fixed effects as well as the constant are suppressed. Observations are weighted by employment in the first year the plant is observed. Final row reports the predicted relative change in the dependent variable implied by the difference-in-differences coefficient. Superscripts ***, ** and * represent statistical significance at the 1, 5 and 10 percent levels.

Table 8: Plant Outcomes (CM)

	$\ln(\text{Emp}_{it})$	$\ln(\text{Emp}_{it})$	$1(\text{Death}_{pt+1})$	$1(\text{Death}_{pt+1})$
Post x NTR Gap _p	-0.380 ***	-0.208 **	0.064 ***	0.042 **
	0.089	0.090	0.020	0.019
Post x NTR Gap _p ^{Upstream}		-0.280		-0.022
		0.427		0.082
Post x NTR Gap _p ^{Downstream}		-0.691 ***		0.103 ***
		0.159		0.041
Post x $\ln(K/\text{Emp}_{p,1990})$	-0.082 ***	-0.070 ***	-0.006 **	-0.009 ***
	0.016	0.015	0.003	0.003
Post x $\ln(NP/\text{Emp}_{p,1990})$	0.052 *	0.034	-0.016 ***	-0.013 ***
	0.031	0.030	0.006	0.005
Post x Contract Intensity _i	-0.189 ***	-0.218 ***	0.003	0.010
	0.081	0.081	0.013	0.014
Post x Δ China Import Tariffs _i	-0.396 ***	-0.278 ***	-0.006	-0.027
	0.104	0.109	0.020	0.018
Post x Δ China Subsidies _i	0.022	0.022	0.023 *	0.023 **
	0.073	0.069	0.012	0.011
Post x Δ China Licensing _i	-0.121	-0.036	0.007	-0.002
	0.146	0.135	0.022	0.023
Post x $1\{\text{Advanced Technology}_i\}$	-0.056 **	-0.055 **	0.007	0.005
	0.028	0.027	0.005	0.004
MFA Exposure _{it}	-0.193 ***	-0.167 ***	0.037 ***	0.035 ***
	0.064	0.053	0.014	0.013
NTR _{it}	0.555	0.524	0.031	0.039
	0.513	0.513	0.052	0.048
U.S. Union Membership _{it}	0.112	0.164	0.012	0.003
	0.132	0.133	0.014	0.012
Observations	1,181,142	1,181,142	2,079,616	2,079,616
R2	0.95	0.95	0.79	0.79
Fixed Effects	p,t	p,t	p,t	p,t
Employment Weighted	Yes	Yes	Yes	Yes
Implied Impact of PNTR	-0.117	-0.143	.	.

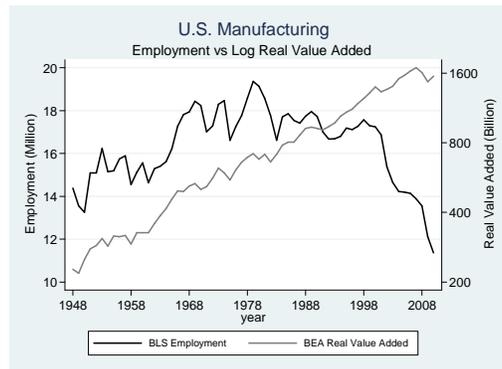
Notes: Table reports results of plant-year level OLS generalized difference-in-differences regressions of either log plant-year employment or an indicator for plant death on the interaction of a post-PNTR indicator and the own, upstream and downstream NTR gaps. Additional controls include time-varying variables -- MFA exposure, NTR tariff rates, union membership rates, plant age, plant TFP (index method) -- as well as interactions of the post-PNTR indicator with time-invariant controls including the log of capital and skill intensity in the first year the plant is observed, contract intensity (Nunn 2007), changes in Chinese import tariffs, changes in Chinese production subsidies, changes in Chinese export licensing requirements and an indicator for whether the industry produces advanced technology products. Data span 1990 to 2007. Robust standard errors adjusted for clustering at the level of the plants' major industries are displayed below each coefficient. Estimates for the year (t) and plant (i) fixed effects as well as the constant are suppressed. Observations are weighted by plant employment in the first year that it is observed in the sample. Final row reports the predicted relative change in the dependent variable implied by the difference-in-differences coefficient. First two columns restricted to the intensive margin of plants active in all years of the sample. Last two columns contain all observations. Superscripts ***, ** and * represent statistical significance at the 1, 5 and 10 percent levels.

Table 9: Plant Input-Output Linkages (LBD)



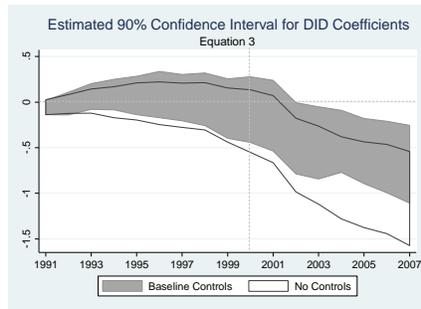
Notes: Figure displays percent of New York Times, Wall Street Journal and Washington Post articles discussing the uncertainty of China's NTR status.

Figure 1: China MFN Uncertainty Index



Notes: Figure compares annual manufacturing employment as of March according to the U.S. Bureau of Labor Statistics (series CEU3000000001) to real value added as measured by the Bureau of Economic Analysis.

Figure 2: U.S. Manufacturing Employment versus Value Added



Notes: Figure displays the 90 percent confidence interval (CI) for the estimated difference-in-differences (DID) coefficients of equation 3. Shaded CI represents the specification which includes all baseline covariates. Unshaded CI represents the specification which includes only the DID coefficients and the fixed effects. "Baseline covariates include time-varying variables – MFA exposure, NTR tariff rates, union membership rates – as well as interactions of year dummies with time invariant controls including the log of 1990 capital and skill intensity, contract intensity (Nunn 2007), changes in Chinese import tariffs, changes in Chinese production subsidies, changes in Chinese export licensing requirements and an indicator for whether the industry produces advanced technology products. Observations are weighted by initial industry employment. Confidence interval is based on robust standard errors adjusted for clustering at the industry level.

Figure 3: Estimated Timing of the PNTR Effect (LBD)

Online Appendix (For Online Publication)

This online appendix contains detailed explanations of data creation as well as additional empirical results referenced in the main text.

A Anecdotal Evidence

A.1 U.S. Discussions of PNTR and Uncertainty

This section lists anecdotes from media reports, Congressional testimony and other government sources describing firms' uncertainty over China's temporary NTR status, and connecting this uncertainty to an unwillingness to invest in establishing closer ties with Chinese firms. They also suggest that uncertainty can have a chilling effect on investment even if the probability of rescinding NTR is small, given the high costs of reverting to a situation where China does not have NTR status. Anecdotes are displayed chronologically by source.

1. *Rowley (1993)*:

- (a) “The persistent threat of MFN withdrawal does little more than create an unstable and excessively risky environment for U.S. companies considering trade and investment in China, and leaves China’s booming economy to our competitors,’ more than 340 such firms and groups said in a letter to [President] Clinton May 12... The firms range from AT&T, Coca-Cola, General Motors, Kellogg and the First National Bank of Chicago to IBM, Boeing, McDonnell Douglas, Caterpillar and the National Wheat Growers Association.”

2. *United States General Accounting Office (1994)*:

- (a) “U.S. government and private sector officials cited uncertainty surrounding the annual renewal of China’s most-favored-nation trade status as the single most important issue affecting U.S. trade relations with China.”

- (b) “A primary concern for the 5 U.S. business associations and 15 large corporations GAO contacted was China’s most-favored-nation trade status. According to these business associations and companies, the uncertainty over whether the U.S. government will withdraw or place further conditions on the renewal of China’s most-favored-nation trade status affects the ability of U.S. companies to do business in China (see pp. 43-5). Some U.S. companies and business associations told GAO that uncertainty about the renewal of China’s most-favored-nation status makes long-term planning difficult and contributes to tensions in U.S.-China trade relationships.”
- (c) “The great majority of the U.S. business associations and companies we in Business Relationships contacted told us that the annual uncertainty surrounding China’s MFN status potentially hinders their business activities in China. In a May 1993 letter to the President, 316 U.S. corporations and trade associations represented by the Business Coalition for U.S.-China Trade jointly expressed their view that “the persistent threat of MFN withdrawal does little more than create an unstable and excessively risky environment for U.S. companies considering trade and investment in China, and leaves China’s booming economy to our competitors.” According to one U.S. company executive we spoke with, this uncertainty precludes long-term business deals and makes strategic planning difficult. The annual MFN review process may also be a negative factor for U.S. companies in securing financing for business transactions in China from the international lending community, according to a recent report prepared by over 20 leading U.S. firms in the electric power and fossil fuel industry. The U.S.-China Business Council and the National Association of Manufacturers affirmed the importance of a stable commercial environment for business planning and stressed that the need to make a politically charged decision about China’s MFN status every spring creates an annual crisis for business people and diplomats alike.”
- (d) “In addition, the uncertainty created by the annual MFN renewal process for China causes great concern for U.S. companies that are attempting to forge long-term business relationships in China.”
- (e) “However, certain U.S. government policies designed to address concerns about China’s human rights, trade, and weapons proliferation practices may

prevent U.S. companies from being able to more fully realize the business opportunities associated with China's economic growth and development. For example, the confidence of U.S. companies in their ability to do business in China is affected by their uncertainty over whether the US. government will renew China's MFN trade status, according to U.S. business associations and companies."

3. *Pearce (1996)*: "We view the imposition conditions upon the renewal of MFN as virtually synonymous with outright revocation. Conditionality [sic] mean uncertainty. We cannot plan and run our businesses if we are wondering whether our most important source of supply is about to disappear. Without continuity and certainty of supply, American toy companies also cannot plan to take advantage of the growing Chinese market."
4. *Milosh (1997)*: "Any annual review process introduces uncertainty, weakening the ability of U.S. traders and investors to make long-run plans, and saddles U.S./China trade and investment with a risk factor cost not faced by our international competitors."
5. *Cohen (1997)*: "The uncertain framework of our current bilateral commercial relationship with China stands in the way of achieving greater access for U.S. trade and investment in China and the Asia-Pacific Region. . . For more than 15 years, as U.S. Business has tried to expand its trade and investment ties to China, it has had to live with the knowledge that its exports and investments were in perpetual jeopardy due to the annual Jackson-Vanick review."
6. *Knowlton (2000)*: "U.S. companies expect to benefit from billions of dollars in new business and an end to years of uncertainty in which they had put off major decisions about investing in China."
7. *St. Maxens (2001)*: "The fact that the United States does not accord China permanent NTR status creates uncertainty for America's toy companies and exposes them to unwelcome risk. While the risk that the United States would withdraw NTR status from China may be small, if it did occur the consequences would be catastrophic for U.S. toy companies given the 70 percent non-MFN U.S. rate of duty applicable to toys. As a result, Mattel strongly supports congressional

approval of legislation granting permanent NTR status to China upon its WTO accession.”

8. *National Retail Federation (2001)*:

- (a) “For years, the annual NTR renewal process has created instability in the U.S.–China relationship. This ongoing instability has hampered opportunities to export to, import from, and invest in China. Although Congress has granted China annual NTR continuously since 1980, the cycle of annual renewals and the uncertainty associated with the process result in costly disruptions that hurt both American consumers and U.S. businesses alike.”
- (b) “The uncertainty of the annual NTR renewal is particularly disruptive for U.S. retailers, which typically place orders for Chinese products 18 months prior to delivery. China offers American consumers many value-priced goods such as clothing, footwear, consumer electronics and toys, as well as products like silk apparel that are simply not available from other manufacturers in the United States. The continuing uncertainty of China’s NTR status forces retailers to gamble. Should they pay other suppliers more to buy the goods they would have gotten from China, which would, in turn, force them to pass the higher prices on to their customers? Or should they risk the uncertainty of sourcing from China, hoping that NTR will continue, so they can realize cost savings which are passed on to their customers? In either case, the uncertainty is reflected in higher product prices for American families.”

9. *U.S. Trade Deficit Review Commission (2001)*: “In the months since the enactment of Permanent Normal Trade Relations (PNTR) legislation with China there has been an escalation of production shifts out of the U.S. and into China. According to our media-tracking data, between October 1, 2000 and April 30, 2001 more than eighty corporations announced their intentions to shift production to China, with the number of announced production shifts increasing each month from two per month in October to November to nineteen per month by April.”

A.2 Chinese Discussions of PNTR and Uncertainty

This section lists anecdotes from Chinese media describing the effect of PNTR on Chinese industries and firms. Here, we provide the professional translations of the

articles. The original Chinese-language quotes are available upon request.

1. *Shanghai Securities News (1999)*: “Secondly, formal agreement has been reached on China’s accession to the WTO, and the estimate is that in the next year, China’s entry into the WTO will have a very positive role in China’s economic development. First of all, this will help to build confidence among investors at home and abroad, especially among United States investors, because currently, China faces the issue every year of maintaining Most Favored Nation trading status.”
2. *Jiangxi Paper Industry Co., Ltd. (2000)*: “The process of China’s accession to the WTO is drawing to a close. After China joins the WTO, foreign products will participate in competition in the domestic market.... Meanwhile, we can enjoy multilateral Permanent Most Favored Nation status among the Member States of the WTO, so as to actively explore and enter the international market and participate in international economic competition.”

A.3 U.S. Discussions of Trade-Induced Technology or Product Upgrading

This section lists excerpts of newspaper articles describing responses by U.S. businesses to greater competition from China after PNTR.

1. *Neikirk (2002)*: “To beat the Chinese and other foreign competitors threatening his business, Bradley and his partner invested several million dollars to double the production capacity of their plastic-part plant, PM Mold, with the latest in robotics and automation equipment. Now, he says he can make twice as many parts – and better ones at that – without adding to his work force, a feat that is driving up productivity as Bradley’s small factory increases its output of parts with the same number of workers.”
2. *Kirkbride (2001)*: “The transition from United States and European dominance in the residential furniture industry to a worldwide market is a mixed blessing for West Michigan’s manufacturers. Kindel Furniture Co. and the John Widdicomb Co., both in Grand Rapids, are thriving by creating ultra high-priced furniture and cultivating a cache of very loyal, very rich followers...‘Clearly, they’re in a different world in the real high end,’...‘They’re making a lot of custom pieces,

maybe 50 to 200 at a time, not the big runs that Chinese factories produce’ (Kirkbride 2001).”

B Data

B.1 Construction of NTR Gaps

Computation of the NTR gap for each NAICS industry takes four steps. First, NTR gaps are computed at the eight-digit HS level as the difference between the non-NTR and NTR import tariff rates provided by Feenstra, Romalis and Schott (2002) and described in the next section. Second, using the concordance developed by Pierce and Schott (2012b), we match all HS import codes used by the United States between 1989 and 2001 to a time-invariant set of eight-digit HS code families. This step ensures that NTR gaps from HS codes added or deleted over time are incorporated in all years for which we may want to compute an NTR gap. Without this step, NTR gaps might be available for a different number of NAICS industries across the years 1989 to 2001 if HS codes matched to certain NAICS industries appear in some years but not others. Third, we match these time consistent HS codes to NAICS industries using a concordance from the U.S. Bureau of Economic Analysis (BEA).⁴⁴ Fourth, we compute the NTR gap for each NAICS industry as the average NTR gap across all time-consistent HS codes matched to that NAICS industry. Figure A.1 plots the distribution of the 1999 NTR gap across industries.

We calculate the upstream NTR gap for NAICS industry i as the weighted average NTR gap across all industries used to produce i , using the coefficients from the BEA’s industry-by-industry total requirements input-output matrix as weights.⁴⁵ Likewise, the downstream NTR gap for NAICS industry i is the weighted average NTR gap of all industries supplied by industry i , again using the total requirements table coefficients as weights. In computing both weighted averages, we set the IO weights to zero for up- and downstream industries within industry i ’s three-digit NAICS sector. We do this in recognition of the fact that U.S. manufacturing establishments often produce clusters of products within the same three-digit NAICS sector (Bernard et al. 2010).

⁴⁴The HS-industry concordance is contained in the file “HSConcord.txt” available at <http://www.bea.gov/industry/zip/NDN0317.zip>.

⁴⁵The industry-by-industry total requirements table is contained in the file “ndn0310.zip” available at <http://www.bea.gov/industry/zip/NDN0310.zip>.

B.2 Relation of the NTR Gap to Other Industry Attributes

Table A.1 summarizes the relationships between the 1999 NTR gap and other industry-level variables used in our analysis with a series of bi-variate OLS regressions. The industry attributes considered in Table A.1 are: 1990 capital intensity; 1990 skill intensity; Nunn’s (2007) measure of contract intensity, defined as the share of intermediate inputs requiring relationship-specific investments in 1997; changes in Chinese import tariffs from 1996 to 2005; changes in the Chinese production subsidies per total sales from 1999 to 2005; the share of Chinese firms eligible to export in 1999; the import-weighted MFA quota fill rate; the share of U.S. workers belonging to a union in 1999; an indicator for industries containing advanced technology products; and the 1999 NTR and non-NTR rates in levels. For reference, the final two rows of the table report the mean and standard deviation of each of these covariates. Construction of the variables used in the table is discussed in detail in Section D.

As indicated in the table, the 1999 NTR gap has negative and statistically significant relationships with capital intensity, union membership, and changes in Chinese production subsidies. It has positive and statistically significant associations with contract intensity, the share of Chinese firms eligible to export under Chinese licensing constraints, industries’ exposure to the MFA, and the indicator for advanced technology. The share of variation in the NTR gap explained by each of these regressors is generally low, and does not exceed 0.23 (for capital intensity).

B.3 Creating Time-Consistent Industry Codes and a “Constant Manufacturing” Sample

As noted in the main text, we use the algorithm developed in Pierce and Schott (2012b) to create time-consistent industry codes over which employment changes can be analyzed. This algorithm creates “families” of four-digit SIC and six-digit NAICS codes that group related SIC and NAICS categories together over the transition from SIC to NAICS in 1997 and subsequent NAICS revisions in 2002 and 2007. For example, if a SIC code splits into several NAICS codes between 1997 and 2002, the SIC code and its NAICS “children” would be grouped into the same family.

Given this process, it is easy to see that some families can grow to be quite large. For this reason, we have created several concordances that limit the inclusion of children that do not account for some threshold level of their parents’ activity. This is

possible because the SIC to NAICS concordance provided by Becker, Gray and Marvakov (2013) provides the share of each parent (child) industry that is allocated to its children (parent). These limits create a tradeoff. Lower thresholds generate a larger number of families with more closely related underlying SIC and NAICS codes. Higher thresholds lead to a smaller number of families, most of which are likely to include both manufacturing and non-manufacturing codes.

In all of the results contained in the main text, we use a threshold of 50 percent to create families.⁴⁶ This threshold works as follows. First, sort all children industries j that match to parent industries i in descending order according to their importance in value terms to parent industry i . Keep all children matches j until the cumulative share of value explained exceeds 50 percent. In most cases, a single child j accounts for the overwhelming majority of parent i 's overall value. These families yield time-consistent industry codes for all U.S. manufacturing industries.

To create the constant manufacturing sample, we exclude any families that contain either a SIC or NAICS code that is ever classified outside manufacturing. In addition, as described in section 2.2 above, we exclude any establishments that are ever classified in a family outside the constant manufacturing sample.

Figure A.2 displays annual employment in our “constant” manufacturing sample against the manufacturing employment series available publicly from the U.S. Bureau of Labor Statistics.⁴⁷ As expected, given the procedure outlined above, the “constant” manufacturing sample accounts for less employment than the BLS series. Despite this level difference, the LBD exhibits a similarly stark drop in employment after 2000.⁴⁸

⁴⁶However, we note that the main results can also be generated using the standard NAICS definitions in Becker, Gray and Marvakov (2013) or using the beta version of the time-consistent LBD NAICS codes created by Teresa Fort and Shawn Klimek, indicating that the results are not driven by our definition of industry families.

⁴⁷Series CEU3000000001, available at www.bls.gov. As the BLS series is NAICS-based, employment for industries that were reclassified out of manufacturing in the change from SIC to NAICS are not included. As noted above, our sample is SIC-NAICS-based, meaning that we also drop NAICS industries not classified as manufacturing under the SIC. For further detail on construction of the BLS series, see Morisi (2003).

⁴⁸As indicated by the roughly sideways movement of manufacturing employment from mid-1960s through 2000, the share of manufacturing employment in total private employment was declining for some time prior to PNTR, a trend discussed in Edwards and Lawrence (2013).

B.4 Total Factor Productivity

We follow Foster et al. (2008) in measuring TFP as the log of deflated revenue minus the log of inputs, weighted by the average cost share for each input at the industry level. Inputs encompass the cost of materials, production employment, non-production employment and the book value of capital. Both revenue and inputs are deflated using price indexes available in Becker et al. (2013).

C U.S. Trade Policy Towards China

C.1 Statutory U.S. Import Tariffs

As noted in the main text, we use the *ad valorem* equivalent NTR and non-NTR tariff rates from Feenstra, Romalis and Schott (2002) to compute the NTR gaps by industry and year. This section describes the distribution of NTR and non-NTR tariff rates by eight-digit HS tariff line and year.

Non-NTR tariff rates, which can contain *ad valorem*, specific and “other” components – exhibit little change from 1989 to 2001. Indeed, 92 percent of the 13,700 unique tariff lines that appear in the Feenstra et al. (2002) dataset exhibit no change in their underlying “ad valorem” component over the years for which they are used. Even fewer tariff lines – 55 and 2, respectively – exhibit changes to their “specific” or “other” components. Furthermore, we find that more than 95 percent of the changes to the “ad valorem” component of the non-NTR rates occur in 1996, indicating they likely are related to changes triggered by the revision of HS codes in that year. For further detail, Pierce and Schott (2012) provide a detailed discussion of these changes.

NTR tariff rates exhibit greater variation over time than non-NTR tariff rates. Of the 13,700 tariff lines used during the 1989 to 2001 period, 6,127, 1,164 and 11 exhibit variation in their underlying “ad valorem,” “specific” and “other” components, respectively, during this period. These changes generally are implemented from 1995 to 1999, indicating they are related to the tariff reductions negotiated during the Uruguay Round of the GATT.

C.2 Annual Renewals of NTR Status

The U.S. House of Representatives considered legislation to overturn the Presidential waiver on Chinese import tariffs every year from 1990 to 2001. Table A.2 records the

share of votes against renewal during these years.

D Alternate Explanations

This section discusses a range of potential alternate explanations for the decline in U.S. manufacturing after 2000, as well as the data gathered to control for them in our regressions.

D.1 Shocks to U.S. Comparative Disadvantage Industries

As documented in Appendix Table A.1, NTR gaps are negatively related to industry capital intensity, with that attribute explaining 23 percent of the variation in the NTR gap across industries. Assuming the U.S. has a comparative disadvantage *vis a vis* China in the production of labor-intensive goods, an alternate explanation of the results in Section 3 is a post-2000 decline in the U.S. competitiveness of labor-intensive industries for some reason unrelated to PNTR, e.g. a general movement towards offshoring perhaps encouraged by the 2001 recession, or a positive productivity shock in China.⁴⁹

We account for this explanation by including interactions of the post-PNTR dummy variable with industries' 1990 capital and skill intensity. As 1990 does not correspond to a Census year, we measure capital and skill intensity as the ratio of the real book value of capital (K) and the number of non-production workers (NP) to total industry employment, respectively, using data from Becker, Gray and Marvakov (2013). Because employment is the denominator in these ratios, they enter equation 2 as time-invariant values in the initial year of the period of analysis rather than time-varying industry attributes.

As indicated in column 3 of Table 1 in the main text, the coefficient on the skill intensity interaction is positive and statistically significant, indicating that more skill intensive industries had higher relative levels of employment in the post-PNTR period. In contrast, the coefficient on the capital intensity interaction is not statistically significant.

⁴⁹See also section Section E below.

D.2 Changes in Chinese Policy

As part of its accession to the WTO, China agreed to ease formal and informal restrictions on foreign investment, reduce import barriers, and eliminate export licensing requirements and production subsidies (WTO 2001). China’s entry into the WTO also eliminated quotas on certain apparel and textile exports that already had been relaxed for other developing economies (Brambilla et al. 2009). These WTO-related reforms, like PNTR, may have influenced both manufacturing employment in the United States and China-U.S. trade. We discuss each of these Chinese policy changes in turn.

Barriers to Investment: In joining the WTO, China agreed to treat foreign enterprises no less favorably than domestic firms. This reduction in barriers to investment may have reduced the fixed and variable costs associated with offshoring, providing U.S. firms with a greater incentive to relocate some or all of their production to China. As direct evidence of these reforms is unavailable, we examine whether U.S. employment losses are concentrated in industries most likely to benefit from changes in the institutional environment, i.e., industries in which relationship specificity in contracting over inputs is more important.

To account for this potential relationship, we add to the baseline regression an interaction of a post-PNTR dummy and Nunn’s (2007) measure of industries’ contract intensity, which rises with the share of intermediate inputs requiring relationship-specific investment.⁵⁰ We expect a negative point estimate: assuming investment in China became easier after WTO accession, it should have the largest impact on U.S. employment in industries where relationship-specific contracting is more important. As indicated in column 3 of Table 1 in the main text, the relationship is negative but statistically insignificant in the baseline specification.

Tariff Barriers: China reduced import tariffs on a number of products both before and after its accession to the WTO. Reductions in Chinese import tariffs might be expected to boost U.S. exports to China and thereby raise U.S. employment. On the other hand, by lowering the cost of foreign inputs and thereby making China a more attractive location for manufacturing, they may have had the opposite effect.

Brandt et al. (2012) report Chinese import tariffs by eight-digit Chinese HS code for 1996 to 2005, though data for some HS codes are missing. We aggregate these tariffs up to the six-digit HS level and then from the six-digit HS level to U.S. NAICS codes using concordances developed by Pierce and Schott (2012a). For each U.S. industry-

⁵⁰These data are available from Nunn’s website at <http://scholar.harvard.edu/nunn/pages/data-0>.

year, this aggregation is the simple average of the tariffs of the six-digit HS codes encompassed by the industry. We then calculate the change in Chinese import tariff rates over the maximum span for which tariffs are available – 1996 to 2005 – and refer to this variable as the change in Chinese import tariffs. This change in tariff rates is then interacted with the post-PNTR dummy and included in the baseline specification.

As shown in column 3 of Table 1 in the main text, this variable has a negative and statistically significant relationship with employment in the baseline specification, indicating that reductions in Chinese import tariffs are associated with relative employment gains for US producers in the post-PNTR period.

Production Subsidies: Some have argued that the rapid expansion of China’s manufacturing sector was driven by subsidies, which may affect some industries more than others (Haley and Haley 2013). We use data from the Annual Report of Industrial Enterprise Statistics compiled by China’s National Bureau of Statistics (NBS), which reports the subsidies provided to responding firms.⁵¹ Following Girma et al. (2009) and Aghion et al. (2012). We use the variable “subsidy” in this dataset to compute subsidy per sales ratios for each four-digit China Industry Classification (CIC) and year. We then concord the CICs to ISIC and then U.S. SIC industries using concordances provided by Dean and Lovely (2010).

We include the interaction of the industry-level change in the subsidy-per-sales ratio with an indicator for the post-PNTR period in the baseline specification. As indicated in column 3 of Table 1 in the main text, we find a statistically insignificant relationship between this covariate and employment in the baseline specification.

Some suspect China of subsidizing a reallocation of production towards products with higher levels of technology, which we measure using an indicator that picks out industries identified by the U.S. Census Bureau as containing products with “advanced technology,” as described in sub-section D.4. As indicated in column 3 of Table 1 in the main text, we find a statistically insignificant relationship between this covariate and employment in the baseline specification.

Export Licensing: As discussed in detail in Bai et al. (2012), China agreed to phase out export licensing requirements by 2003. Because export licenses had formerly been more difficult to obtain in some industries than others, their removal may have led to a surge in Chinese exports and subsequent decline in U.S. manufacturing employ-

⁵¹The NBS data encompass a census of state-owned enterprises (SOEs) and a survey of all non-SOEs with annual sales above 5 million Renminbi (~\$600,000). The version of the NBS dataset available to us from Khandelwal et al. (2013) spans the period 1998 to 2005.

ment in the industries where licensing was most binding.⁵² Bai et al. (2012) reports the share of Chinese producers in each four-digit CIC industry that were eligible to export in 1999. We concord these shares to ISIC and then U.S. SIC industries using concordances provided by Dean and Lovely (2010) and the United Nations, available at <http://unstats.un.org/unsd/cr/registry/regot.asp>.

We then include in the baseline regression an interaction of a post-PNTR indicator with the share of firms eligible for export licenses in 1999 from Bai et al. (2012). As indicated in column 3 of Table 1 in the main text, this coefficient is statistically insignificant.

Textile and Clothing Quotas: During the Uruguay Round of trade negotiations, the United States, the EU and Canada agreed to eliminate quotas on developing country textile and clothing exports in four phases starting in 1995 (Brambilla et al. 2009). China was not eligible for these reductions until its accession to the WTO. First, we use HS-level data on MFA quotas provided by Khandelwal et al. (2013), which are matched to industries using the concordance in Pierce and Schott (2012a). Then, we measure the extent to which industries were exposed to the relaxation of quotas as the import-weighted average fill rate of the textile and clothing products that were under quota, where fill rates are defined as the actual imports divided by allowable imports under the quota. Fill rates are set to zero for unbound products. The measure of MFA exposure varies over time and reflects the sequential phasing out of the MFA in stages.

As indicated in column 3 of Table 1 in the main text, we find a negative and statistically significant relationship between this interaction and job loss after PNTR, indicating that exposure to the elimination of MFA quota restrictions was associated with relative employment declines.

D.3 Union Resistance

Another explanation for the decline in U.S. manufacturing employment is that all manufacturing firms desired to reduce employment after 2000, but that unions impeded reductions in some industries more than others. We measure union membership using data from the website www.unionstats.com – assembled by Hirsch and Macpherson (2003) – which publishes information on the share of workers that are members of a union by Current Population Survey (CPS) industry classification and year. We match

⁵²Khandelwal et al. (2013) show that the allocation of export licenses in the apparel industry restricted the exports of its most productive producers.

CPS industries to SIC codes using the concordances posted at unionstats.com.

As indicated in column 3 of Table 1 in the main text, the coefficient for union membership is statistically insignificant in the baseline specification.

D.4 The IT Boom-Bust

The information technology (IT) sector experienced a well-known boom and bust around the time that PNTR was implemented. It is possible that the employment declines after 2000 were concentrated in IT industries.

The U.S. Census Bureau identifies products – defined at the ten-digit HS level – that contain advanced technology in ten areas: biotech, life sciences, opto-electronics, IT, electronics, flexible manufacturing, advanced materials, aerospace, weapons and nuclear technology. We match these HS codes to NAICS industries using concordances developed by Pierce and Schott (2012a) and define an indicator that takes the value 1 if an industry includes ATP products, and 0 otherwise.⁵³ We then include in the baseline specification an interaction of a post-PNTR dummy variable and the indicator for ATP products. As noted in column 3 of Table 1 in the main text, the coefficient estimate for this interaction is statistically insignificant in the baseline specification.

D.5 The U.S. NTR Rate

Some of the variation in post- versus pre-PNTR U.S. manufacturing employment growth may be driven by changes to U.S. NTR tariff rates over our sample period. To control for such changes, we include the time-varying NTR rate for each industry in the baseline specification. However, as *ad valorem* equivalent (AVE) import tariffs are not available from Feenstra et al. (2003) after 2001, we assume these rates are constant after that year. While this assumption appears strong, we note that most of the changes in NTR tariffs driven by the Uruguay round had been implemented by 2001, and that separate analysis of the actual *ad valorem* and specific tariffs in the U.S. tariff schedule (available on the USITC website) indicates few changes to U.S. NTR tariffs between 2001 and 2007.

Moreover, to further investigate the influence of our assumption of constant U.S. AVE U.S. tariff rates after 2001, we estimate our own series of AVE tariff rates following

⁵³The Census ATP classification can be downloaded from <http://www.census.gov/foreign-trade/reference/codes/atp/>.

the USITC method as closely as possible. Use of these derived AVE tariffs yields estimates that are very similar to those in the baseline specification, as discussed in Section I and shown in column 3 of table A.5. We prefer the Feenstra, Romalis and Schott (2002) tariff series because they are available for a larger number of industries, in part due to the concordance issues discussed in Section 2.

D.6 Non-PNTR-Induced Technical Change

Another explanation for our results is that they are driven by labor-saving technical changes, such as automation, which are spuriously correlated with the NTR gap. While technical change unrelated to PNTR is difficult to measure, several of the variables discussed above – including indicators for advanced technology products (ATP) and measures of industry capital intensity – serve as useful proxies for where it might show up. As indicated in column 3 of Table 1 in the main text, however, coefficient estimates for these variables are statistically insignificant in the baseline specification. Moreover, we show in Section 4 that there is no relationship between the U.S. NTR gap and manufacturing employment in the EU. If labor-saving technological innovations unrelated to PNTR were spuriously correlated with the U.S. NTR gap, their impact also should be manifest in other developed economies.⁵⁴

E Chinese Productivity Growth

We use the firm-level Chinese production data described in Section 2 of this online appendix to investigate the relationship between productivity growth in Chinese industries and the U.S. NTR gap. Following Khandelwal et al. (2013), we define the total factor productivity for firm f as $\ln(TFP_f) = \ln(va_f) - \alpha_f \ln(w_f) - (1 - \alpha_f) \ln(k_f)$, where va_f , w_f , and k_f denote firm value added, wages and fixed assets (net of depreciation) and α_f is the firm’s share of wages in total value added. Wages are defined as reported firm wages plus employee benefits (unemployment insurance, housing subsidies, pension and medical insurance), and capital is defined as reported capital stock at original purchase price less accumulated depreciation.⁵⁵ We aggregate these productivity measures to the industry level by taking weighted averages using firms’ employment

⁵⁴In contrast, we do find evidence for trade-induced technical change that is associated with PNTR, as discussed in Section 5.3 of the main text.

⁵⁵This approach assumes revenue-based TFP reveals variation in physical efficiency, an assumption whose limitations are discussed in Section 5.3 of the main text.

as weights. Next, we use concordances provided by Brandt et al. (2012) to match HS-level NTR gaps for the United States to the four-digit Chinese Industry Classification (CIC) codes used in the NBS data.

Appendix Table A.3 reports the results of industry-level OLS regressions of Chinese TFP on year fixed effects, industry fixed effects and interactions of year fixed effects and the U.S. NTR gap. Coefficient estimates for all but the interaction terms are suppressed. As indicated in the table, the association between TFP and the NTR gap is statistically insignificant at conventional levels for all years.

F U.S. and EU Employment Data from UNIDO

Our comparison of the relationship between the NTR gap and manufacturing employment in the United States and the European Union in Section 4 uses data from the United Nations Industrial Development Organization’s (UNIDO) INDSTAT 4 database for 1997 to 2005.⁵⁶ This database contains information on a number of industry characteristics, including employment, at the four-digit International Standard Industrial Classification (ISIC) Revision 3 level.⁵⁷ Manufacturing industries in the ISIC begin with two digit codes from 15 to 37. We exclude industries that begin with 22 from our definition of manufacturing as they include publishing, which was classified as manufacturing under the SIC, but not the NAICS. Our definition of the European Union is based on the current set of 28 EU members, available at europa.eu/about-eu/countries/member-countries. Because of instances of missing data, our sample includes only industry-country pairs for which data are present in every year. Lastly, we note that data for the U.S. are unavailable in 2003.

It does not appear as though the EU data are subject to higher levels of measurement error than the U.S. data. EU members use standardized statistical systems (such as NACE) as part of the European Statistical System (ESS) to ensure that statistics are comparable across countries and over time, and the ESS coordinates its standardization activities with other international agencies, including the UN.⁵⁸ This standardized

⁵⁶Additional information regarding these data are available at www.unido.org/resources/statistics/statistical-databases/indstat4-2013-edition.html.

⁵⁷As noted in the main text, these industries are more aggregate than the four-digit SIC and six-digit NAICS industries reported in the LBD. To examine the relationship between UNIDO employment and the U.S. NTR gaps, we aggregate the latter from the eight- to the six-digit HS level and then map them to the four-digit ISIC level using publicly available concordances from the World Bank, available at www.wits.worldbank.org/wits/product_concordance.html.

⁵⁸Additional information regarding the ESS is available online at

system should limit country-specific changes in classification systems within the EU. In addition, for EU countries that are members of OECD, UNIDO receives data directly from OECD, which dedicates substantial resources to reporting statistics that are comparable over time and across countries. Since almost all EU countries were members of OECD during the time period we examine (exceptions include Estonia, Slovenia and Romania), this means that almost all of the UNIDO country-level data have passed through OECD's screens.

Nevertheless, we performed additional robustness checks to help rule out the possibility of spurious changes in employment due to industry classification changes in the UNIDO data. First, we re-estimated the triple differences specification while only including EU countries that were OECD members during the period examined, in case the statistics for non-OECD members were less accurate. The coefficient estimates are essentially unchanged by this restriction. Second, in case large swings in employment are indicative of spurious changes driven by industry classification changes, we re-estimated the regression after dropping EU industry-country pairs in which year-over-year employment growth was ever higher than 10 percent in absolute value terms. Again, the results are essentially unchanged by this restriction.

G Prior Trends

To further examine the possibility of prior trends in the relationship between the NTR gap and U.S. manufacturing employment, we regress manufacturing industry employment growth on the NTR gap for every decade available in the NBER-CES manufacturing industry database starting with 1960. Results are reported in Appendix Table A.4. We find that the coefficient on the NTR gap is negative and significant only for the last decade, 2000 to 2009, the period that includes the imposition of PNTR (2009 is the last year in which the data are available). The coefficient on the NTR gap is not statistically significant for the three prior decades, 1970 to 1980, 1980 to 1990, and 1990 to 2000 indicating that the NTR gap was not correlated with pre-PNTR employment trends in the three decades preceding PNTR. The coefficient on the NTR gap is positive and significant for the 1960 to 1970 decade, although the magnitude in terms of absolute value is substantially smaller than that associated with PNTR from 2000 to 2009. One potential explanation for this relationship is that the U.S. withdrew

epp.eurostat.ec.europa.eu/portal/page/portal/pgp_ess/about_ess.

NTR status from all communist countries in the 1950s (and from Cuba in 1962) and, as a result, the NTR gap picks up tariff *increases* during this period. We note that the results in Appendix Table A.4 are robust to including controls for industry capital and skill intensity, as well as the full set of time-invariant industry characteristics included in the baseline specification, equation 2.

H Non-Linear Estimates

Appendix Figure A.3 displays the relationship between predicted employment and the DID terms for the baseline linear versus non-linear specifications estimated in Sections 3.1 and 3.2.2 of the main text.

I Other Robustness Exercises

In this section we investigate the extent to which the baseline estimates are robust to different methods for controlling for the business cycle, to different measures of the NTR rate, and to instrumenting the NTR gap with the non-NTR tariff rate.

I.1 Business Cycle Controls

Changes in employment are also clearly affected by business cycle fluctuations. To the extent that aggregate shocks affect all industries equally, their effect on employment will be captured by the year fixed effects included in equation 2. Furthermore, we note that by including interactions of initial capital and skill intensity with the full set of year dummies, equation 3 allows for annual aggregate shocks to have differential effects on industries based on variation in those industry characteristics.

We use two additional techniques to control for the role of business cycle fluctuations. First, we re-estimate equation 2 after including interactions of capital and skill intensity with real GDP, indexed to a base year of 1990. Second, we follow Treffer (2004) by including industry-year-specific predictions of the the change in employment associated with growth in U.S. real GDP and the U.S. real effective exchange rate, as well as one and two-period lags of growth in these two variables. Results for these specifications are reported in columns 1 and 2 of Appendix Table A.5. As shown in the Table, inclusion of the additional business cycle controls has little effect on our DID coefficient either in terms of statistical or economic significance.

Finally, we note that examining the relationship between PNTR and employment *growth* over long time differences following the two business cycle peaks that occur during our sample period yields similar results, as reported in an earlier version of this paper (Pierce and Schott 2013). That approach possesses two attractive attributes relative to the baseline specification reported in the main text. First, because there is only one post-PNTR observation and one pre-PNTR observation for each industry, it mitigates the serial correlation problems that can lead to inconsistently estimated standard errors in DID specifications with long time series, as discussed in Bertrand, Duflo and Mullainathan (2004). Second, because the pre-PNTR period is defined to correspond to a similar period in the previous business cycle, it follows Trefler (2004) in providing an implicit control for cyclicity.

I.2 Alternative Measures of Tariff Rates

As discussed in section D.5, the data on U.S. NTR tariff rates from Feenstra, Romalis and Schott (2002) ends in 2001. To investigate the influence of potential changes in U.S. tariffs after 2001, we estimate our own series of AVE NTR tariff rates by following the USITC method for producing them as closely as possible. The procedure is as follows. First, using publicly available U.S. tariff data, sum the duties collected for each eight-digit HS product by year. Second, divide this sum by the corresponding dutiable value to derive the *ad valorem* equivalent rate. These revealed tariff measures capture changes in tariff rates due to NAFTA and other preferential trade agreements for all years through 2007. As shown in column 3 of Appendix Table A.5, using these newly constructed AVE tariff data, in place of the Feenstra, Romalis and Schott (2002) data, does not lead to any material change in the statistical or economic significance of our results. We note that a limitation of this constructed revealed tariff data is that they are unavailable for some industries that are covered in the Feenstra et al. (2002) data, with the result that their inclusion in our employment regressions reduces the number of U.S. manufacturing industries that can be analyzed.

I.3 Instrumenting for NTR Gap with Non-NTR Rates

Lastly, we instrument for the interaction of $Post - PNTR_t \times NTR\ Gap_i$ in equation 2 with the interaction $Post - PNTR_t \times NNTR_i$, where $NNTR_i$ is the non-NTR rate for industry i set in the Smoot-Hawley Tariff Act of 1930. The results, displayed in

column 4 of Appendix Table A.5 show that the second-stage estimate of θ is similar in terms of statistical significance and that the implied impact of PNTR is somewhat smaller than in the baseline specification, -0.09 versus -0.15 log points. Results from the first stage regression (not shown) reveal that most of the variation in the NTR gap is due to variation in the Non-NTR rate. The t statistic for the coefficient estimate on $Post - PNTR_t \times NNTR_i$ in the first stage is 193.

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	ln(TFP _{it})
1{y=1999} x NTR Gap _i	0.208
	0.191
1{y=2000} x NTR Gap _i	0.169
	0.185
1{y=2001} x NTR Gap _i	0.180
	0.248
1{y=2002} x NTR Gap _i	-0.203
	0.252
1{y=2003} x NTR Gap _i	-0.125
	0.245
1{y=2004} x NTR Gap _i	-0.227
	0.193
1{y=2005} x NTR Gap _i	-0.189
	0.202
Observations	3379
R2	0.49
Fixed Effects	i,t

Notes: Table displays the results of a Chinese four-digit CIC industry-year level OLS regression of log TFP in industry (i) in year (t) on year and industry fixed effects as well as interactions of the year fixed effects and the 1999 U.S. NTR gap. The data span 1998 to 2005. Coefficient estimates for all but the interactions are suppressed. Robust standard errors adjusted for clustering at the industry level are displayed below each coefficient. Superscripts ***, ** and * represent statistical significance at the 1, 5 and 10 percent levels.

Table A.3: PNTR and Chinese Productivity Growth

	1960-1970	1970-1980	1980-1990	1990-2000	2000-2009
NTR Gap	0.464 ***	0.077	0.059	-0.074	-1.067 ***
	0.092	0.1	0.114	0.117	0.14
Constant	-0.024	0.005	-0.157	-0.033	-0.134
	0.031	0.035	0.04	0.041	0.049
Observations	379	379	379	379	379
R-squared	0.063	0.002	0.001	0.001	0.134

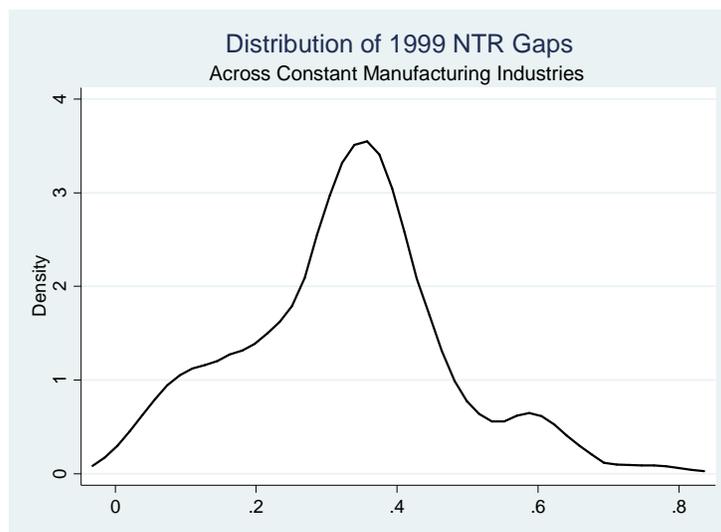
Notes: Table displays results of OLS regressions of industry-level employment growth (log difference) on the NTR Gap for all decades available in the NBER-CES Manufacturing Industry Database. Regressions are weighted by the initial value of industry employment. Superscripts ***, ** and * represent statistical significance at the 1, 5 and 10 percent levels.

Table A.4: PNTR and U.S. Manufacturing Employment by Decade (Public Data)

	ln(Emp _{it})	ln(Emp _{it})	ln(Emp _{it})	ln(Emp _{it})
Post x NTR Gap _i	-0.475 ***	-0.461 ***	-0.484 ***	-0.300 ***
	0.147	0.146	0.164	0.044
Post x ln(K/Emp _{i,1990})	-0.044 ***	-0.016	-0.009	-0.003
	0.018	0.025	0.027	0.008
Post x ln(NP/Emp _{i,1990})	0.186 ***	0.130 ***	0.132 ***	0.203 ***
	0.047	0.052	0.056	0.015
Post x Contract Intensity _i	-0.178	-0.178	-0.058	-0.154 ***
	0.112	0.113	0.120	0.034
Post x ΔChina Import Tariffs _i	-0.248 *	-0.248 *	-0.157	-0.075 *
	0.140	0.140	0.177	0.045
Post x ΔChina Subsidies _i	0.064	0.066	-0.042	0.034
	0.088	0.088	0.117	0.030
Post x ΔChina Licensing _i	-0.240	-0.236	-0.433 *	-0.442 ***
	0.164	0.165	0.224	0.049
Post x 1{Advanced Technology _i }	-0.038	-0.036	-0.052	-0.002
	0.045	0.045	0.053	0.017
MFA Exposure _{it}	-0.342 ***	-0.345 ***	-0.344 ***	-0.335 ***
	0.063	0.059	0.062	0.020
NTR _{it}	-0.724	-0.448		-0.365 ***
	0.672	0.670		0.148
U.S. Union Membership _{it}	-0.086	-0.124	-0.165	0.062
	0.200	0.203	0.209	0.070
ln(RGDP _{it}) x ln(K/Emp _{i,1990})	0.104			
	0.097			
ln(RGDPT) x ln(NP/Emp _{i,1990})	-0.193			
	0.181			
Trefler Business Cycle _{it}		0.242 **		
		0.106		
Revealed NTR _{it}			0.495	
			0.291	
Observations	5,706	5,706	4,956	5,706
R2	0.99	0.99	0.99	
Fixed Effects	i,t	i,t	i,t	i,t
Employment Weighted	Yes	Yes	Yes	Yes
Implied Impact of PNTR	-0.153	-0.148	-0.155	-0.096

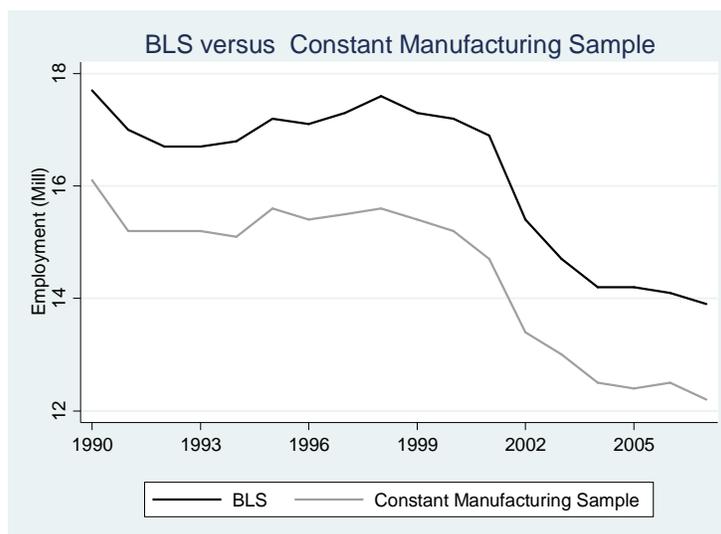
Notes: Table reports results of OLS generalized difference-in-differences regressions of log industry-year employment on covariates discussed in text. Column 1 augments the baseline specification (column 3, Table 1) with the interaction of initial capital and skill intensity and U.S. GDP. Column 2 includes a control for the change in employment predicted by industry-level regressions using current and lagged changes in real exchange rates and GDP, following Trefler (2004). Column 3 replaces the NTR rate from Feenstra, Romalis and Schott (2002) with revealed tariffs calculated using USITC data (see text). Column 4 reports second stage results of a two-stage least squares specification that instruments the interaction of Post and the NTR gap with the interaction of Post and the Non-NTR rate. Estimates for the year (t) and industry fixed effects as well as the constant are suppressed. Observations are weighted by initial industry employment. Final row reports the predicted change in the dependent variable implied by the difference-in-differences coefficient (see text). Superscripts ***, ** and * represent statistical significance at the 1, 5 and 10 percent levels.

Table A.5: Other Robustness Exercises (LBD)



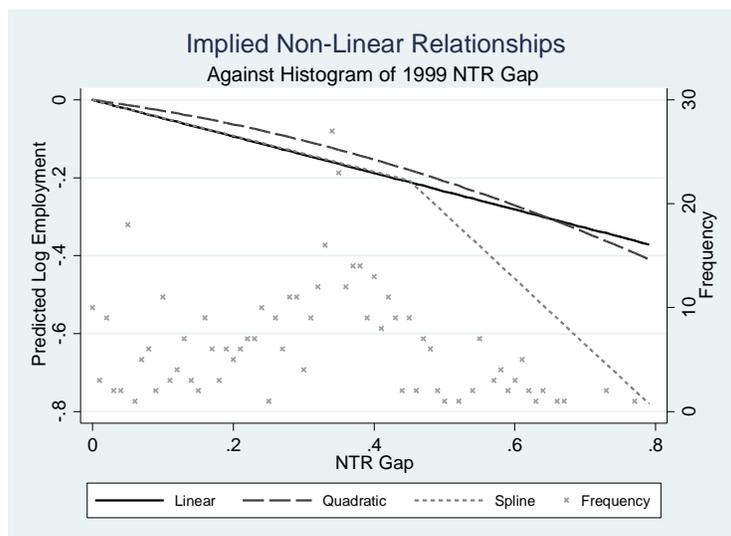
Notes: Figure displays the distribution of the NTR gaps across constant-manufacturing industries in 1999.

Figure A.1: Distribution of NTR Gaps Across Industries, 1989-2001



Notes: Figure compares annual manufacturing employment as of March in the publicly available BLS manufacturing employment series versus the constant manufacturing sample.

Figure A.2: BLS versus Constant Manufacturing Sample



Notes: Figure compares the predicted effect associated with the interaction of the post-PNTR indicator and the NTR gap according to the linear and non-linear specifications displayed in Table 3. These predicted effects are displayed against the histogram of the 1999 NTR gap.

Figure A.3: Implied Impact from Non-Linear Models (LBD)