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

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PRELIMINARY

Abstract

This paper finds a link between the sharp drop in U.S. manufacturing employment after 2001 and the conferral of permanent normal trade relations on China in late 2000. We find that employment losses are larger in industries where the threat of tariff hikes declined the most, and that the shift in policy is associated with suppressed job creation, exaggerated job destruction and substitution away from low-skill workers. Consistent with greater offshoring, employment losses coincide with an acceleration of U.S. imports from China and the number of U.S. importers, Chinese exporters and importer-exporter pairs.

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1 Introduction

According to the Bureau of Labor Statistics, U.S. manufacturing employment grew from 13.2 million in 1950 to 19.5 million in 1979 before falling back to 13.8 million in 2007. Surprisingly, two-thirds of this decline occurred in the years following the relatively mild 2001 recession. In fact, the 1.5 million jobs lost in the first year of that downturn is almost twice the 900 thousand jobs lost during the first year of the Great Recession.

This paper uses establishment-level production and trade data from the U.S. Census Bureau to examine the relationship between the sharp drop in U.S. manufacturing employment after 2001 and a major change in U.S. trade policy in 2000. In October of that year – just a few months before the March 2001 peak – the U.S. Congress granted China *permanent* Normal Trade Relations (*P*NTR). With this change in status, Chinese imports became permanently eligible for the relatively low tariffs the United States applies to WTO members, versus the generally higher rates applied to imports from countries outside the WTO, like North Korea.

While trade liberalization is a prime suspect in the overall decline of U.S. manufacturing employment in recent decades, the October 2000 liberalization is notable for having had little effect on the actual tariffs applied to Chinese imports. Indeed, these rates do not change in the years before and after China's change in status. Rather, it appears as if the principal impact of *P*NTR was to alter expectations about whether U.S. tariffs on Chinese imports would remain low. Prior to its receipt of *P*NTR, China's exports were subject to potentially large increases in U.S. import tariffs if the politically contentious annual renewals of its *temporary* NTR status were rejected by Congress.[1] The shift in U.S. policy in October 2000 and the related entry of China into the WTO in December 2001 eliminated the possibility of these jumps.

Models of investment under uncertainty demonstrate that firms are more likely to undertake irreversible investments as the ambiguity surrounding their expected profit decreases. These models provide insight into why the U.S. conferral of *P*NTR on China might cause a decline in U.S. manufacturing employment via the responses of firms in both China and the United States. In China, *P*NTR provides producers with greater incentives to enter or expand into the U.S. market, raising the level of competition in the United States and putting further price pressure on U.S. producers. In the United States, greater assurance of continued low Chinese import tariffs raises U.S. firms' expected profit from finding or establishing low-cost Chinese suppliers of inputs and final goods. These incentives can encourage the local producers of these goods to shrink or exit, discourage new domestic producers from entering, and promote the growth of intermediaries that allow U.S. producers and consumers to import indirectly. The shift in U.S. trade policy can also lower the demand for manufacturing workers by inducing producers to invest in more skill-intensive production technologies and mixes of products that are more consistent with U.S. comparative advantage.

We measure the uncertainty associated with China's temporary NTR status before

[1] China was first granted temporary NTR in February 1980, and the annual votes by Congress needed to maintain this status proceeded smoothly until the Tiananmen Square incident in June 1989, after which they became controversial and less certain of success.

2001 as the "NTR gap," defined as the difference between the NTR applied tariff rates and the non-NTR rates to which they would be raised without annual Congressional approval. Handley (2012) demonstrates theoretically and empirically that the maximum level to which a tariff might be raised is an important dimension of trade policy uncertainty, and it is one that is easily captured by the NTR gap in our setting. We find that while NTR gaps are more-or-less stable in the years leading up to China's change in status, they exhibit substantial variation across industries. Our identification strategy exploits this cross-sectional variation by using a difference-in-differences specification to test whether employment loss in industries with high NTR gaps (first difference) is larger after the 2001 peak than after previous peaks (second difference). One attractive feature of this approach is its ability to isolate the role of the change in policy. While high- and low-gap industries are not identical, comparing outcomes within industries across peaks isolates the differential impact of China's change in status. At the same time, comparison of employment changes across similar intervals of the business cycle allows us to control for the manufacturing sector's cyclicality.

Given the potential importance of input-output linkages, we consider three dimensions of exposure to risk reduction: the direct effect of the eliminating the NTR gap in one's own major output industry as well as two indirect effects corresponding to the removal of uncertainty in one's upstream "supplier" and downstream "customer" industries. Beginning with an analysis of employment growth at the industry level, we find negative and statistically significant relationships between import-tariff uncertainty and relative industry employment growth up to six years after the 2001 peak. Our estimates imply that for an industry with average NTR gaps, the shift in U.S. policy reduces employment growth from 2001 to 2002 by an additional -8.7 percentage points compared with the same interval after the 1981 and 1990 peaks. Six years after the 2001 peak, the implied cumulative difference grows to -29.6 percentage points. All three NTR gaps are influential in these declines.

A major benefit of using establishment-level data to examine employment growth at the industry level is the ability to evaluate changes along gross margins of adjustment that are "intensive" and "extensive" to establishments. We find that PNTR is associated with both exaggerated job destruction and suppressed job creation, with the relative contribution of the latter rising in the years after 2001. These results help explain the well-documented "joblessness" of the 2001 recovery in the manufacturing sector. Faberman (2012), for example, has demonstrated that this joblessness is the result of a shift down in job creation beginning in the late 1990s coupled with a sharp increase in job destruction starting in 2001. Here, we find that PNTR coincides with both of these trends.

Analysis of employment growth at the plant level both confirms our industry findings and provides evidence that U.S. manufacturing plants respond to greater competition from China by substituting human or physical capital for low-skilled workers. In particular, our results show that while the relationship between employment growth and the own-industry NTR gap is negative and statistically significant for production workers, it is positive and statistically significant for non-production workers. To the extent that the latter embody higher levels of skill, this substitution is consistent with trade-induced technical change and product-mix upgrading.

Finally, we use firm-level U.S. import data to examine the relationship between $PNTR$ and U.S. trade with China. As these data are unavailable until the mid-1990s, we amend our difference-in-differences specification to evaluate outcomes across trading partners in the years before and after 2001 rather than across business cycles. These comparisons reveal a positive and statistically significant relationship between the shift in U.S. trade policy and the relative growth of U.S. imports from China in terms of import value, the number of U.S. importers, the number of foreign exporters, and the number of importer-exporter pairs. Consistent with the existence of a relationship between $PNTR$ and offshoring, these relationships demonstrate that U.S. imports surge in precisely the set of goods where domestic employment loss is concentrated, and with the exact trading partner that is the subject of the shift in U.S. trade policy.

The paper proceeds as follows: Section 2 outlines our contribution to existing research, Section 3 describes our data, Section 4 provides a brief discussion of the models used to guide our empirical analysis, Sections 5 through 7 present our results, and Section 8 concludes with suggestions for further research.

2 Related Literature

This paper contributes to a large body of research spanning international trade, labor and macroeconomics that explores a link between globalization and domestic employment. In the international trade literature, a number of studies have found a negative relationship between import competition and manufacturing employment, especially when that competition is from low-wage countries in general, and China in particular.[2] The macroeconomics literature, by contrast, has generally not found a major role for international trade in patterns of job creation and destruction over the business cycle, or in the jobless recoveries to recessions observed in the past two decades.

We make contributions to several strands of these literatures. First, we show that a substantial portion of the loss of U.S. manufacturing employment during and after the 2001 recession is related to a discrete and easily identifiable change in policy – the U.S. conferral of $PNTR$ on China. While others, including most recently Autor, Dorn and Hansen (2012), have highlighted a negative relationship between U.S. employment and Chinese imports, our research points to a specific cause for the acceleration of Chinese imports starting in 2001, and relates it to a wide range of outcomes across U.S. and Chinese producers.[3] In particular, we show that the largest relative declines in employment

[2]Early work in this area, by Freeman and Katz (1991) and Revenga (1992), documents a negative relationship between growth in U.S. manufacturing employment and either imports or changes in import prices at the industry level. Subsequent research focuses on the impact of imports from low-wage countries across industries (e.g., Sachs and Shatz 1994) and establishments within industries (Bernard, Jensen and Schott 2006). More recent papers investigate the effect of China on manufacturing employment in a range of countries, including Denmark (Mion and Zhu 2012), the EU (Bloom, Draca and Van Reenen 2012), Mexico (Utar and Torres Ruiz 2011) and the United States (Autor, Dorn and Hansen 2012).

[3]In focusing on the impact of a particular policy, this paper is closest to Bloom, Draca and Van Reenen (2012) and Utar and Torres Ruiz (2011), who show that employment losses across EU and Mexican apparel and textile manufacturers coincide with the removal of import quotas on Chinese exports of these goods.

in the years after 2001 are concentrated in industries characterized by high NTR gaps, and that these industries experience the largest surges in Chinese import value as well as the number of U.S. importers and Chinese exporters.

Second, our examination of firms' reactions to import-tariff uncertainty contributes to the broad literature analyzing investment under uncertainty as well as its recent application to international trade.[4] Our effort in this regard is most closely related to the work of Handley (2012) and Handley and Limao (2012), who show that if uncertainty regarding either the timing or the magnitude of tariff changes in a destination market falls, the productivity threshold for entry into exporting to that market falls, as relatively low-productivity firms lose their incentive to wait and see how tariffs will change before absorbing the sunk costs associated with entry. Our contribution to this literature is to demonstrate the strong and wide-ranging effects of perhaps the most significant change in import-tariff uncertainty since the turn of the century – the granting of PNTR to China.

Third, we provide evidence of a link between international trade and the joblessness of the 2001 recovery in manufacturing. Several papers, including Baily and Lawrence (2004) and Mankiw and Swagal (2006) argue that international trade plays a small role in this phenomenon. Here, our use of highly disaggregated data and our focus on a specific policy yields strong evidence that trade is directly and indirectly associated with the large and long-lasting decline in U.S. manufacturing employment in the years after 2001. Moreover, our finding that PNTR has a more profound effect on production workers than non-production workers relates to recent research by Jaimovich and Siu (2012), which shows that the increasing joblessness of both manufacturing and non-manufacturing recoveries in recent decades is driven by the disproportionate loss of jobs that perform routine tasks.

Finally, our consideration of own-, upstream- and downstream-industry NTR gaps contributes to a growing literature related to supply-chain co-location. Baldwin and Venables (2012), for example, consider different forms of supply chains that emerge in response to the forces that encourage (e.g., transport costs) or discourage (e.g., factors costs) co-location. A key implication of the model they develop is that offshoring may jump discretely if a change in trade costs triggers a relatively large portion of a supply chain to move abroad. Relatedly, Ellison, Glaeser and Kerr (2010) show that proximity to input suppliers and final customers is the most important factor in the agglomeration patterns of U.S. manufacturing industries. Here, we use the own NTR gap to identify employment loss associated with potential increased competition from China in one's own industry. The upstream and downstream NTR gaps, by contrast, help identify employment loss due to greater potential Chinese competition in the industries of establishments' major suppliers and customers.

[4] Dixit and Pindyck (1994) provide an overview of this "real options" literature.

3 Data

3.1 Measuring Establishments' Employment

Our principal dataset for tracking manufacturing employment is the the U.S. Census Bureau's Longitudinal Business Database (LBD), assembled and updated annually by Jarmin and Miranda (2002). The LBD tracks the employment and major industry of virtually every establishment with employment in the non-farm private U.S. economy annually as of March 12, from 1976 to 2009.[5] 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 as the four-digit SIC or six-digit NAICS category representing their largest share of shipments. Information from Census' Company Organization Survey is used to map establishments to "firms," and longitudinal identifiers in the LBD allow establishments and firms to be followed over time. With these identifiers, we can determine the births and deaths of establishments and firms and thereby decompose changes in industry employment along intensive and extensive margins of adjustment.

For some of our results, we augment the data in the LBD with detailed establishment-level characteristics from Census's quinquennial Census of Manufactures (CM), conducted in years ending in "2" and "7". For every manufacturing establishment, the CM tracks the value of shipments, value added, capital (book value), production hours and a breakdown of employment between production and non-production workers.[6] Nominal data are deflated using industry-level price indexes in the NBER-CES Manufacturing Industry Database from Becker and Gray (2009).[7]

The long time horizon considered in this paper encompasses the use of two different industry classification schemes: the Standard Industrial Classification (SIC), used until 1997, and the North American Industry Classification System (NAICS) used thereafter. The switch between these schemes as well as changes within each scheme complicate creation of an accurate and consistent set of "manufacturing" establishments across which outcomes can be compared over time.[8] In addition, the set of activities that are classified as manufacturing changes between schemes. Some industries within printing and publishing, for example, are characterized as manufacturing under the SIC, but not the NAICS, while others, e.g., retail bakeries, are considered manufacturing under the NAICS, but not the SIC.

We develop a new SIC-NAICS concordance to ensure that our results are not driven

[5]Excluded industries include Agriculture, Forestry and Fishing, U.S. Postal Service, Certificated Passenger Air Carriers, Elementary and Secondary School, Colleges and Universities, Labor Organizations, Political Organizations, Religious Organizations and Public Administration. Businesses without employment are also excluded.

[6]Information in the CM is reported directly by establishments, whereas data in the LBD are drawn primarily from administrative IRS data. As a result, we use data from CM when those data are available for *both* the beginning and end years of any sample we examine.

[7]These data are available at http://www.nber.org/data/nbprod2005.html. As they end in 2005, we assume that prices rise in 2006 and 2007 at the same rate as observed for 2005.

[8]The SIC and NAICS classifications are revised every five years as part of the CM. Some of these revisions are more extensive than others, e.g., the 1987 revision of the SIC.

by such changes, and use it to construct a conservative set of "constant" manufacturing industries and establishments that span intervals of interest. Starting with the standard SIC to SIC, SIC to NAICS and NAICS to NAICS concordances used by the U.S. Census Bureau, graciously provided by Randy Becker and Wayne Gray, we use the algorithm developed in Pierce and Schott (2012) to create "families" of four-digit SIC and six-digit NAICS codes that group related SIC and NAICS categories together over time.[9] Unless noted otherwise, our use of the word "industry" below refers to these families. While the majority of these families contain either manufacturing or non-manufacturing categories exclusively, a subset contains a mixture of the two.

To create a "constant" manufacturing sample for a given time interval, we drop two sets of establishments from the universe of manufacturing establishments available for that interval. First, we drop all establishments from families containing a mix of constant-manufacturing and non-constant-manufacturing SIC or NAICS industries. This drop occurs over all intervals, as the composition of a family is time invariant. Second, we drop all establishments whose major industry switches between manufacturing and non-manufacturing over the interval of interest. This drop does depend on the interval, as the same establishment might remain in manufacturing for some intervals but not others.

Figure 1 displays annual employment in our "constant" manufacturing sample against the manufacturing employment series available publicly from the U.S. Bureau of Labor Statistics.[10] As expected, given the procedure outlined above, the "constant" manufacturing sample accounts for less employment than the BLS series. Despite this level difference, however, the two series track each others' movements over time quite closely.

Figure 2 compares the cumulative percent change in employment for constant manufacturing versus non-manufacturing as a share of their respective 1981, 1990 and 2001 levels. As indicated in the left panel of the figure, the decrease in manufacturing employment after 2001 stands out in several respects. First, it exhibits no recovery; while employment declines after 1981 and 1990 begin to reverse in two and four years, respectively, employment falls more or less steadily from 2001 to 2007. Second, except for the second year of the 1981 recession, the drop in manufacturing employment after 2001

[9] For example, if an 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. If one of those NAICS codes later concords with an updated NAICS code, whose family history includes a broader set of SIC, those subsequent NAICS and SIC codes also join the original 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 the parent's activity. (Industry-to-industry concordances generally specify both the identity of a parent's children as well as the share of activity – usually output or employment – which they inherit.) These limits create a tradeoff. Higher thresholds generate a larger number of families with more closely related underlying SIC and NAICS codes. Lower thresholds lead to a smaller number of families, most of which are likely to include both manufacturing and non-manufacturing codes. As a result, lower thresholds create spawn constant manufacturing sample results in a much smaller share of raw manufacturing employment than higher thresholds.

[10] Series CEU3000000001, available at www.bls.gov. As the BLS series is NAICS-based, manufacturing employment prior to 1997 excludes SIC industries that do not map into NAICS manufacturing industries. 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).

dwarfs the previous declines by a wide margin. Third, losses within manufacturing are substantially more severe and long-lasting than those outside manufacturing.[11]

3.2 Calculating the NTR Gap

The United States has two principal tariff classifications. "NTR" or "column 1" tariffs are the rates applied to countries with which the United States has normal trade relations, including members of the WTO. "Non-NTR" or "column 2" tariffs, originally set in the Smoot-Hawley Tariff Act of 1930, are applied to countries with which the United States does not have normal trade relations, e.g., North Korea. Both types of tariffs are set at the product level, where "products" are defined according to the aggregation scheme used to track international trade. In 1989 the United States joined most other countries in using the Harmonized System (HS) to classify imports and exports. The first six digits of these categories are common across countries and are managed by an international non-governmental organization. Use of additional digits (i.e., beyond 6) is at the discretion of individual countries. While U.S. import and export transactions are tracked according to ten-digit HS categories, U.S. import tariffs are assigned according to eight-digit HS categories, often referred to as "tariff lines".

As discussed in greater detail in Pregelj (2005), the U.S. Trade Act of 1974 gives the President the power to temporarily grant NTR status to non-market economies otherwise classified as non-NTR, subject to certain conditions. While this act does not require Congressional approval, it can be overturned by a congressional vote of disapproval. China first received NTR status on an annually renewable basis in 1980. Initially uncontroversial, these renewals began facing strong opposition in Congress after the Tiananmen Square incident in 1989, with the result that their success became less certain during the 1990s (see, for example, Wang 1993). On October 10, 2000, Congress granted China permanent NTR (PNTR) in another controversial vote that cleared the way for China's accession to the WTO in December 2001.[12] As discussed in Pregelj (2005) and numerous popular press articles written at the time, Congress' willingness to confer PNTR status was uncertain right up until the vote.[13]

Feenstra, Romalis and Schott (2002), henceforth FRS, report *ad valorem* equivalent U.S. NTR and non-NTR tariff rates for 1989 to 2001.[14] We measure the potential tariff increase faced by U.S. importers of a Chinese good prior to PNTR as the gap between these rates, where a higher gap indicates a greater potential increase. Figure 3 plots the

[11] Dey, Houseman and Polivka (2012) note that manufacturers' use of temporary employment services as a substitute for permanent employees increased from 1989 to 2004, but that this substitution does not account for the steep employment decline observed after 2000.

[12] While the United States also signed a bilateral trade agreement with Vietnam in December 2001, trade with Vietnam in the early 2000s was small.

[13] Press coverage in 1999 and 2000 gives no indication that conferral of PNTR was imminent. "Support Shrinks for China's Trade Status" by David Sanger in the June 4, 1999 edition of *The New York Times*, for example, discusses the high level of controversy associated with the mere annual renewal of NTR status the year before PNTR was implemented. See also "China and the WTO: Dire Straits" in the May 23, 2000 edition of *The Economist*.

[14] U.S. import tariffs can include both *ad valorem* and specific (i.e., per unit) components. The tariff rates tracked by FRS are the *ad valorem* equivalent of all tariffs applied to a tariff line.

distribution of the NTR gap across tariff lines at four-year intervals from 1989 to 2001. As indicated in the figure, these distributions are relatively stable across time, with the major change being a shift toward higher NTR gaps as Uruguay-Round reductions in U.S. NTR rates are implemented in the mid 1990s. This shift does not affect the ranking of tariff lines over time substantially: correlation coefficients for the 1989 versus 1993, 1993 versus 1997 and 1997 versus 2001 NTR gaps, for example, are 0.97, 0.77 and 0.94, respectively. This stability, the fact that non-NTR tariff rates were initially set decades before, and uncertainty surrounding China's eventual receipt of PNTR, argue in favor of their plausible exogeneity with respect to lobbying or other activity associated with PNTR and China's subsequent accession to the WTO.

For each NAICS industry n we compute the average NTR gap across the eight-digit HS tariff lines with which it is associated using concordances provided by the U.S. Bureau of Economic Analysis (BEA).[15] We then compute an upstream and downstream NTR gap for each NAICS industry n using information provided in the "use" table of the BEA's 1997 input-output matrix, which reports the value of all industries g that are used to produce industry n.[16] The upstream NTR gap for industry n is the weighted average NTR gap across the industries g that supply n, using the "use" values (v) as weights,

$$NTR\ Gap_n^{Up} = \sum_g w_{gn}^{Up} NTR\ Gap_g, \tag{1}$$

where,

$$w_{gn}^{Up} = \frac{v_{gn}^{Up}}{\sum_g v_{gn}^{Up}}. \tag{2}$$

To compute the downstream NTR gap, we follow the same procedure after reversing the g and n indexes in the "use" table.[17] As the input-output matrix includes many services that are not traded, and therefore are assumed to have an NTR gap of zero, the weighted averages taken in equation 1 are lower than the own-industry NTR gap.

We use eight-digit HS NTR and non-NTR rates from 1999, the year before the policy change, to create the own-, upstream- and downstream-industry NTR gaps used throughout the paper. This choice has little substantive impact, as we obtain findings very similar to those reported below using NTR gaps from any of the years available to us, 1989 to 2001.

Table 1 reports the average own-, upstream- and downstream-industry NTR gaps by three-digit NAICS categories. We find that own-industry NTR gaps tend to be higher for

[15] We map tariff lines to BEA input-output categories using the 1997 concordance "HSConcord.txt" available at http://www.bea.gov/industry/zip/NDN0317.zip. We then map input-output categories to NAICS categories using the 1997 concordance "NAICS-IO.xls" available at http://www.bea.gov/industry/zip/ndn0306.zip.

[16] This matrix is contained in the file "NAICSUseDetail.txt" available at http://www.bea.gov/industry/zip/ndn0306.zip.

[17] The "use" values in the input-output matrix are assigned according to BEA input-output categories. As a result, we split the "use" value evenly among all NAICS industries to which a BEA input-output category maps.

labor-intensive industries such as apparel, textiles and furniture, and lower for capital-intensive industries such as food and petroleum. As noted in the introduction, one benefit of our difference-in-differences specification is its ability help control for such variation: even though high-gap industries are not identical to low-gap industries, our approach controls for any time-invariant differences between industries. At the same time, comparison of industries across similar stages of the business cycle allows us to account for the cyclicality of U.S. manufacturing employment.

Table 1 also highlights variation in the extent to which industries are exposed to risk reduction via their upstream suppliers and downstream customers. Industries in Computers and Electrical Equipment, for example, tend to face both high upstream and high downstream exposure. Machinery and Transportation Equipment industries, on the other hand, exhibit high upstream gaps but relatively low downstream gaps, while the reverse is true for industries in Chemicals and Primary Metals. Across all six-digit NAICS industries, we find that the correlations between own and upstream, own and downstream, and upstream and downstream NTR gaps are 0.79, 0.18 and 0.22, respectively.

While we find substantial variation in NTR gaps across industries, we find no change in the revealed tariffs imposed on Chinese goods before and after the change in U.S. policy in late 2000. We compute the revealed tariff on Chinese imports as the average ratio between duties collected and dutiable value across all manufacturing products imported from China using the trade data in FRS, and extended by Schott (2008). As demonstrated in Table A.1 of the electronic appendix, there is no statistically significant difference in the revealed tariffs applied to Chinese imports during the period of interest. This result suggests that the surge in U.S. imports from China documented below is not due to a reduction in applied import tariff rates.[18]

3.3 U.S. Business Cycle Peaks

The NBER Business Cycle Dating Committee identifies four business cycle "peaks" during the period for which our employment data are available: January 1980; July 1981; July 1990; and March 2001.[19] Given the proximity of the 1980 and 1981 recessions, as well as the greater severity of the latter, we ignore the 1980 peak and focus on employment loss following the 1981, 1990 and 2001 peaks.

As illustrated in Figure 4, the 1981 recession stands out in terms of declining economic activity, measured either in terms of aggregate GDP or the Industrial Production Index (IPI). Peak to trough, the IPI falls 8.6 percent during the 1981 recession versus less

[18] As part of its entry into the WTO in late 2001, China benefited from a relaxation of quotas on apparel and textile products associated with a phasing out of the global Agreement on Textiles and Clothing (Brambilla et al. 2009). The implicit change in tariffs associated with removal of these quantitative restrictions is not captured by this regression. The entire set of apparel and textile industries (irrespective of whether quotas on their products were relaxed) accounted for approximately 7 percent of U.S. manufacturing employment in 2000. Dropping the apparel and textiles industries from our analysis yields results similar to those reported below for all industries.

[19] These data are available at www.nber.org/cycles.html. We note that these peaks do not necessarily correspond to the manufacturing employment peaks of these business cycles. We ignore the 2007 recession as the the LBD is available only until 2009, and the last CM available is 2007.

than half that amount during the 1990 and 2001 recessions. Loss of manufacturing employment, by contrast, is far more severe following the 2001 recession than the 1981 and 1990 recessions.

While this loss is dramatic, it is important to note that it is not accompanied by a decline in value added. Indeed, as illustrated in Figure 5, real value added in U.S. manufacturing as measured by the BEA continues to increase after 2001, though at a slower rate (2.8 percent) compared with the average from 1948 to 2000 (3.7 percent). This growth, combined with the sharp decline in employment, implies a substantial increase in labor productivity, which we examine in greater detail below.

4 Theoretical Motivation

Our empirical analysis is guided by recent models of exporting under uncertainty and application of their insights to deterministic models of importing.

Handley and Limao (2012) consider the effect of import-tariff uncertainty in a standard, Melitz- (2003) style model of exporting, where firms that are heterogeneous in unit costs consider the irreversible investment needed to enter an export market. As is well known in the deterministic versions of these models, firms enter the export market if their unit cost is below a cutoff that equates the fixed cost of exporting with the profit earned in the export market. The authors show that if uncertainty regarding either the timing or the magnitude of tariff changes in the destination market falls, the cost cutoff for exporting rises, as relatively low-cost firms lose their incentive to wait and see how tariffs change before entering. In an extension, Handley (2012) demonstrates that entry also rises with reductions in the maximum level to which tariffs might increase, even if the actual applied tariffs remain the same. Here, we interpret China's receipt of PNTR as just such a decline, and therefore expect it to be associated with an increase in the number of Chinese firms that export to the United States as well as the value of goods they export.

For insight into the potential reaction of firms in the United States, we rely on models of importing similar in spirit to Melitz (2003).[20] Groizard, Ranjan and Rodriguez-Lopez (2012), for example, build a framework in which heterogeneous domestic manufacturers choose the fraction of inputs to source from a low-wage country based on their productivity draw and fixed and variable costs of importing. A decline in import tariffs raises the demand for foreign inputs and thereby reduces domestic employment in the manufacturing sector for two reasons. First, firms that are not productive enough to import shrink relative to firms that use imports to lower costs and gain market share. Second, firms productive enough to engage in offshoring see their employment fall as foreign inputs are substituted for those previously produced in-house. In theory, these firms may experience a net increase in employment if price declines associated with offshoring induce a substantial enough increase in demand for the their output.[21]

[20] Though trade costs in these models are deterministic, we assume that reductions in import-tariff uncertainty yield the same implications as declining import tariffs.

[21] Empirically, Groizard, Ranjan and Rodriguez-Lopez (2012) show that shows that reductions in U.S. trade costs between 1992 and 2004 influenced both gross job creation and gross job destruction among

PNTR might affect U.S. employment by promoting indirect as well as direct offshoring. Though many models of importing, like the one just described, focus on producers who import inputs directly from foreign suppliers, one can imagine the emergence of intermediaries (e.g., wholesalers) that match foreign goods to purely domestic producers. Bernard et al. (2010), for example, report that wholesalers and retailers account for more than half of U.S. imports from China in 2002. In the model of *exporting* developed by Ahn, Khandelwal and Wei (2010), firms that are not sufficiently productive to overcome the costs associated with finding their own foreign customers export via an intermediary. In our setting, the shift in U.S. trade policy might promote the expansion and entry of agents that facilitate indirect importing. By further driving down the relative demand for domestically produced but higher-priced substitutes, these agents may encourage local producers to shrink, exit or decide not to enter.

Finally, a reduction in import-tariff uncertainty may encourage firms to invest in the development of either labor-saving technologies (other than direct or indirect offshoring), or product mixes that compete less directly with imports from China. Acemoglu (2002), for example, develops a model in which trade liberalization can affect the skill bias of technical change.

5 PNTR and Industry Employment

In this section we show that employment losses are larger in industries where the threat of tariff hikes declined the most. Examining employment loss by intensive and extensive margins of adjustment, we also find that the shift in U.S. policy is associated with both suppressed job creation and exaggerated job destruction.

5.1 Industry Employment Growth d Years After Each Peak

We investigate the relationship between PNTR and industry-level cumulative employment growth using an OLS difference-in-differences specification that identifies differential growth in high NTR gap industries (first difference) d years after 2001 compared to analogous periods after the 1981 and 1990 peaks (second difference). We estimate the following equation using data from the LBD and CM:

$$\Delta Emp_i^{t:t+d}/Emp_i^t = \alpha_{do} 1\{t = 2001\} \times \sum_o NTR\,Gap_{io} + \gamma_d \mathbf{X}_{it} + \delta_{id} + \delta_{td} + \varepsilon_{itd}. \quad (3)$$

The dependent variable is the cumulative percent change in industry i's employment relative to its peak t level. To examine how the effect of PNTR evolves over time, we estimate this equation separately for intervals from $d = 1$ to $d = 6$ years after each peak. The first three variables on the right-hand-side of the specification are the three difference-in-difference (DID) terms: interactions of an indicator variable for the 2001 peak and the own, upstream and downstream NTR gaps for industry i, which vary by

manufacturing establishments in California.

industry but not by t or d. These three NTR gaps are indexed by o. $\mathbf{X}_{it}$ is a vector of industry characteristics in peak year t. For regressions using the LBD, $\mathbf{X}_{it}$ contains only the log level of peak-year t employment, $ln(Emp_i^t)$. Regressions based on the CM include a larger set of controls and are estimated across decades that span each peak. δ_{id} and δ_{td} are industry and peak-year fixed effects, which control for time-invariant differences between industries and common macro-level shocks. These fixed effects are indexed by d, i.e., that they are specific to a particular interval after each peak.

The first six columns of Table 2 report results using the LBD. We find that almost all estimates of α_{do} are negative and statistically significant at the ten percent level (noted with bold-faced type), and that their absolute magnitudes generally rise with d, indicating that the association between employment growth and PNTR is persistent. We assess the economic significance of the coefficients in the last block of rows of the table by multiplying the estimate for each DID term by the average NTR gaps for manufacturing as a whole reported in the final row of Table 1. The implied effects are substantial: the cumulative employment growth of an industry with the average NTR gaps is -8.7 percentage points (-0.052*0.34-0.450*0.11-0.189*.11) lower one year after the 2001 peak compared to previous downturns. This implied effect rises in absolute magnitude to -29.6 percentage points (-0.334*0.34-1.362*0.11-0.334*.11) six years after the peak.

The final four rows of of Table 2 reveal that all three NTR gaps contribute significantly to the implied impact of PNTR, implying that an industry's employment may fall substantially even if it is only indirectly exposed to trade liberalization via its upstream suppliers or downstream customers.[22] Of the -29.6 percentage-point differential reduction in cumulative industry employment just discussed, half (-14.7 percentage points) is accounted for by the upstream NTR gap, 38 percent (-11.2 percentage points) by the own-industry NTR gap and 12 percent (-3.7 percentage points) by the downstream NTR gap.

The negative and statistically significant coefficient with respect to the upstream NTR gap is particularly interesting as, in theory, the elimination of import-tariff uncertainty on upstream industries can have two countervailing effects on own-industry employment. As noted in Section 4, if reduction in upstream uncertainty results in greater availability of lower-cost inputs, own-industry costs and therefore prices might decline, boosting demand and the need for workers.[23] On the other hand, if eliminating upstream uncertainty pushes upstream production offshore, customers of that production may find it optimal to move to the same offshore location in order minimize transportation or other costs that depend on geographic proximity. The strong association between employment growth and the upstream NTR gap exhibited in our results suggests that the second channel dominates.

The final column of Table 2 reports results based on the CM, which are estimated

[22] To the extent that an establishment contains several sections of a supply chain, the upstream and downstream NTR gaps may identify exposure to risk reduction that is more direct than indirect.

[23] A number of papers, beginning with Amiti and Konings (2007), show tariff reductions on the inputs of a firm's major output industry make a substantial contribution to productivity growth following trade liberalization.

across the 1977-87, 1987-97 and 1997-07 "CM decades".[24] Use of the CM allows us to include capital and skill intensity as two additional industry-level control variables, and the longer time interval captures employment changes that might precede official NBER peaks. We measure capital intensity as the log of the ratio of real book value of capital to total employment, $ln(K/Emp_i^t)$, and skill intensity as the log log of the ratio of non-production workers to total employment, $ln(NP/Emp_i^t)$. As indicated in the table, all three DID estimates remain negative and statistically significant at conventional levels. Economic significance is also similar, with the implied impact of the shift in U.S. policy being -31.8 percentage points for growth between 1997 and 2007 versus previous decades, compared with the -29.6 percentage point decline implied for the longest of the LBD intervals, 2001 to 2007.

5.2 Industry Employment Growth by Margins of Adjustment

We use the longitudinal identifiers in the LBD to decompose industry job loss into six mutually exclusive and comprehensive gross margins of adjustment that are "extensive" and "intensive" to establishments. We examine one intensive and two extensive margins. The intensive margin traces "plant expansion" (PE) and "plant contraction" (PC) in employment within continuing plants at continuing firms.[25] The first extensive margin tracks changes in employment due to "plant birth" (PB) and "plant death" (PD) within continuing firms. For this margin, a plant is coded as being born within an incumbent firm if it appears in the data for the first time during the noted interval and is associated with an already present firm identifier. Similarly, a plant is classified as dying within a continuing firm if it is part of the firm at the beginning of the interval but is no longer present afterward. The second extensive margin accounts for employment growth due to "firm birth" (FB) and firm death" (FD). A firm is classified as being born during in an interval if none of its plants are present in the LBD before that interval. Likewise, a firm is classified as dying if all of its plants no longer appear in the data after the interval.

Figure 6 reports a decomposition of cumulative manufacturing employment growth in the years after 1981, 1990 and 2001 according to the three gross job creation (PE, PB and FB) and three gross job destruction (PC, PD and FD) margins.[26] As indicated in the figure, the contribution of gross job creation in the years after 2001 is small relative to the years after previous peaks, especially four to six years out. As a result, the job destruction that occurs immediately after 2001 is not offset by subsequent job creation, as in the two previous business cycles. Figure 7 performs a similar decomposition with respect to the net intensive and net extensive margins of adjustment, referred to as PEC,

[24] In this case, $d = 10$ and the first indicator variable for each DID term is $1\{t = 1997\}$.

[25] Surviving plants whose ownership is transferred between surviving firms are included in the intensive margin. Excluding these plants from the intensive margin has no material impact on our results. We note that while this margin is intensive with respect to the establishment, it may be extensive with respect to production units with a plant, such as production lines. Unfortunately, the change from SIC to NAICS discussed in Section 3 prevents us from investigating product-mix changes across business cycles within continuing plants.

[26] Growth by gross and net margin of adjustment is presented in tabular form in Table A.3 of the electronic appendix.

PBD and FBD, respectively. Here, the behavior of the intensive and firm birth-death extensive margins stand out. In particular, initial declines in the net intensive margin disappear four or five years after the 1981 and 1990 peaks. That is not the case after the 2001 peak, where the declines are both more substantial and more persistent.

We assess the impact of China's receipt of PNTR status on gross margins of employment adjustment by estimating equation 3 separately for each margin m and interval d. The dependent variable in each of these regressions is the cumulative change in employment in industry i and margin m from t to d as a percent of initial *industry* (not industry-margin) employment,

$$\frac{\Delta Emp_{im}^{t:t+d}}{Emp_i^t} = \frac{\left(Emp_{im}^{t+d} - Emp_{im}^{t}\right)}{Emp_i^t}. \tag{4}$$

As a result, changes across margins sum to the dependent variable in equation 3, i.e., $\sum_m \Delta Emp_{im}^{t:t+d}/Emp_i^t = \Delta Emp_i^{t:t+d}/Emp_i^t$.

Table 3 reports results for $d = 6$. Given the normalization in equation 4, the sum of the DID coefficients for the six gross margins, in the first six columns of the table, sum to the DID coefficient for overall employment, estimated in the previous section and repeated in the final column of Table 3 for comparison. As above, estimates are in bold if they are statistically significant at the ten percent level, and the final block of rows summarizes economic significance.

Coefficient estimates for the DID terms in Table 3 are negative for all of the gross margins and, while their statistical significance varies, the p-values reported in the eleventh row of the table indicate their joint significance for all margins. In terms of economic significance, we find a strong link between PNTR and both gross job creation and gross job destruction. As indicated in the final rows of the table, -13.0 percentage points (-.063-.020-.047) of the predicted -29.6 percentage point differential decline in cumulative employment associated with PNTR from 2001 to 2007 is due to suppression of plant expansion (PE), plant birth (PB) within continuing firms and firm birth (FB), versus -16.6 percentage points (-.053-.067-.045) for elevated plant contraction (PC), plant death (PD) within continuing firms and firm death (FD).

DID estimates for all time periods and margins are reported in Table A.4 of the electronic appendix. We summarize their economic significance in Table 4 by decomposing the overall implied impact of the shift in U.S. policy over each interval by NTR gap (panel A), gross job creation versus destruction (panel B) and both of these dimensions simultaneously (panels C and D). As illustrated in panel B, anemic job creation accounts for an increasingly large share of the overall implied cumulative effect of PNTR, rising from 22 percent (-1.9/-8.7) between 2001 and 2002 to 44 percent (-13.0/-29.6) between 2001 and 2007.

This relationship between gross margins and PNTR suggests a strong role for trade policy in the well-documented "joblessness" of the 2001 manufacturing recovery. Faberman's (2012) analysis of post-war U.S. manufacturing employment, for example, highlights a precipitous and persistent decline in job creation rates beginning in the late 1990s. That decline, coupled with elevated job destruction in the years after 2001, are the reason that manufacturing employment does not recover after the 2001 recession. Here, we provide an explanation for this "fundamental shift" in manufacturing trends by showing that anemic job creation and exaggerated job destruction coincide with reductions in import-tariff uncertainty.

Our results also provide intuition for why previous studies have failed to find a connection between import competition and manufacturing job loss during the 2000s. Mankiw and Swagal (2006), for example, argue against a role for trade because few of the firms that report mass layoffs during this period attribute them to offshoring.[27] But this approach misses two potentially important links between employment and trade policy. First, it focuses on job destruction, whereas here we demonstrate that a large portion of the job loss associated with PNTR is due to a lack of job creation – particularly plant expansion and firm birth. Second, it concentrates on "direct" offshoring, i.e., within-firm movement of jobs abroad. But trade liberalization may induce several forms of "indirect" offshoring (beyond suppressing job creation). Table 2 reports a strong relationship between job loss and a reduction in import-tariff uncertainty in firms' downstream industries, potentially driven by the disappearance of one's domestic customers. In addition, the strong contribution of firm death in Table A.4 suggests that firms competing head-to-head with China may simply exit rather than move production offshore.

Panels C and D of Table 4 reveal that the contributions of the three NTR gaps to gross job creation and destruction vary. We find that the own-industry NTR gap contributes relatively more to the implied impact of PNTR via suppressed job creation than exaggerated job destruction. For $d = 6$, for example, it accounts for 45 percent (-.059/-.130) of the implied decline associated with gross job creation, but just 32 percent (-.053/-.166) of the implied decline associated with gross job destruction. The up- and downstream NTR gaps, by contrast, are relatively more influential with respect to gross job destruction.

Estimations using the CM are similar to those from the LBD in terms of statistical and economic significance, with one intriguing difference: lackluster job creation accounts for a larger share of the implied impact of PNTR over the longer 1997-07 CM time intervals (54 percent) compared to the shorter 1997-07, $d = 6$ LBD time intervals (44 percent). Examination of DID estimates by gross margin in Table A.4 indicates that this difference is driven by more anemic firm birth and plant birth within continuing firms across the CM time intervals.

One interpretation of this difference between the LBD and CM estimations is that anticipation of an impending change in China's status in the years leading up PNTR discouraged entry before encouraging exit. Such an outcome is consistent with the onset of a decline in job creation a few years ahead of PNTR (as documented in Faberman 2012), and can be rationalized by models of investment under uncertainty: as the likelihood of a change in China's status rises, the expected profits of entering decline, suppressing firm birth. Firms that have already paid the sunk costs of entry to be in the market, however,

[27]The Mass Layoff Statistics database from the U.S. Bureau of Labor Statistics (http://www.bls.gov/mls/) identifies firms who lay off more than 50 workers for more than 30 days. If the layoff is associated with the movement of production to either another location within the company or to another company under a formal contract, respondents are also asked to identify whether the new location is inside the United States.

have no reason to exit until the greater competitive pressure from China manifests, which presumably does not happen until China's change in status actually occurs.

5.3 *P*NTR and the Jobless 2001 Recovery in Manufacturing: A Coarse Counterfactual

We provide an alternate estimate of PNTR's contribution to the joblessness of the 2001 manufacturing recovery by comparing observed employment to a coarse counterfactual. We multiply the estimated DID coefficients for each gross margin and time interval in electronic appendix Table A.4 by the corresponding NTR gaps for each industry to compute the margin-industry-interval differential cumulative growth rate associated with the shift in U.S. policy. We then add the employment implied by these growth rates back to the actual employment for each margin, industry and interval. Summing over industries yields counterfactual employment by margin for the manufacturing sector as a whole.

Figure 8 displays the results. The solid black line in the figure traces out the deviation of actual employment from the 2001 peak from 2001 to 2007. The two dashed lines reveal the implied effect of adding back employment due to exaggerated job destruction and anemic job creation. As indicated in the figure, our estimates imply that, absent the shift in U.S. policy, U.S. manufacturing employment would have risen nearly 10 percent between 2001 and 2007, versus an actual decline of more than 15 percent. While PNTR cannot explain the overall joblessness of the 2001 recovery, its implied impact in manufacturing is substantial. Indeed, the data displayed in Figure 8 indicate that manufacturing employment would have been higher by over 4 million employees in 2007 without the effect of PNTR.

6 *P*NTR and Plant Outcomes

In this section we examine the effect of PNTR on manufacturing plants using data from the CM. These data allow us to examine a broad range of outcomes and to use a rich set of establishment characteristics as controls. We begin by estimating a plant-level variant of equation 3:

$$\Delta ln(Emp_{ei}^{t:t+10}) = \alpha_{do} 1\{t = 1997\} \times \sum_{o} NTR\, Gap_{io} + \gamma \ln(\mathbf{X}_{et}) + \delta_t + \delta_e + \varepsilon_{eit}, \quad (5)$$

The dependent variable is the log difference in establishment e's employment across CM decades, i.e., $t \in \{1977, 1987, 1997\}$. The three DID terms capture the own, upstream or downstream NTR gaps of the establishment's major industry i. $\mathbf{X}_{et}$ is a matrix of plant characteristics in year t that includes employment, capital and skill intensity, plant age and plant total factor productivity (TFP).[28] We include plant fixed effects, δ_e, to

[28]We measure TFP with an index number approach in which output is measured as the logarithm of deflated revenue and inputs–cost of materials, production employment, non-production employment and book value of capital–are weighted by the average cost share for each input, at the industry level. While we deflate revenue with industry-level price deflators from Bartelsman, Becker and Gray (2005)

control for unobserved plant characteristics that are time invariant and, as above, include peak-year t fixed effects to mitigate the impact of cyclicality. Our use of a log difference as the dependent variable restricts our examination to the intensive margin.

Table 5 reports results for total employment growth as well as growth in non-production employment, production employment and production hours. As above, the final block of rows in the table computes economic significance, in this case by multiplying the DID estimates by the respective averages for manufacturing as a whole (from the final row of Table 1), exponentiating, and subtracting 1.

Three trends stand out. First, we find that the implied impact of PNTR on 1997 to 2007 employment growth is almost four times stronger for production workers (-17.0 percentage points) than non-production workers (-4.6 percentage points). Second, results for production hours are very similar to those for production workers, suggesting no substantial change in hours worked per employee. Finally, the relationship between the own-industry NTR gap and the differential growth of non-production workers is positive and statistically significant. This implies that non-production worker growth for a continuing plant with the average own-industry NTR gap is 8.3 percentage points higher from 1997 to 2007 than in the previous two decades.

To the extent that non-production workers embody higher levels of human capital than production workers, this outcome suggests a relative increase in continuing plants' skill intensity that is consistent with evidence of skill-biased technical change and product-mix upgrading found elsewhere in the literature. Bloom, Draca and Van Reenen (2012), for example, demonstrate innovation and greater use of computers by European firms in response to heightened competition from China, while results in Bernard, Jensen and Schott (2006), Khandelwal (2010) and Schott (2008) suggest that high-wage countries alter their product mix to escape competition from low-wage countries like China. Moreover, to the extent that production workers are more likely to engage in routine tasks, our results are in accord with Jaimovich and Siu's (2012) demonstration that jobs focusing on such tasks are more likely to disappear during economic downturns. Here, we show that in manufacturing, this disappearance can be associated with a major change in U.S. trade policy.

Table 6 examines the effect of PNTR on plant attributes other than employment. We analyze changes in continuing plants' real capital stock, real value added and real shipments, as well as the ratios of each of these outcomes to total employment. The first column of the table repeats results for overall employment from Table 5. The second and third columns reveal that the PNTR-implied decline in continuing plants' real capital stock is less severe than the decline their employment, yielding a relative increase in implied capital intensity over 1997 to 2007. This link between PNTR and increased capital intensity dovetails the just-discussed rise in skill intensity.

The final four columns of Table 6 examine the relationship between the shift in U.S. trade policy and the relative growth of continuing plants' labor productivity. Coefficient

to obtain our measure of output, we note that this approach does not control for within-industry price differences and the level of observed "productivity" can be affected by changes in plant-level prices. For a detailed discussion of the properties of this TFP measure, as well as the limitations of revenue-based forms of productivity, see Foster, Haltiwanger and Syverson (2008).

estimates imply that PNTR is associated with declines in real shipments and real value added that are about two times stronger than the decline in employment, i.e., -30.6 and -32.1 percentage points versus the -13.2 percentage points reported in the first column of Table 6. As a result, continuing plants possessing the average NTR gaps are predicted to experience labor productivity growth that is -18.1 and -19.6 percentage points lower between 1997 and 2007 than was experienced by these plants in the prior two decades. Given the trend in aggregate labor productivity growth implicit in Figure 5, these results imply that most of the growth in labor productivity experienced in the years after 2001 is due to continuing plants with relatively low-exposure to reductions in import-tariff uncertainty as well as reallocation towards higher labor-productivity entrants along the extensive margin. Price declines associated with indirect importing is one potential channel for these gains.

7 *P*NTR and Trade Flows

In this section we use the U.S. Census Bureau's Longitudinal Firm-Trade Transaction Database (LFTTD) assembled by Bernard, Jensen and Schott (2009) to assess the behavior of U.S. importers and Chinese exporters. The LFTTD tracks all U.S. international trade transactions from 1992 to 2008 and links them to the *firm* identifiers used in the LBD and CM.[29] For each import transaction we observe the identity of the U.S. importer, the ten-digit Harmonized System (HS) product traded, the U.S. dollar value and quantity shipped, the shipment date, the origin country and the foreign supplier of the imported product.

As the firm-level U.S. import data are unavailable prior to the 1990s, we amend our difference-in-differences specification to compare outcomes across trading partners rather than business cycles,

$$\Delta Z_{ch}^{1997:2007} = \alpha\{c = China\} * NTR\,Gap_h + \gamma ln(\mathrm{Z}_h) + \delta_c + \delta_h + \varepsilon_{ch}. \tag{6}$$

We analyze the 1997 to 2007 interval to mimic the CM decades examined above, but note that we find similar relationships across narrower windows that begin in 2001.[30] $\Delta Z_{ch}^{1997:2007}$ represents the change in one of several dimensions of U.S. imports of ten-digit HS product h imported from country c. The first term on the right-hand side is an interaction of an indicator variable picking out China and the NTR gap for the product. δ_c and δ_h represent country and product fixed effects that control for unobserved country- and product-specific variation. The DID coefficient α captures the differential change of high NTR gap products (first difference) imported from China versus all other U.S. trading partners (second difference).

[29] The U.S. Census' Shippers Export Declaration Form and the U.S. Customs and Border Patrol Forms 7501 and 7533 used to collect information on U.S. export and import transactions are available at http://www.census.gov/foreign-trade/regulations/forms/new-7525v.pdf. and http://www.cbp.gov/xp/cgov/toolbox/forms/, respectively. See U.S. Census (2002) for a discussion of the quality of the U.S. trade data.

[30] Figure A.1 in the electronic appendix demonstrates a similar relationship with respect to U.S. import penetration from China using publicly available data.

As product-country trade data exhibit an abundance of zeros, we use the normalized growth rate introduced by Davis, Haltiwanger and Schuh (1996) for the dependent variable,

$$\Delta Z_{ch}^{1997:2007} = \frac{\left(Z_{ch}^{2007} - Z_{ch}^{1997}\right)}{\frac{1}{2}\left(Z_{ch}^{2007} + Z_{ch}^{1997}\right)}, \tag{7}$$

which is bounded by 2 and -2 and equals those values for observations that start or end at zero, respectively. For the same reason, we define $ln(\mathrm{Z}_h)$ to be the denominator of the right-hand side term in equation 7 rather than the initial level.

Results for import value, the number of U.S. firms that import from China, the number of Chinese firms that export to the United States, and the number of importer-exporter pairs are reported in Table 7. We find a positive and statistically significant relationship between the NTR gap and all of these dimensions of U.S. importing. Our estimates imply that a product with the average NTR gap (0.32) exhibits growth in import value from China between 1997 and 2007 that is 19.6 "normalized" percentage points higher than the growth in import value across all other U.S. trading partners over this period. The differential growth for the numbers of U.S. importers, Chinese exporters and importer-exporter pairs is 32.2, 39.5 and 34.7 "normalized" percentage points, respectively.

These large relative increases in U.S. imports from China as well as export and import participation by Chinese and U.S. firms are impressive given that PNTR had no effect on the tariff rates actually applied to Chinese imports. They are also in remarkable accord with the predictions of Handley's (2012) model of trade policy uncertainty, and an application of the insights of that framework to models of offshoring. Indeed, U.S. imports surge in precisely the set of goods where domestic employment loss is concentrated, and with the exact trading partner that is the subject of the shift in U.S. trade policy.

8 Conclusion

This paper examines the sharp decline in U.S. manufacturing employment that occurs after 2001. We show that this decline coincides with a major shift in U.S. trade policy – the conferring of permanent normal trade relations status on China – that affected expectations about how import tariffs on Chinese goods might change rather than the actual levels of these tariffs.

Our results provide evidence in favor of the two dominant explanations for the decline in U.S. manufacturing employment that have appeared in the literature. Consistent with models of offshoring, we show that the largest declines in employment and increases in imports were found in the industries that experienced the greatest reductions in tariff uncertainty. At the same time, in accord with models of skill-biased technical change and product-mix upgrading, we show that reductions in import tariff uncertainty are associated with increases in continuing plants' skill and capital deepening.

Our results also raise a number of questions worthy of further study, including the precise mechanism by which labor productivity grew in the years after 2001, the effect of PNTR on skilled- and unskilled workers' wages, and the affect of the shift in U.S.

policy on the nature of U.S. manufacturing. We hope to contribute answers to all of these questions in the near future.

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NAICS	Industry	Own	Up	Down
311	Food	0.14	0.06	0.04
312	Beverage and Tobacco	0.24	0.11	0.07
313	Textile Mills	0.51	0.18	0.43
314	Textile Product Mills	0.53	0.18	0.08
315	Apparel	0.57	0.21	0.06
316	Leather	0.31	0.12	0.09
321	Wood Product	0.24	0.06	0.09
322	Paper	0.34	0.11	0.14
323	Printing	0.18	0.08	0.04
324	Petroleum and Coal	0.22	0.04	0.04
325	Chemical	0.30	0.10	0.17
326	Plastics and Rubber	0.37	0.14	0.15
327	Nonmetallic Mineral	0.29	0.05	0.10
331	Primary Metal	0.22	0.08	0.28
332	Fabricated Metal	0.38	0.08	0.14
333	Machinery	0.33	0.11	0.06
334	Computer and Electronics	0.40	0.13	0.14
335	Electrical Equipment	0.35	0.12	0.08
336	Transportation Equipment	0.26	0.14	0.05
337	Furniture	0.43	0.10	0.04
339	Miscellaneous	0.45	0.09	0.04
All		0.34	0.11	0.11

Notes: Table reports the average own-, upstream- and downstream-NTR gaps across sic-digit NAICS categories by three-digit NAICS category. The correlations between own and upstream, own and downstream, and upstream and downstream across six-digit NAICS categories are 0.79, 0.18 and 0.22.

Table 1: Average NTR Gap Across NAICS Manufacturing Industries

	LBD Intervals						CM
	$\Delta Emp^{t:t+1}$	$\Delta Emp^{t:t+2}$	$\Delta Emp^{t:t+3}$	$\Delta Emp^{t:t+4}$	$\Delta Emp^{t:t+5}$	$\Delta Emp^{t:t+6}$	$\Delta Emp^{t:t+10}$
1{t=2001}xNTR Gap_{Own}	-0.052	0.004	**-0.158**	**-0.253**	**-0.269**	**-0.334**	**-0.367**
	0.038	0.065	**0.072**	**0.070**	**0.085**	**0.094**	**0.167**
1{t=2001}xNTR Gap_{Up}	**-0.450**	**-0.832**	**-1.027**	**-1.084**	**-1.108**	**-1.362**	**-1.371**
	0.168	**0.267**	**0.275**	**0.305**	**0.315**	**0.341**	**0.485**
1{t=2001}xNTR Gap_{Down}	**-0.189**	-0.131	**-0.224**	**-0.281**	**-0.319**	**-0.334**	**-0.419**
	0.053	0.083	**0.085**	**0.100**	**0.110**	**0.118**	**0.156**
$\ln(Emp_t)$	-0.007	**-0.112**	**-0.110**	**-0.180**	**-0.227**	**-0.225**	**-0.452**
	0.013	**0.049**	**0.020**	**0.037**	**0.037**	**0.039**	**0.083**
$\ln(K/L_t)$							**-0.167**
							0.071
$\ln(S/L_t)$							-0.197
							0.169
Observations	1,089	1,089	1,089	1,089	1,089	1,089	0
R2	0.493	0.577	0.585	0.641	0.661	0.639	0
Fixed Effects	i,t	i,t	i,t	i,t	i,t	i,t	i,t
Clustering	i	i	i	i	i	i	i
P-value of Joint Significance	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Implied Impact of PNTR							
Own	-0.017	0.001	-0.053	-0.085	-0.090	-0.112	-0.123
Upstream	-0.049	-0.090	-0.111	-0.117	-0.120	-0.147	-0.148
Downstream	-0.021	-0.015	-0.025	-0.031	-0.035	-0.037	-0.047
Total	-0.087	-0.103	-0.189	-0.233	-0.245	-0.296	-0.318

Notes: Each column displays the results of an OLS regression of the percent change in industry (i) employment across intervals noted in top row. There are three observations for each industry corresponding to growth up to six years after the 1981, 1990 and 2001 peaks (t). First seven columns use data from the LBD. Final column uses data from the CM and is estimated over CM decades (see text). Own-, upstream- and downstream-industry NTR Gap is the difference between non-NTR and NTR tariff in these sets of industries, respectively (see text). Standard errors adjusted for clustering at the industry level are displayed below each coefficient. Coefficients in bold are statistically significant at the 10 percent level. Estimates for the constant and fixed effects are suppressed. Eleventh row reports p-value of an F-test of the joint significance of the first three covariates. Final block of rows reports the differential employment growth implied by the shift in U.S. policy (see text).

Table 2: Industry Employment Growth and China's Change in NTR Status

	ΔEmp$^{t:t+6}$ (LBD)						
	Gross Job Creation			Gross Job Destruction			
	PE	PB	FB	PC	PD	FD	ALL
1{t=2001}xNTR Gap$_{Own}$	-0.055	-0.028	**-0.093**	**-0.087**	-0.037	-0.034	**-0.334**
	0.038	0.026	**0.043**	**0.039**	0.044	0.029	**0.094**
1{t=2001}xNTR Gap$_{Up}$	**-0.368**	-0.054	-0.117	-0.208	**-0.348**	**-0.268**	**-1.362**
	0.113	0.095	0.131	0.127	**0.188**	**0.144**	**0.341**
1{t=2001}xNTR Gap$_{Down}$	-0.042	**-0.046**	-0.031	-0.017	**-0.152**	-0.046	**-0.334**
	0.042	**0.027**	0.048	0.045	**0.063**	0.038	**0.118**
ln(Emp$_t$)	**-0.044**	-0.015	**-0.111**	**-0.026**	**-0.029**	0.000	**-0.225**
	0.017	0.010	**0.027**	**0.009**	**0.006**	0.008	**0.039**
Observations	1,089	1,089	1,089	1,089	1,089	1,089	1,089
R2	0.618	0.489	0.631	0.429	0.504	0.785	0.639
Fixed Effects	i,t	i,t	i,t	i,t	i,t	i,t	i,t
Clustering	i	i	i	i	i	i	i
P-value of Joint Significance	0.000	0.103	0.055	0.006	0.004	0.007	0.000
Implied Impact of PNTR							
Own	-0.018	-0.009	-0.031	-0.029	-0.012	-0.011	-0.112
Upstream	-0.040	-0.006	-0.013	-0.022	-0.038	-0.029	-0.147
Downstream	-0.005	-0.005	-0.003	-0.002	-0.017	-0.005	-0.037
Total	-0.063	-0.020	-0.047	-0.053	-0.067	-0.045	-0.296

Notes: Each column displays the results of an OLS regression of the cumulative percent change in industry (i) employment along the noted margin six years after the 1981, 1990 and 2001 peaks (t). First six columns report results for the gross margins of adjustment; the final column reports results for the overall change in employment. Standard errors adjusted for clustering at the industry level are displayed below each coefficient. Coefficients in bold are statistically significant at the 10 percent level. Estimates for the constant and fixed effects are suppressed. Eleventh row reports p-value of an F-test of the joint significance of the first three covariates. Final block of rows reports the differential employment growth implied by the shift in U.S. policy (see text).

Table 3: Industry Employment Growth and China's Change in NTR Status Six Years After Each Peak

Table 4: Decomposing the Overall Implied Impact of PNTR

	Levels							Percent						
	LBD						CM	LBD						CM
Panel A	d=1	d=2	d=3	d=4	d=5	d=6	d=10	d=1	d=2	d=3	d=4	d=5	d=6	d=10
NTR Gap_{Own}	-0.017	0.001	-0.053	-0.085	-0.090	-0.112	-0.123	20	-1	28	36	37	38	39
NTR Gap_{Up}	-0.049	-0.090	-0.111	-0.117	-0.120	-0.147	-0.148	56	87	59	50	49	50	47
NTR Gap_{Down}	-0.021	-0.015	-0.025	-0.031	-0.035	-0.037	-0.047	24	14	13	13	14	13	15
Total	-0.087	-0.103	-0.189	-0.233	-0.245	-0.296	-0.318	100	100	100	100	100	100	100
Panel B								0	0	0	0	0	0	0
Gross Job Creation	-0.019	-0.021	-0.075	-0.100	-0.101	-0.130	-0.172	22	20	40	43	41	44	54
Gross Job Desctruction	-0.068	-0.082	-0.114	-0.133	-0.144	-0.166	-0.145	78	80	60	57	59	56	46
	-0.087	-0.103	-0.189	-0.233	-0.245	-0.296	-0.317	100	100	100	100	100	100	100
Panel C: Job Creation														
NTR Gap_{Own}	-0.016	0.004	-0.034	-0.048	-0.049	-0.059	-0.077	87	-21	45	47	49	45	45
NTR Gap_{Up}	0.001	-0.026	-0.036	-0.045	-0.039	-0.058	-0.079	-6	128	48	45	38	45	46
NTR Gap_{Down}	-0.003	0.001	-0.005	-0.008	-0.013	-0.013	-0.016	18	-6	7	8	13	10	9
	-0.019	-0.021	-0.075	-0.100	-0.101	-0.130	-0.172	100	100	100	100	100	100	100
Panel D: Job Desctruction														
NTR Gap_{Own}	-0.001	-0.003	-0.019	-0.038	-0.041	-0.053	-0.045	1	4	17	28	28	32	31
NTR Gap_{Up}	-0.050	-0.064	-0.075	-0.072	-0.081	-0.089	-0.069	73	77	66	54	56	54	48
NTR Gap_{Down}	-0.018	-0.016	-0.020	-0.024	-0.022	-0.024	-0.031	26	19	17	18	15	14	21
	-0.068	-0.082	-0.114	-0.133	-0.144	-0.166	-0.145	100	100	100	100	100	100	100

Table decomposes the implied economic impact of PNTR on cumulative growth d years after the 2001 peak according to the the three NTR gaps (from Table 2) or job creation versus destruction (from Tables 3 and 4 in the main and Table A.4 in the electronic appendix). Levels reported in panels C and D sum to the levels reported in panels A and B.

	ΔEmploy-ment	ΔNon-Production Workers	ΔProduction Workers	ΔProduction Hours
NTR Gap_{Own} * 1{t=1997}	**-0.136**	**0.238**	**-0.343**	**-0.371**
	0.043	**0.052**	**0.051**	**0.055**
NTR Gap_{Up} * 1{t=1997}	**-0.579**	**-0.808**	**-0.402**	-0.180
	0.149	**0.176**	**0.176**	0.186
NTR Gap_{Down} * 1{t=1997}	**-0.248**	**-0.418**	**-0.175**	**-0.327**
	0.057	**0.066**	**0.067**	**0.072**
$\ln(Emp_t)$	**-0.882**	**-0.897**	**-0.856**	**-0.838**
	0.007	**0.008**	**0.008**	**0.008**
$\ln(K/L_t)$	**0.034**	**0.040**	**0.011**	**-0.018**
	0.004	**0.005**	**0.005**	**0.005**
$\ln(S/L_t)$	0.010	**-1.312**	**0.524**	**0.447**
	0.007	**0.009**	**0.009**	**0.010**
ln(Age)	-0.015	0.007	**-0.024**	0.010
	0.011	0.012	**0.013**	0.014
ln(TFP)	**0.025**	**0.026**	**0.034**	**0.020**
	0.003	**0.003**	**0.003**	**0.003**
Observations	283,720	283,720	283,720	283,720
R2	0.837	0.835	0.815	0.785
Fixed Effects	e,t	e,t	e,t	e,t
Clustering	e	e	e	e
Implied Impact of PNTR				
Own	-0.045	0.083	-0.109	-0.117
Upstream	-0.061	-0.084	-0.042	-0.019
Downstream	-0.027	-0.045	-0.019	-0.036
Total	-0.132	-0.046	-0.170	-0.172

Notes: Table reports establishment-level OLS regressions of the log difference in noted employment outcome across three CM decades (see text). Sample is restricted to the intensive margin. All regressions include peak year (t) and establishment (e) fixed effects. Standard errors adjusted for clustering at the plant level are displayed below each coefficient. Coefficients in bold are statistically significant at the 10 percent level. Estimates for the constant and fixed effects are suppressed. Final block of rows reports the differential employment growth implied by the shift in U.S. policy, i.e., the dot product of the first three covariates and the respective averages of the three NTR gaps (0.32, 0.11 and 0.11, repsectively).

Table 5: Plant Employment Growth Across CM Decades

	ΔEmploy-ment	ΔCapital	ΔCapital / Employment	ΔShipments	ΔShipments / Employ-ment	ΔValue Added	ΔVA / Employment
NTR Gap_{Own} * 1{t=1997}	**-0.136**	**-0.300**	**-0.163**	**-0.287**	**-0.150**	**-0.244**	-0.108
	0.043	**0.063**	**0.056**	**0.059**	**0.052**	**0.073**	0.067
NTR Gap_{Up} * 1{t=1997}	**-0.579**	0.205	**0.784**	**-1.093**	**-0.514**	**-1.101**	**-0.522**
	0.149	0.214	**0.192**	**0.213**	**0.189**	**0.254**	**0.231**
NTR Gap_{Down} * 1{t=1997}	**-0.248**	**-0.192**	0.056	**-0.979**	**-0.731**	**-1.258**	**-1.009**
	0.057	**0.084**	0.075	**0.080**	**0.069**	**0.096**	**0.087**
$\ln(Emp_t)$	**-0.882**	**-0.896**	**-0.014**	**-0.709**	**0.173**	**-0.703**	**0.179**
	0.007	**0.010**	**0.008**	**0.009**	**0.008**	**0.011**	**0.010**
$\ln(K/L_t)$	**0.034**	**-1.332**	**-1.365**	**-0.184**	**-0.217**	**-0.179**	**-0.213**
	0.004	**0.008**	**0.008**	**0.006**	**0.006**	**0.007**	**0.007**
$\ln(S/L_t)$	0.010	**0.030**	**0.021**	**0.030**	**0.020**	**0.023**	0.013
	0.007	**0.010**	**0.009**	**0.010**	**0.009**	**0.012**	0.011
ln(Age)	-0.015	**0.038**	**0.053**	**-0.054**	**-0.040**	**-0.037**	-0.022
	0.011	**0.016**	**0.014**	**0.015**	**0.014**	**0.018**	0.016
ln(TFP)	**0.025**	**0.024**	-0.001	**-0.051**	**-0.076**	**-0.089**	**-0.113**
	0.003	**0.004**	0.003	**0.004**	**0.004**	**0.005**	**0.005**
Observations	283,720	283,720	283,720	283,720	283,720	283,720	283,720
R2	0.837	0.842	0.848	0.756	0.66	0.701	0.596
Fixed Effects	e,t	e,t	e,t	e,t	e,t	e,t	e,t
Clustering	e	e	e	e	e	e	e
Implied Impact of PNTR							
Own	-0.045	-0.096	-0.053	-0.092	-0.049	-0.078	-0.036
Upstream	-0.061	0.022	0.088	-0.111	-0.054	-0.112	-0.055
Downstream	-0.027	-0.021	0.006	-0.103	-0.078	-0.130	-0.106
Total	-0.132	-0.094	0.041	-0.306	-0.181	-0.321	-0.196

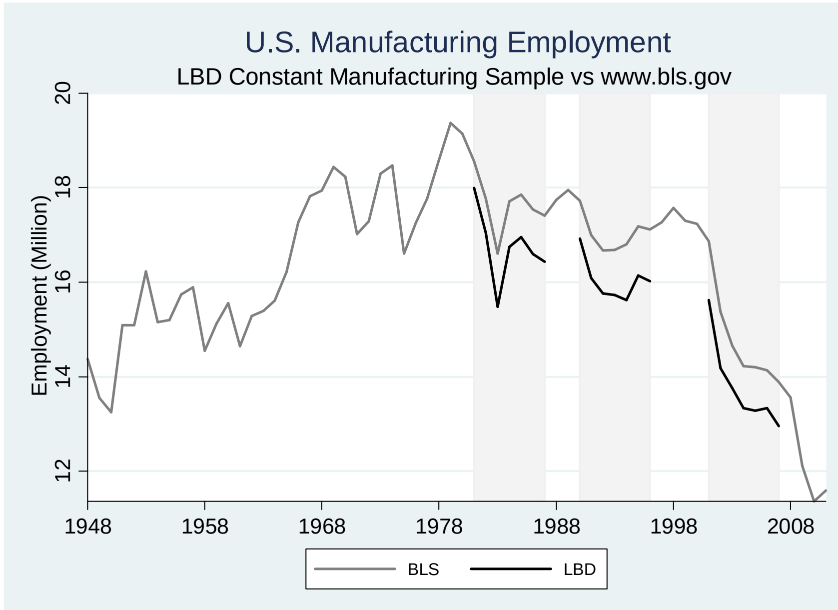
Notes: Table reports establishment-level OLS regressions of the log difference in noted outcome across three CM decades (see text). Sample is restricted to the intensive margin. All variables are in real 2005 dollars (see text). All regressions include peak year (t) and establishment (e) fixed effects. Standard errors adjusted for clustering at the plant level are displayed below each coefficient. Coefficients in bold are statistically significant at the 10 percent level. Estimates for the constant and fixed effects are suppressed. Final block of rows reports the differential employment growth implied by the shift in U.S. policy (see text).

Table 6: Other Plant Outcomes Across CM Decades

	ΔValue	ΔUS Importers	ΔChinese Exporters	ΔImporter-Exporter Pairs
NTR Gap_h* 1{c=China}	**0.179**	**0.279**	**0.333**	**0.298**
	0.052	**0.046**	**0.045**	**0.046**
$\ln(Value_{ch})$	**-0.009**			
	0.002			
$\ln(US\ Importers_{ch})$		**-0.068**		
		0.003		
$\ln(Chinese\ Exporters_{ch})$			**-0.095**	
			0.003	
$\ln(Pairs_{ch})$				**-0.066**
				0.003
Observations	277,070	277,070	277,070	277,070
R2	0.33	0.36	0.36	0.37
Fixed Effects	h,c	h,c	h,c	h,c
Clustering	h	h	h	h
Implied Impact of PNTR	0.196	0.322	0.395	0.347

Notes: Table reports the results of ten-digit HS by country OLS regressions of the 1997 to 2007 normalized change (see text) on the noted difference-in-differences term. Remaining right-hand-side variables are the average level of the dependent variable observed in the begin and end year. Regressions include ten-digit HS product (h) and country (c) fixed effects. Sample is restricted to product-country import transactions associated with firms in our constant manufacturing sample. Coefficients in bold are statistically significant at the 10 percent level. Estimates for the constant and fixed effects are suppressed. Final row reports the differential employment growth implied by the shift in U.S. policy (see text).

Table 7: U.S. Import Growth, 1997 to 2007



Notes: Figure compares annual manufacturing employment as of March according to the U.S. Bureau of Labor Statistics (series CEU3000000001) and the authors' constant manufacturing sample, constructed from the Census Bureau's Longitudinal Business Database (see text). Shaded areas correspond to periods 1981 to 1978, 1990 to 1996 and 2001 to 2007.

Figure 1: Post-War U.S. Manufacturing Employment

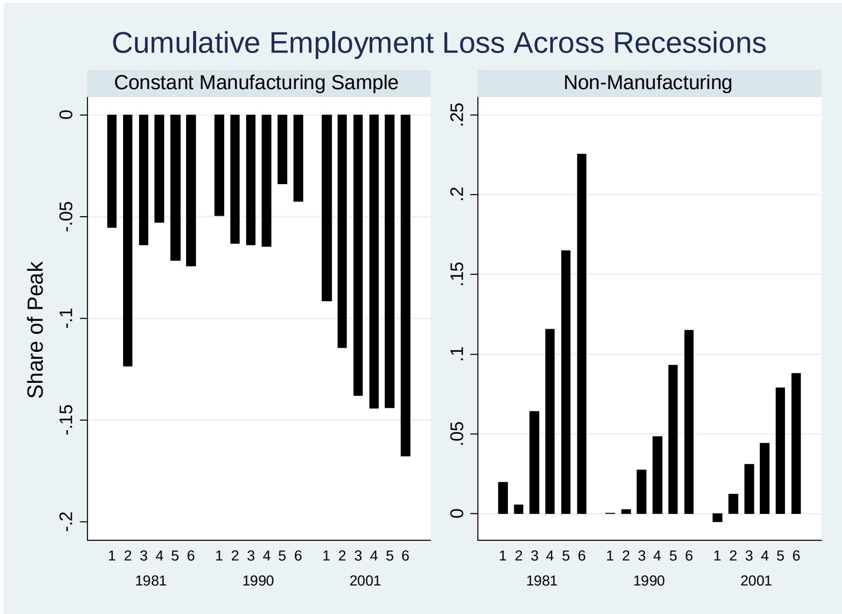


Figure 2: Cumulative Employment Loss, by Recession

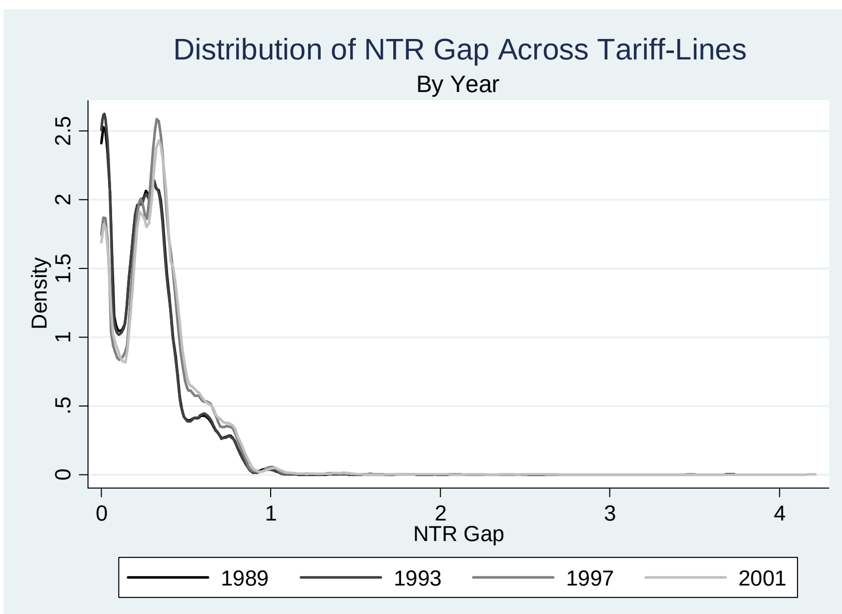


Figure 3: Distribution of Risk Across Tariff Lines

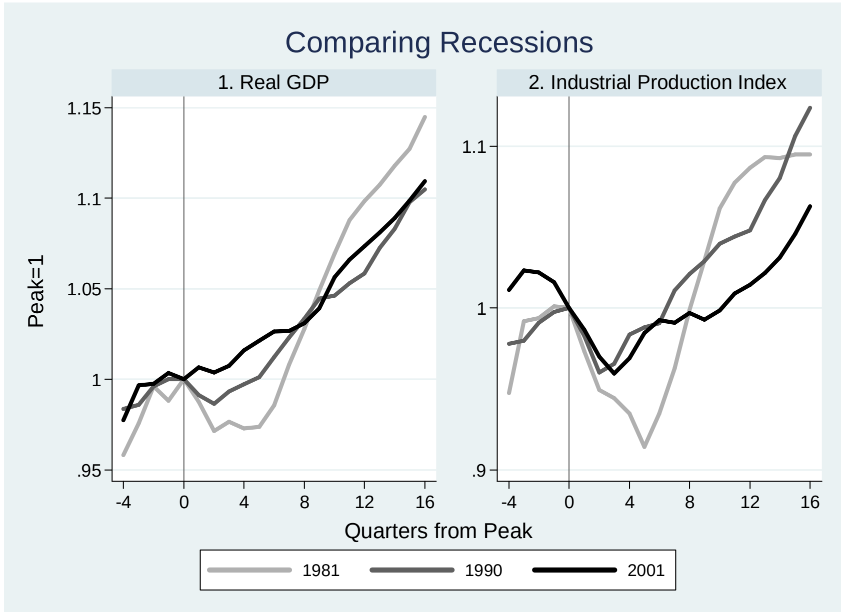
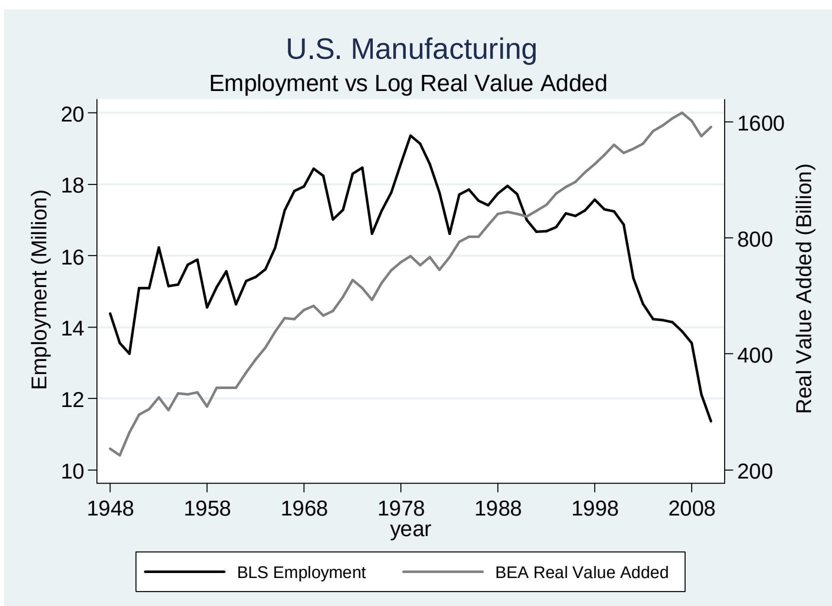
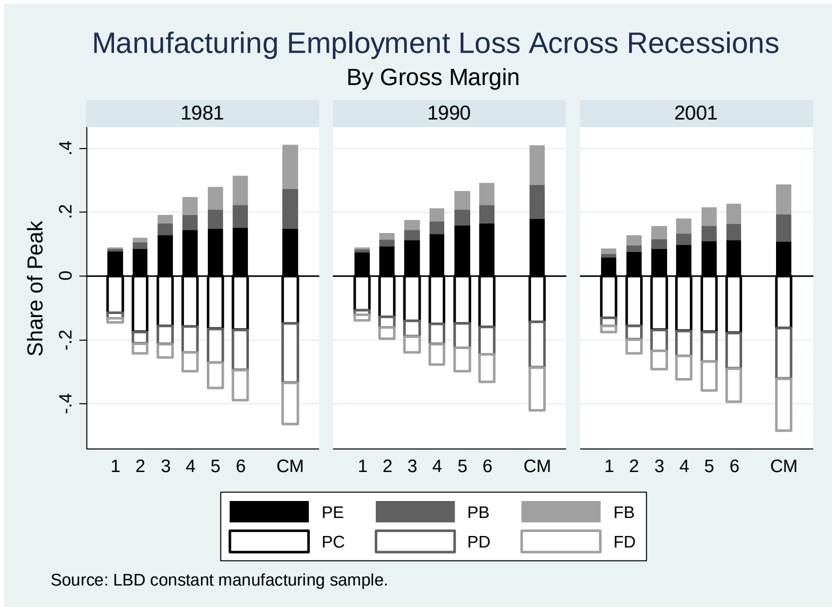


Figure 4: Real GDP and IPI During the 1981, 1990 and 2001 Recessions



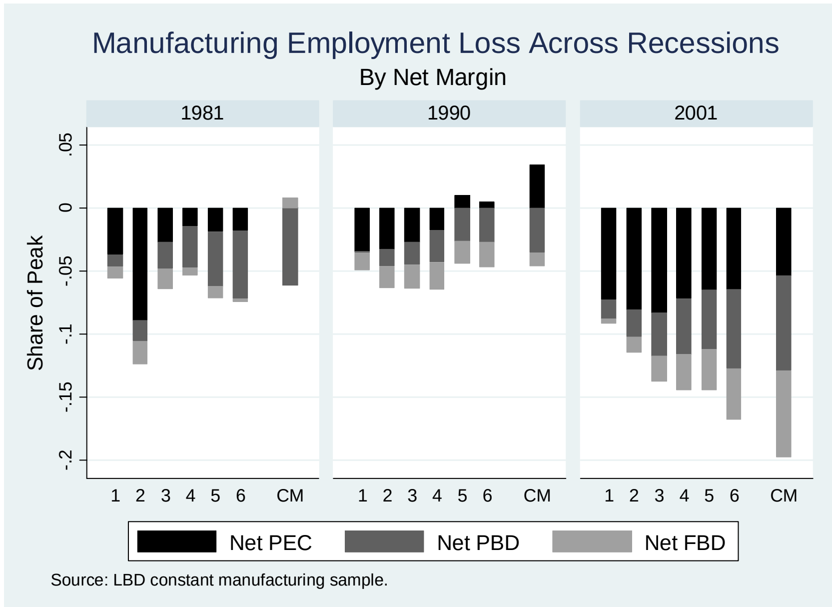
Notes: Figure compares annual manufacturing employment as of March according to the U.S. Bureau of Labor Statistics (series CEU3000000001) to real value added as measured by the Bureau of Economic Analysis.

Figure 5: Post-War U.S. Manufacturing Employment



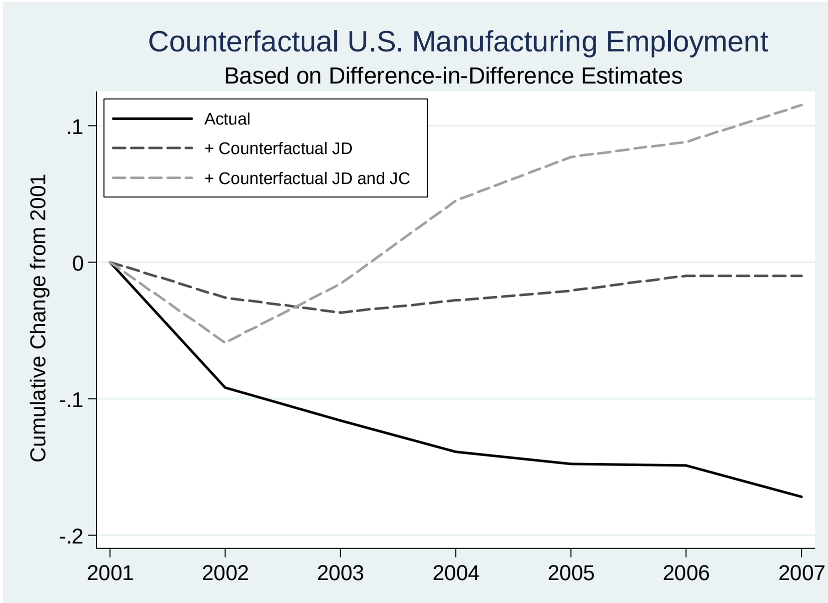
Notes: First six bars in each panel report the decomposition of overall growth by gross margin for first six years after noted peak. Final bar in each panel, labeled "CM", displays the cumulative change across the associated CM decade: 1977 to 1987, 1987 to 1997 and 1997 to 2007.

Figure 6: Cumulative Manufacturing Employment, by Recession and Gross Margin



Notes: First six bars in each panel report the decomposition of overall growth by net margin for the first six years after noted peak. Final bar in each panel, labeled "CM", displays the cumulative change across the associated CM decade: 1977 to 1987, 1987 to 1997 or 1997 to 2007.

Figure 7: Cumulative Manufacturing Employment, by Recession and Net Margin



Notes: Bottom line represents the actual decline in employment following the 2001 peak. Successively higher lines represent the addition of implied jobs lost due to exaggerated job destruction and anemic job creation, respectively.

Figure 8: Cumulative Manufacturing Employment, by Recession and Net Margin

Electronic Appendix

This appendix contains the additional empirical results referenced in the main text.

A Revealed Tariffs on Chinese Imports

We compute the revealed tariff on Chinese imports as the ratio between duties collected and dutiable value across all ten-digit HS manufacturing products imported from China using the trade data in Feenstra, Romalis and Schott (2002) and extended by Schott (2008). We regress the revealed tariffs for all countries over the years 1998 to 2002 and 1997 to 2003 on an interaction of two indicator variables: whether the observation is for China and whether the observation is for a year after 2000. As indicated in Table A.1, there is no statistically significant relationship between this difference-in-differences term and revealed tariffs over these periods.

B Chinese Import Penetration and *P*NTR

A number of papers in the international trade literature have reported a correlation between increases in U.S. import penetration (or share of import value) by low-wage countries and employment losses across U.S. establishments, industries or regions. China is by far the most influential low-wage country in this trend, and we find that the acceleration of its penetration of the U.S. market after 2001 is concentrated in industries most affected by China's change in NTR status.

China's U.S. import penetration is its import share multiplied by the standard expression for import penetration,

$$PEN_{it}^{China} = \frac{M_{it}^{China}}{M_{it}} \frac{M_{it}}{Shipments_{it} + M_{it} - X_{it}}, \tag{A.1}$$

where M_{it}, X_{it} and $Shipments_{it}$ represent total imports, exports and domestic shipments for manufacturing industry i in year t, respectively. We compute PEN_{it}^{China} using industry-level domestic shipment data from the publicly available NBER-CES Manufacturing Industry Database assembled by Becker and Gray (2009) and HS-level import and export data from Feenstra, Romalis and Schott (2002) and Schott (2008). We map the HS-level trade data to either SIC or NAICS industries using the concordances of Pierce and Schott (2012).

Figure A.1 plots PEN_{it}^{China} separately for industries that are above and below the median own-industry NTR gap. As indicated in the figure, the sharp acceleration of the overall trend in Chinese manufacturing import penetration starting in 2001 is due almost entirely to industries with above-median NTR gaps.

Table A.2 uses our main difference-in-differences specification to examine whether the change in the U.S. import penetration from China six years after each peak is relatively greater after 2001. The first column of the table demonstrates that this penetration rises with the NTR gap across the 2001 recession. The second column reveals that this relationship between ΔPEN_{it}^{CHN} and the NTR gap also appears relative to the 1981 and 1990 recessions. We find similar results across longer and short time windows, e.g., the LBD intervals analyzed in the main text.

C Employment Growth by Margin of Adjustment

The first six columns of Table A.3 report the cumulative change in U.S. manufacturing employment up to six years after each business cycle peak, by gross and net margin of adjustment. By comparison, the final column of the table reports the same breakdown of employment across three CM decades: 1977 to 1987, 1987 to 1997 and 1997 to 2007.

Table A.4 reports estimates of equation 4 for $d = 1$ to $d = 5$. As indicated in the table, the estimated magnitudes of the difference-in-difference terms generally increase in absolute value over time. This trend suggests that the relative lack of a recovery in manufacturing employment following the 2001 recession displayed in Figure 2 is driven by both exaggerated job destruction and anemic job creation.

Appendix References

1. Becker, Randy and Wayne B. Grey. 2009. NBER-CES Manufacturing Industry Database. www.nber.org/data/nbprod2005.html.

2. Feenstra, Robert C., John Romalis and Peter K. Schott. 2002. U.S. Imports, Exports and Tariff Data, 1989-2001. NBER Working Paper 9387

3. Pierce, Justin and Peter K. Schott. 2012. "Concording U.S. Harmonized System Categories Over Time" Journal of Official Statistics (Forthcoming).

4. Schott, Peter K. 2008. The Relative Sophistication of Chinese Exports," Economic Policy 53:5-49.

Appendix Tables and Figures

Table A.1: Change in Revealed Tariffs

	Revealed Tariff on Chinese Imports	Revealed Tariff on Chinese Imports
1{c=China}*1{t>2000}	-0.0002	-0.0010
	0.0045	0.0156
Observations	787,614	1,119,627
R-squared	0.015	0.011
Years	1998-2002	1997-2003
Fixed Effects	Ten-Digit HS, Country	Ten-Digit HS, Country

Notes: Table reports OLS regression of change in product-country revealed tariffs (see text) on an indicator for years after 2000. Sample includes all ten-digit HS products imported from China during noted intervals. Regression includes HS product and country fixed effects. Robust standard errors adjusted for clustering at the product level are reported below coefficients. Results for constant and fixed effects are suppressed.

Table A.2: Change in China Import Penetration Across Recessions

	ΔPEN^{CHN}	ΔPEN^{CHN}
NTR Gap	**0.167**	
	0.031	
x 2001 Recession		**0.120**
		0.042
1981 Recession		-0.007
		0.013
1990 Recession		0.018
		0.012
Constant	-0.006	0.010
	0.011	0.012
Observations	324	957
R-squared	0.08	0.59
FE	No	Industry,Year

Notes: Table reports OLS regression of change in U.S. import penetration from China across three decades, 1977-87, 1987-97 and 1997-07 on noted covariates. Columns 2 and 4 contain data for 1977, 1987 and 1997. Standard errors adjusted for clustering at the industry level are reported below coefficients. Estimates that are statistically significant at the 10 percent level are in bold.

Margin of Adjustment	1981-82	1981-83	1981-84	1981-85	1981-86	1977-87
Plant Expansion (PE)	0.078	0.086	0.129	0.144	0.147	0.149
Plant Contraction (PC)	-0.115	-0.175	-0.156	-0.158	-0.166	-0.149
Net Within-Firm PEC	-0.037	-0.089	-0.027	-0.015	-0.019	0.000
Plant Birth (PB)	0.007	0.020	0.035	0.048	0.062	0.124
Plant Death (PD)	-0.017	-0.037	-0.057	-0.081	-0.105	-0.186
Net Within-Firm PBD	-0.009	-0.016	-0.021	-0.033	-0.043	-0.061
Firm Birth (FB)	0.004	0.013	0.027	0.054	0.069	0.138
Firm Death (FD)	-0.013	-0.031	-0.043	-0.060	-0.079	-0.130
Net FBD	-0.009	-0.018	-0.016	-0.006	-0.010	0.008
Total	-0.055	-0.124	-0.064	-0.053	-0.072	-0.053

	1990-91	1990-92	1990-93	1990-94	1990-95	1977-87
Plant Expansion (PE)	0.073	0.094	0.114	0.132	0.158	0.178
Plant Contraction (PC)	-0.107	-0.127	-0.141	-0.149	-0.148	-0.144
Net Within-Firm PEC	-0.034	-0.033	-0.027	-0.018	0.010	0.034
Plant Birth (PB)	0.012	0.021	0.030	0.038	0.050	0.107
Plant Death (PD)	-0.014	-0.035	-0.048	-0.063	-0.077	-0.142
Net Within-Firm PBD	-0.001	-0.014	-0.018	-0.025	-0.026	-0.035
Firm Birth (FB)	0.004	0.020	0.032	0.042	0.057	0.124
Firm Death (FD)	-0.018	-0.036	-0.050	-0.064	-0.075	-0.135
Net FBD	-0.014	-0.017	-0.018	-0.022	-0.018	-0.011
Total	-0.050	-0.063	-0.064	-0.065	-0.034	-0.012

	2001-02	2001-03	2001-04	2001-05	2001-06	1977-87
Plant Expansion (PE)	0.057	0.075	0.087	0.099	0.111	0.108
Plant Contraction (PC)	-0.130	-0.156	-0.169	-0.172	-0.176	-0.162
Net Within-Firm PEC	-0.073	-0.080	-0.083	-0.072	-0.065	-0.053
Plant Birth (PB)	0.011	0.021	0.030	0.035	0.046	0.085
Plant Death (PD)	-0.026	-0.043	-0.064	-0.079	-0.093	-0.161
Net Within-Firm PBD	-0.015	-0.022	-0.034	-0.044	-0.047	-0.076
Firm Birth (FB)	0.018	0.031	0.039	0.046	0.058	0.093
Firm Death (FD)	-0.022	-0.043	-0.060	-0.074	-0.090	-0.162
Net FBD	-0.004	-0.012	-0.021	-0.028	-0.032	-0.069
Total	-0.092	-0.115	-0.138	-0.144	-0.144	-0.198

Note: Table reports decomposition of total percent change in U.S. manufacturing employment over the noted intervals according to gross and net margins of adjustment (see text). All changes are expressed as a percent of beginning year employment.

Table A.3: Cumulative Change in U.S. Manufacturing Employment by Recession and Margin of Adjustment

		LBD Intervals						CM		LBD Intervals						CM
		$\Delta E^{t:t+1}$	$\Delta E^{t:t+2}$	$\Delta E^{t:t+3}$	$\Delta E^{t:t+4}$	$\Delta E^{t:t+5}$	$\Delta E^{t:t+6}$	$\Delta E^{t:t+10}$		$\Delta E^{t:t+1}$	$\Delta E^{t:t+2}$	$\Delta E^{t:t+3}$	$\Delta E^{t:t+4}$	$\Delta E^{t:t+5}$	$\Delta E^{t:t+6}$	$\Delta E^{t:t+10}$
PE	Own	-0.025	-0.009	-0.032	**-0.053**	**-0.064**	-0.055	**-0.070**	PD	0.025	0.032	0.018	-0.004	-0.022	-0.037	0.002
		0.021	0.023	0.035	**0.029**	**0.035**	0.038	**0.042**		0.024	0.030	0.033	0.034	0.040	0.044	0.058
	Upstream	-0.089	**-0.258**	**-0.391**	**-0.353**	**-0.305**	**-0.368**	**-0.293**		**-0.237**	-0.232	-0.214	-0.205	-0.247	**-0.348**	-0.327
		0.071	**0.076**	**0.099**	**0.105**	**0.113**	**0.113**	**0.128**		**0.119**	0.151	0.154	0.154	0.186	**0.188**	0.221
	Downstream	-0.001	-0.017	-0.028	-0.034	-0.042	-0.042	-0.050		-0.053	-0.057	**-0.080**	**-0.124**	**-0.138**	**-0.152**	**-0.188**
		0.030	0.028	0.032	0.041	0.044	0.042	0.041		0.039	0.046	**0.048**	**0.050**	**0.057**	**0.063**	**0.073**
PC	Own	-0.036	**-0.055**	**-0.074**	**-0.095**	**-0.072**	**-0.087**	-0.050	FB	-0.017	0.018	**-0.049**	**-0.071**	-0.066	**-0.093**	**-0.127**
		0.028	**0.032**	**0.032**	**0.037**	**0.040**	**0.039**	0.038		0.012	0.023	**0.021**	**0.026**	0.047	**0.043**	**0.049**
	Upstream	-0.111	-0.145	**-0.212**	**-0.179**	**-0.240**	-0.208	-0.048		0.028	0.033	0.095	0.040	0.060	-0.117	-0.172
		0.107	0.107	**0.113**	**0.105**	**0.132**	0.127	0.127		0.035	0.064	0.079	0.100	0.159	0.131	0.162
	Downstream	**-0.093**	-0.065	**-0.073**	-0.048	-0.016	-0.017	-0.043		-0.015	0.017	-0.006	-0.030	-0.042	-0.031	0.011
		0.039	0.040	**0.044**	0.044	0.048	0.045	0.041		0.012	0.028	0.024	0.032	0.042	0.048	0.053
PB	Own	-0.007	0.004	-0.020	-0.018	-0.017	-0.028	-0.034	FD	0.009	0.014	-0.002	-0.013	-0.028	-0.034	**-0.087**
		0.007	0.024	0.024	0.019	0.022	0.026	0.056		0.013	0.021	0.023	0.024	0.026	0.029	**0.035**
	Upstream	**0.071**	-0.018	-0.039	-0.107	-0.113	-0.054	**-0.267**		**-0.111**	**-0.212**	**-0.265**	**-0.280**	**-0.262**	**-0.268**	**-0.264**
		0.040	0.080	0.081	0.067	0.079	0.095	**0.150**		**0.049**	**0.076**	**0.096**	**0.109**	**0.127**	**0.144**	**0.139**
	Downstream	-0.015	0.012	-0.015	-0.004	-0.037	**-0.046**	**-0.105**		-0.012	-0.020	-0.023	-0.041	-0.043	-0.046	-0.044
		0.010	0.026	0.024	0.022	0.026	**0.027**	**0.043**		0.015	0.023	0.029	0.032	0.035	0.038	0.045

Notes: Each block of the table reports the difference-in-difference estimate from a separate OLS regression of the cumulative percent change in industry employment along a noted margin on own-, upstream- and downstream-industry NTR gap (see text). First six columns report results using the LBD, displaying regression results from cumulative changes from one to five years after each of the 1981, 1990 and 2001 peaks. Final column uses CM decades (see text). PE and PC are plant expansion and contraction within continuing firms. PB and PD are plant birth and plant death within continuing firms. FB and FD are firm birth and death. Coefficients in bold are statistically significant at the 10 percent level. Final row of each panel reports p-value of an F-test of the joint significance of the first three covariates.

Table A.4: Industry Employment Growth and China's Change in NTR Status, by Year and Gross Margin of Adjustment

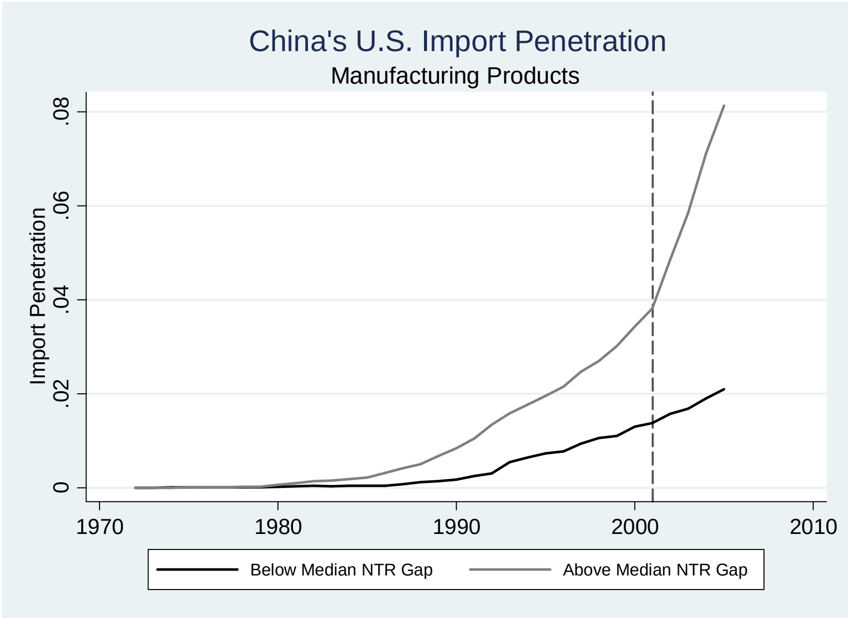


Figure A.1: U.S. Manufacturing Import Penetration