Exporting out of Agriculture: The Impact of WTO Accession on Structural Transformation in China*

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Abstract

This paper analyzes the effect of China's accession to the World Trade Organization in 2001 on structural transformation at the local level, exploiting cross-sectional variation in tariff uncertainty faced by local economies pre-2001. Using a new panel of approximately 2,000 Chinese counties observed from 1996 to 2013, we find that counties more exposed to the reduction in tariff uncertainty post-accession are characterized by increased exports and foreign direct investment, shrinking agricultural sectors, expanding secondary sectors, and higher total and per capita GDP. These findings are robust to a range of alternate specifications, and to controlling for other contemporaneous reforms.

JEL Classification: F14, F16, O14, O19

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1 Introduction

Over the past two decades, the explosive growth in manufacturing exports from China has dramatically reshaped the world economy—and increasingly, heated debates about the effect of this growth on the economies of the U.S. and Europe are reshaping politics in the developed world as well. Between 1996 and 2013, China's manufacturing exports increased from 3% to 17% of total manufacturing exports worldwide, and its per capita income in purchasing power parity terms increased from 29% to 92% of the global average.[1] Moreover, a large body of empirical work has documented that this dramatic expansion of Chinese exports had substantial and persistent effects on manufacturing employment and wages in the U.S. and Europe.[2]

However, relatively little is known about the parallel effects of this expansion on local labor markets and structural transformation in China, despite a broader literature documenting that its manufacturing sector expanded robustly during this period, stimulated partially by export-led growth. In this paper, we provide new evidence of the effect of positive shocks to China's export sector on employment, output, and value added in primary, secondary and tertiary production at the county level; here, the primary sector includes agriculture and agricultural extensions, the secondary sector includes manufacturing and mining, and the tertiary sector includes services. We employ a newly assembled panel that includes a nationwide sample of approximately 2,000 counties observed between 1996 and 2013, and utilize an identification strategy that allows us to examine the effects of cross-sectionally varying shocks generated by China's accession to the World Trade Organization (WTO) in 2001.

China's accession to the WTO was the culmination of a lengthy period of negotiations and internal liberalization, but it did not lead to discontinuous changes in the tariff rates imposed on Chinese exports by its trading partners, including the United States. In fact, Chinese products had enjoyed low tariff rates in the U.S. market since 1980. However, WTO accession did remove uncertainty pertaining to China's Most Favored Nation (MFN) status within the U.S. Previously, this status required annual renewal by Congress, a risky process that generated considerable uncertainty around tariff rates. If the renewal had failed, Chinese exports would have been subject to the much higher non-MFN rates reserved for non-market economies.[3] The U.S. permanently granted Normal Trade Relations (NTR)—a U.S. term for MFN status—to

[1] The years between 1996 and 2013 will be the main period of interest in this analysis. The data are drawn from the World Development Indicators.

[2] See Autor et al. (2016) for a useful review; the literature will be discussed in more detail later in the introduction.

[3] For example, in 2000, the average U.S. MFN tariff was 4%, but China would have faced an average non-MFN tariff of 31% had its MFN status been revoked.

China in October 2000, tied to China's accession to the WTO in December 2001 and effective as of January 1, 2002 (Handley and Limão, 2017). This generated a sharp and sudden decrease in the tariff uncertainty surrounding Chinese exports in a key export market. By contrast, the status of Chinese exports in other major markets was not affected by WTO membership.

Our empirical design utilizes variation across industries in the gap between the NTR tariffs permanently granted by the U.S. post–2001 and the non-NTR rates, in conjunction with variation across counties in the composition of employment by industry reported in the 1990 census.[4] The interaction of these two sources of variation generates a county-level variable, denoted the NTR gap, capturing the exposure of local industries to tariff uncertainty prior to WTO membership. The county is an important unit of analysis in the literature on the Chinese economy, corresponding to a local labor market with defined fiscal and economic policies (Chen and Kung, 2016; Zhang, 2006). If tariff uncertainty is a significant barrier to exporting, then counties characterized by larger NTR gaps should benefit more from WTO accession, experiencing more rapid export expansion and substitution into the secondary sector post–2001.

The main results indicate that counties more exposed to tariff uncertainty prior to 2001 did experience significantly faster growth in exports, greater expansion in the secondary sector, and more rapid increases in total and per capita GDP following WTO accession, conditional on county and province-year fixed effects and prefecture-specific trends. Comparing two counties, one in the 25^{th} percentile and the other in the 75^{th} percentile of the NTR gap, the more exposed county shows evidence of a differential 16% increase in exports, a differential 35% increase in secondary GDP, and a differential 15% increase in total GDP in the decade following 2001. This export-driven expansion also has ancillary effects on other sectors: productive factors shift out of agriculture, agricultural production and value added decline, and tertiary output expands. Our paper is the first to exploit the post-WTO reduction in tariff uncertainty in China to analyze sectoral reallocation and growth, and the first to analyze the impact of WTO accession on county-level economic outcomes. It is also one of the first papers to present evidence of the employment and GDP effects of enhanced access to advanced country markets in a developing country context.[5]

[4] Pierce and Schott (2016b) and Handley and Limão (2017) use this empirical strategy to examine the effects of permanent NTR status on U.S. manufacturing employment and consumer prices using industry-level data. Although our findings complement these studies, our paper differs significantly in its focus on the regional effects of this trade policy change using detailed country-level data from China.

[5] Further details about relevant papers are provided below, but we should note that Facchini et al. (2016) use a similar identification strategy in the Chinese context, but analyze only the impact on migration at the prefecture level, while Liu and Ma (2016) and Feng et al. (2016) analyze the effect of tariff uncertainty in China on firm-level outcomes. Other related papers analyzing access to advanced country markets include McCaig (2011a), McCaig and Pavcnik (2014b) and McCaig and Pavcnik (2014a) all focusing on Vietnam.

While a range of both internal and external reforms linked to China's WTO membership had a significant impact on its economic evolution in this period, we preferentially focus on the impact of the reduced trade uncertainty in the U.S. market for several reasons. First, the previous literature has noted that this reduced uncertainty is a major benefit of China's WTO accession, and had a significant impact on industrial production in the U.S.; thus, we can reasonably expect a parallel effect in the Chinese economy. Second, the discontinuous nature of this reform renders it conducive to analysis. Third, given that tariff uncertainty ex ante reflects differences between NTR and non-NTR rates determined by the U.S. Congress in the Smoot-Hawley Tariff Act of 1930, the potential for endogeneity in the NTR gap is limited.

Importantly, however, our empirical specifications all control for variation in U.S. tariff levels during this period, as well as a range of other trade reforms implemented by both China and the U.S., including the elimination of export licensing requirements, the reduction in barriers to foreign investment, and the expiration of the Multi-Fiber Arrangement (MFA). In general, variation in the level of tariffs imposed by the U.S. and other trading partners during this period is small in magnitude relative to the potential increase in tariffs risked if China's NTR status had been revoked prior to WTO accession. While we show that this variation in levels has some effect on economic outcomes, the effects of tariff uncertainty prove to be significantly larger.

In addition, there is no evidence of any significantly different trends when comparing counties characterized by different NTR gaps prior to China's WTO accession. When we estimate a more complex specification evaluating the differences between high and low NTR gap counties over time, we observe that these counties do not show any significant difference in observable characteristics prior to 2001. The gap in their economic trajectories emerges only post–2001, consistent with the hypothesis that the key channel is more secure access to the U.S. market. In addition, we verify that the key results are consistent when differential trends for counties characterized by different initial economic conditions are included. We also conduct a placebo test utilizing export data from UNCOMTRADE that demonstrates that the cross-sectional variation in the NTR gap is associated only with increased exports to the U.S., and does not predict any increase in exports to other major export markets.

This paper contributes to several related literatures. First, an extensive literature analyzes the effects of increased manufacturing exports from China on manufacturing employment and production in developed countries; Autor et al. (2016) provide a useful overview. Autor et al. (2013) and Acemoglu et al. (2016) exploit variation across metropolitan statistical areas in their exposure to competition with Chinese exports. The identification strategy employed in

this paper is closely related to Pierce and Schott (2016b), who use industry data to analyze the effects of diminished trade policy uncertainty on U.S. manufacturing employment. The same authors have also presented evidence regarding the effects of Chinese import competition on voting patterns (Pierce and Schott, 2016a) and mortality (Pierce and Schott, 2016c).[6] Similarly, Handley and Limão (2017) structurally estimate the impact of reduced trade policy uncertainty on U.S. consumer prices. Additional research has analyzed the effect of Chinese import competition on manufacturing employment in Norway, Spain, Germany and Brazil (Balsvik et al., 2015; Costa et al., 2016; Dauth et al., 2014, 2017; Donoso et al., 2015). Our paper contributes to this literature by documenting the extent to which the increase in Chinese manufacturing exports had a significant impact on local labor markets and structural transformation in China.

Second, a number of studies have sought to identify the impact of trade liberalization on the Chinese manufacturing sector, focusing on industries or firms as the unit of analysis, and primarily analyzing variation in tariff levels. Brandt et al. (2015) demonstrate that the reduced Chinese import tariffs following WTO accession led to significant gains in manufacturing productivity, and Brandt and Morrow (2014) and Manova and Zhang (2012) show that reduced tariffs have also resulted in increased access to imported inputs. Bai et al. (2017) and Khandelwal et al. (2013a) analyze the impact of the removal of export restrictions and MFA quotas on export growth and manufacturing productivity at the firm level, respectively. Recent work has also found that the diminished trade policy uncertainty following China's WTO accession has boosted patent applications (Liu and Ma, 2016) and stimulated entry into export-oriented production (Feng et al., 2016).[7]

Although our findings complement these studies, our paper differs significantly in its focus on structural transformation and county-level growth, as well as the channels through which the reduction of trade policy uncertainty following WTO accession may affect these outcomes. In particular, utilizing county-level data rather than firm-level data allows us to identify the effects of export expansion across multiple sectors (primary, secondary and tertiary) and to trace patterns of factor substitution across sectors. It also enables us to identify the effects of China's WTO accession on the extensive, growth margin, in addition to the intensive margin.

Third, our work joins a growing literature analyzing processes of structural transformation,

[6] In a different subliterature, a related identification strategy is employed by McCaig (2011b), though the latter analyzes the effects of actual tariff cuts (from non-NTR to NTR levels) in Vietnam, rather than tariff uncertainty.

[7] A smaller literature has analyzed structural transformation in China in a broader context. Brandt et al. (2013) analyze shifts in factor market distortions in the non-agricultural economy. Marden (2015) provides evidence that agricultural growth in the early reform period is associated with significantly faster growth in non-agricultural output. Leight (2016) analyzes the effect of Bartik-style labor demand shocks on local industrialization in China.

in this case stimulated by export expansion. Foster and Rosenzweig (2004) estimate the impact of shocks to the returns to agriculture in India induced by Green Revolution technology, and find that industrial growth is fastest in areas where agricultural growth is lagging. Hornbeck and Keskin (2015) find no evidence that positive agricultural growth generated by the construction of an aquifer in the U.S. stimulates non-agricultural growth, while Bustos et al. (2015) present evidence that technological innovations in the soybean sector in Brazil generate industrial growth only when they are labor-saving. Also relevant is recent empirical work documenting that productivity is much lower in the agricultural sectors of developing economies compared to the non-agricultural sectors of the same economies (Gollin et al., 2014; Lagakos and Waugh, 2013). This suggests there may be substantial gains to aggregate productivity if factors substitute from agricultural to non-agricultural production (McMillan et al., 2014).

Finally, our study relates to the extended literature on the causal effects of trade liberalization on a range of economic outcomes in developing countries, including poverty and consumption inequality (Hasan et al., 2006, 2012; Topalova, 2010, 2007), regional labor market outcomes (Chiquiar, 2008; Dix-Carneiro and Kovak, 2015; Kovak, 2013; McCaig et al., 2017), investment in human capital (Edmonds et al., 2010), and fertility and child health outcomes (Anukriti and Kumler, 2014). This literature generally analyzes domestic tariff cuts; the existing papers evaluating the effects of expanded access to developed country export markets primarily focus on Vietnam. Exploiting shocks generated by a bilateral trade agreement, McCaig (2011a) finds that the U.S. tariff cuts reduced poverty in Vietnam, and McCaig and Pavcnik (2014b) and McCaig and Pavcnik (2014a) analyze reallocation of labor between household businesses and the formal sector. Another recent paper analyzes trade shocks linked to China's WTO accession on internal migration, but it utilizes only prefecture-level data (Facchini et al., 2016). Our study contributes to this literature by presenting evidence on the employment, GDP and value added effects of the elimination of trade policy uncertainty in a developing country context.

The remainder of the paper proceeds as follows. Section 2 provides more background on China's accession to the WTO and a simple conceptual framework. Section 3 describes the data. Section 4 presents the identification strategy and the empirical results. Section 5 presents robustness checks, and Section 6 concludes.

2 Background and conceptual framework

2.1 China's WTO accession

China's accession to the WTO in 2001 was the outcome of a lengthy and extensive negotiation process initiated in 1986. As a member, China both received new trade access benefits and committed to additional, liberalizing domestic reforms. However, both the benefits and the reforms inherent in WTO accession were largely phased in gradually and did not result in any discontinuous jumps in 2001. It is useful to highlight the most important policy changes implemented by China as part of this process, including reduced import tariffs, the relaxation of export licensing rules, and fewer barriers to foreign investment.

First, Chinese import tariffs had already been sharply cut prior to 2001 (from a weighted average of over 45% in 1992 to approximately 13% in 2000). WTO accession entailed further cuts (to approximately 7%), but these shifts were relatively small compared to the pre-accession reforms (Bhattasali et al., 2004). Figure 1a shows the evolution of the average weighted domestic tariff rate over time, calculated using industry-level tariffs and the share of each industry in total Chinese imports as reported in 1996 (the first sample year). Agricultural tariffs remained relatively high (22%) as of 2001 and required further cuts to 17.5% by 2004, with deeper cuts for agricultural products prioritized by the U.S. (e.g., corn). In addition, sanitary and other non-tariff barriers to U.S. exports of citrus, meat and grains were eliminated when China accepted U.S. inspection standards, and American companies were also allowed to freely trade agricultural products within China (Cheong and Yee, 2003).

Second, restrictions on direct exporting were substantial prior to WTO accession, though variable by industry, while firms that were not granted licenses to export directly were required to export via partners. In 2000, slightly more than half of the large firms observed in annual surveys of large industrial enterprises were not permitted to export directly, but all firms were allowed to export freely by 2004 (Bai et al., 2017). Third, prior to WTO accession, China had generally implemented relatively attractive policies to draw in foreign investment. However, foreign firms were subject to performance requirements, including criteria related to local content, technology transfers, and investments in research and development. These requirements were eliminated following China's accession to the WTO, facilitating a more rapid inflow of foreign investment (Long, 2005).

What about changes in the tariffs imposed by trading partners? Figure 1b shows fluctuations in tariffs over time for China's most important trading partners: the NTR tariffs imposed by the

U.S. and the average tariff rates imposed on Chinese exports by the European Union, Japan, Korea, and Taiwan. On average during this period, the U.S. is the destination for approximately 20% of Chinese exports, followed by the European Union at 17%, Japan at 12%, Korea at 5% and Taiwan at 2%. We again construct these rates as weighted averages of industry-level tariffs, utilizing the shares of total exports constituted by each industry's output in 1996 as weights. The estimated tariffs imposed by Korea are highest (averaging between 8% and 10%), but show no significant trend. Tariffs imposed by the U.S. and Taiwan decline gradually, and the tariffs imposed by Japan and the EU are roughly constant. In all cases, there is no evidence of any dramatic shifts in tariff rates at the point of China's WTO accession.[8] Despite their gradual nature, however, all of the preceding shifts in trade policy are relevant in understanding the evolution of local economies during this period, and we will control for these shifts in our empirical specifications.

Importantly, there was a discontinuous jump in one important dimension of China's market access in 2001: the tariff uncertainty faced in the U.S. market. Prior to WTO accession, the United States granted China NTR tariff rates on a discretionary basis subject to annual congressional renewal. Failure of that renewal would have triggered the imposition of much higher tariffs, originally set by the Smoot-Hawley Act, and designated for non-market economies. Hence, although the tariff applied to Chinese imports remained low because China's NTR status was never withdrawn, the required annual approval generated considerable uncertainty. Using media and government reports, Pierce and Schott (2016b) document that firms perceived the annual renewal of MFN status as far from guaranteed, particularly in periods of political tension in the early 1990s.[9] The CEOs of 340 firms stated in a letter to President Clinton that the "persistent threat of MFN withdrawal does little more than create an unstable and excessively risky environment for U.S. companies considering trade and investment in China, and leaves

[8] In Figure A1 in the Appendix, we provide an alternate representation of the evolution of both domestic tariffs and trading partner tariffs over time, utilizing county-level employment weights provided by the 1990 census to calculate a county-level weighted average tariff and then reporting the mean weighted county-level tariff by year over time. (These average county-level tariffs will subsequently be employed as control variables in the regressions of interest.) The graphs are largely similar, except that the tariffs imposed by Korea on Chinese imports appear much higher, reflecting Korea's extremely high tariffs on agricultural exports from China.

[9] Anecdotal evidence from the Chinese media has emphasized that China's WTO accession "will help build confidence among investors at home and abroad, especially among United States investors, because China currently faces the issue of maintaining its Most Favored Nation trading status every year" (Shanghai Securities News, 1999). Chinese companies have also expressed that "[they] can enjoy multilateral Permanent Most Favored Nation status among the Member States of the WTO, so as to actively explore and enter the international market and participate in international economic competition" (Jiangxi Paper Industry Co. Ltd., 2000). Chinese newsletters described the U.S.'s decision to sever the ties between China's MFN status and human rights record as having "removed a major issue of uncertainty"; in addition, the renewal of China's MFN status would encourage investment and re-exports by "removing the threat of potential losses that would have arisen as a result of revocation" (South China Morning Post, 1994).

China's booming economy to our competitors" (Rowley, 1993).

In October 2000, Congress passed a bill that granted permanent NTR status to China, effective as of January 1, 2002. The EU had granted China permanent NTR status much earlier (effective in 1980); thus, China did not face any tariff uncertainty in this market either before or after its WTO accession (Pierce and Schott, 2016b). The permanency of China's NTR status in other markets is ambiguous, but the descriptive evidence generally suggests there were no dramatic changes in the status of China's exports to other markets during this period, and analysts have noted that WTO members other than the U.S. had already provided China with permanent MFN status prior to its accession to the WTO (Rumbaugh and Blancher, 2004).

In Figure 2, we provide some preliminary graphical evidence consistent with the hypothesis that WTO accession represented a major turning point in the Chinese economy. We can observe that employment in the primary (agricultural) sector declined rapidly between 1990 and 2015, while secondary and tertiary employment increased (Panel A). At the same time, the composition of output also shifted dramatically toward the secondary and tertiary sectors (Panel B). Both panels show some evidence of a trend break around 2001, marking China's accession to the WTO. Figure 3 similarly highlights the dramatic expansion of China's exports to the U.S. and the concomitant rise in its import penetration ratio in the U.S. market post–2001.[10]

Again, a number of policy shifts during this period shaped economic outcomes. However, we will preferentially focus on reduced trade uncertainty given that the previous literature has highlighted this shift had a major impact on the U.S. market, and given the discontinuous nature of the reduction in uncertainty. We will also present evidence that while the other reforms implemented during this period had a meaningful impact on local economic outcomes in China, the effect of reduced tariff uncertainty generally proves to be largest in magnitude. Our analysis allows us to separately identify the impact of tariff uncertainty vis-a-vis levels by exploiting the fact that tariff uncertainty varies only comparing the pre and post period, and is proxied by the difference between low tariff rates and the counterfactual high rates specified by the U.S. tariff schedule. By contrast, realized tariff levels imposed by both the U.S. and other trading partners vary continuously over time. Further details are provided in section 3.2.

[10]China's import penetration in the U.S. market is defined as U.S. imports from China divided by the total U.S. expenditure on goods, measured as the gross U.S. output plus U.S. imports minus U.S. exports. The last three series are drawn from the World Development Indicators. While Chinese imports from the U.S. also increased in this period, the rate of increase is much smaller compared with the growth in China's exports.

2.2 Conceptual framework

The reduction of tariff uncertainty can affect county-level economic outcomes through several channels. First, a reduction in tariff uncertainty creates incentives for Chinese firms to increase their exports to the U.S. market. A large literature has established that price uncertainty (in this case generated by tariff uncertainty in the destination market) generates an option value of waiting, decreasing investment (Bernanke, 1983; Dixit, 1989; Bloom et al., 2007). When tariff uncertainty is reduced, firms facing positive demand in the destination market, primarily manufacturing firms, have a greater incentive to make irreversible investments required to enter foreign markets (Handley and Limao, 2015; Handley and Limão, 2017). Given that industries differ in their exposure to tariff uncertainty, firms in industries with greater exposure ex ante will face a greater decline in the option value of waiting post-WTO accession. Exports from these industries, and counties with a greater concentration in these exposed industries, will differentially increase.

Second, a reduction in tariff uncertainty induces U.S. firms to increase foreign direct investment (FDI) into China, as again the option value of delaying investment declines. In addition, export-oriented industries in China are generally characterized by high FDI, as foreign investors producing for export have benefited from a variety of preferential policies, including the exemption of imported components from import duties (Zhang and Song, 2000) and the establishment of preferential zones that offer reduced taxes on profits and other benefits (Cheng and Kwan, 2000). Accordingly, a growing export sector can be expected to attract increased FDI, and these effects would be particularly large in industries and counties more exposed to tariff uncertainty ex ante and those industries facing non-trivial foreign demand, primarily in manufacturing.

Third, another channel through which a reduction in tariff uncertainty may affect county-level economic outcomes is the reallocation of productive factors across sectors. Increased demand for exports and increased FDI in the secondary sector will increase the returns to capital and labor, leading factors to flow into this sector (Acemoglu et al., 2016). We denote this the local reallocation effect. On the other hand, an increase in exports and FDI at the county level generates a positive local income effect and an increase in local demand, benefiting producers of non-tradables, as well as any producers of tradables that sell partly to the local market. We describe this as the local demand effect. If there is some input in the tradable sector that is not mobile across sectors, the local demand effect will dominate the reallocation effect for the non-tradable (tertiary) sector, leading to its expansion (Kovak, 2013).[11] In addition, if

[11]The existing literature analyzing the response of U.S. local labor markets to Chinese trade shocks also find

preferences are non-homothetic, a positive local income effect will shift consumption away from agricultural and agricultural-derived goods, reinforcing the reallocation of productive factors toward the secondary sector (Gollin et al., 2014).

By examining economic outcomes at the level of counties, or local labor markets, we are able to capture both the direct effect of reduced uncertainty on the expansion of sectors that benefit from increased exports and increased FDI, as well as the indirect effects generated by the reallocation of productive factors and the expansion of local demand. Moreover, the reduction in tariff uncertainty may have disproportionate effects on counties with certain baseline characteristics. Since capital investments are generally irreversible, counties with an initially higher concentration of capital-intensive industries are likely to respond more robustly to the reduction in tariff uncertainty. Similarly, the effect of reduced tariff uncertainty is likely to be larger for counties that specialize in industries exporting a higher proportion of their output to the U.S. ex ante. Finally, counties that include special export zones, and thus host a particularly high concentration of export-oriented firms, may show a particularly large response to the reduction in tariff uncertainty. We will also test these hypotheses in the empirical analysis.

3 Data

The empirical analysis incorporates three sources of data: county-level economic outcomes, the county-level NTR gap, and other policy shifts. We will discuss each data source in turn.

3.1 County-level data

The main outcomes of interest are economic indicators at the county level reported by provincial economic yearbooks. Each year, every province in China publishes a statistical yearbook, primarily reporting economic indicators for the full province or for larger aggregate units such as prefectures. However, most provincial yearbooks also include some economic indicators reported at the county level. These data were compiled and digitized for every year available between 1996 and 2014. (Each yearbook reports data from the previous year; thus, 2013 is the final year observed in the data.) To the best of our knowledge, this study is the first to construct a comprehensive county-level panel of economic outcomes for this time period.

Only one limitation is imposed on the sample. We exclude provincial-level autonomous regions: Tibet, Xinjiang, Ningxia, Inner Mongolia, and Guangxi, as well as the island of Hainan,

that the local demand effect dominates local reallocation effects (Autor et al., 2013; Acemoglu et al., 2016).

for which data is generally unavailable. Otherwise, all counties that can be matched between the 1990 county census and the provincial yearbooks are included. Aggregated to the county level, the 1990 census reports data on 2104 units that are (approximately) at the county level in the provinces of interest; of these units, 86%, or 1805 counties, can be matched to the yearbooks.[12]

The county-level panel includes information on exports; GDP, value added and employment by sector; and detailed information about investment in agriculture. GDP, value added and employment are reported for the primary, secondary, and tertiary sectors. Again, the primary sector includes agriculture, fishing, and forestry; the secondary sector includes manufacturing and mining; and the tertiary sector includes services. Exports, GDP and value added are reported in millions of yuan, and per capita GDP is reported in yuan. The nominal figures for GDP and value added reported in the provincial yearbooks are deflated using World Bank deflators. Additional variables capturing investment in agriculture include cultivated area (reported in thousands of hectares), agricultural machinery used (reported in 10,000 kilowatts), and grain and partial cash crop output (reported in thousands of tons).[13]

Summary statistics are reported in Table 1. The average population in the sampled counties and years is approximately 500,000. More than half of reported employment is in the primary sector, followed by the tertiary and secondary sectors. Per capita income is approximately 10,000 yuan or $1300. The largest share of GDP is constituted by the secondary sector, followed by the tertiary and primary sectors.

Missing data Data is missing from the county-level panel for two reasons: counties cannot be matched between the census and the provincial yearbooks, and counties are matched to the yearbooks but specific indicators are not available. Here, we will briefly discuss each case; a detailed discussion can be found in Section A1.1 in the Appendix.

First, some counties that are observed in the census do not appear in provincial yearbooks. These are disproportionately counties that are part of larger, prefecture-level cities, as some provinces omit data for these areas. Accordingly, any bias due to missing counties will orient the sample toward rural areas that are not already fully industrialized. The differences between

[12]The 1990 census has one unusual characteristic that differentiates it from subsequent census rounds (2000 and 2010) and from the provincial yearbooks: data for prefecture-level cities are reported only at the prefecture level, not for the constituent county-level units. In some cases, provincial yearbooks report data for these county-level units of prefecture cities. Accordingly, a single census observation can in these cases be linked to multiple county-level observations in subsequent waves of yearbook data.

[13]The production of cash crops is calculated as the sum of the production of meat and edible oils, the most commonly reported cash crops. This is clearly an incomplete measure of cash crop production, but allows us to generate some evidence about evolution of non-staple cultivation.

counties observed and not observed in provincial yearbook data are summarized in Table A1 in the Appendix, in which we estimate a series of specifications regressing county covariates as observed in the 1990 census on a dummy for missing, conditional on province fixed effects. The results suggest that counties missing from the sample are characterized by larger populations, higher levels of education, and a greater concentration of labor outside of agriculture.

Second, for those counties that are observed in provincial yearbooks, different provinces in different years opt to report different indicators at the county level in their yearbooks. As a result, the number of observations varies significantly for different variables, as evident from the summary statistics. The indicators that are reported most infrequently include employment at the sector level and exports, while indicators reported near-universally include gross domestic product, total employment, population, primary and secondary value added, and measures of agricultural inputs and production.[14] (For each variable presented in Table 1, we also note the number of counties reporting any data for that variable. This figure ranges between 1400 and 1700, excepting exports and employment at the sectoral level.)

We also present further evidence in Table A2 in the Appendix that the number of observations for the key variables of interest is in general lower for more populous counties, and higher for those that are more agricultural and have a lower proportion of employment outside the primary sector. This is again consistent with more urban and industrialized counties being generally underrepresented in the sample. We will subsequently demonstrate that the primary results are all robust to controlling for patterns of selection into the sample. In addition, we will present evidence around the evolution of exports and secondary employment — key outcomes of interest that are infrequently reported in the county-level data — drawing on an additional survey of large-scale manufacturing firms.

3.2 County-level NTR gap measure

Our empirical analysis seeks to identify the effect of the substantial reduction in tariff uncertainty in the U.S. market that China experienced following its accession to the WTO. To estimate the impact of China's permanent NTR status, we define the NTR gap at the industry level for each of the 39 subsectors of tradable production represented in the census data.

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

[14] In particular, a strong positive correlation exists between the probability of reporting any data on export sales value and county-level GDP, and five relatively poor provinces (Shanxi, Sichuan, Guizhou, Shaanxi, Gansu, and Qinghai) report almost no data on exports

The $Non\,NTR\,Rate_i$ is the higher tariff rate that would have applied if the U.S. Congress had revoked China's annual NTR status for industry i, and the $NTR\,Rate_i$ is the lower tariff rate guaranteed by permanent NTR status.

The industry-level NTR gap data were constructed by Pierce and Schott (2016b) using ad valorem equivalent NTR and non-NTR rates. The NTR gap for industry i is the average NTR gap across the four-digit ISIC Revision 3 tariff lines belonging to that industry. Throughout the empirical analysis, we use the NTR gaps for 1999, two years before the U.S. granted China permanent NTR status.[15] We manually match the industry categories in ISIC Revision 3 to the industry categories reported in the Chinese employment data, and Table A1 in the Appendix provides the details associated with this matching.

We then construct a county-level NTR gap measure equal to the weighted average of industry gaps, where the baseline composition of employment by industry prior to WTO accession is used to construct the weights. More specifically, we utilize the employment data reported in the 1990 census to calculate the share of tradable employment by industry in each county, interacting the NTR gap faced by industry i with each industry's county-specific employment share.

$$NTR\,Gap_c = \sum_i empshare_{ic}^{1990} \times NTR\,Gap_i \tag{2}$$

Given that each county's sectoral composition prior to WTO accession is used to construct the employment shares, the NTR gap does not reflect endogenous changes in employment composition that are driven by reduced trade policy uncertainty. Counties characterized by a larger NTR gap experience a greater reduction in trade policy uncertainty post–2001, and thus ceteris paribus should show greater expansion in export-oriented industries. Permanent NTR rates were effective for China as of January 1, 2002, and thus our analysis characterizes all years from 2002 onward as the post-reform period.

In addition, we preferentially employ the employment shares observed in the 1990 census rather than the 2000 census to minimize potential endogeneity in employment composition. We hypothesize that by 2000, counties with more informed leaders or enterprises with more foresight may have already shifted toward subsectors that were less exposed to trade policy uncertainty. This would generate some correlation between county-level unobserved characteristics and the size of the county NTR gap. We will subsequently demonstrate that the results are robust to the use of 2000 employment weights, and are also consistent when the employment shares are

[15] We follow Pierce and Schott (2016b) in utilizing the 1999 NTR gaps. These NTR gaps are almost identical to those in 2000 or 2001; accordingly, the results are robust to the use of data from other years.

recalculated with respect to total employment (including non-tradable employment).[16]

Table A5 in the Appendix summarizes the NTR gap observed for each industry. The highest NTR gaps are observed for textiles, garments, other manufacturing, medical and pharmaceutical products, and furniture manufacturing; the lowest NTR gaps are observed for mining products and agricultural output. At the county level, the average NTR gap is .123 with a standard deviation of .043. Approximately 5% of counties face NTR gaps of more than 20%.

Figure 4 shows a histogram of the NTR gap at the county level. While there is some evidence of outliers, we will demonstrate that the primary results estimated in Section 4.1 are robust to winsorizing the NTR gap. Figure A2 in the Appendix shows a map of cross-country variation in the NTR gap, utilizing the residuals after the NTR gap is regressed on province fixed effects. Overall, there is substantial variation in exposure to reduction in tariff uncertainty across Chinese counties.

3.3 Other policy changes

In the main empirical analysis, we also consider a number of other policy changes in China and the U.S. to isolate the impact of China's accession to the WTO. In particular, we examine whether other policy shocks could be the cause of the structural change that China has experienced over the past decade. Other policy shocks may constitute plausible alternative explanations if their timing coincides with China's WTO accession and if these shocks would disproportionately affect counties that are more exposed to reduced tariff uncertainty post–2001. As previously noted, major domestic reforms in this period included lower import tariffs, the elimination of import licensing requirements, and reduced restrictions on FDI.

In our regressions, we use data on China's import tariffs from the WITS–TRAINS database, data on export licensing requirements from Bai et al. (2017), and data on the nature of contracting from Nunn (2007) to control for these policy changes. The data on the nature of contracting provide a measure of the proportion of intermediate inputs employed by a firm that require relationship-specific investments by the supplier; counties with high concentrations of industries characterized by different contracting methods may be differentially affected by reductions in barriers to foreign investment. For each of these variables, we construct a county-

[16]Data on GDP, revenue, and export value per subsector are not available in any year; accordingly, weights can only be constructed using employment data. Constructing measures of exposure to trade shocks using employment weights is common in the literature, and has been theoretically derived by Kovak (2013) as the correct measure of trade exposure. Employment weights are also employed by Topalova (2007, 2010), McCaig (2011a), Kovak (2013), and Autor et al. (2013) in analyzing the effects of trade exposure on poverty and local labor market outcomes in regional labor markets in India, Vietnam, Brazil, and the United States, respectively.

level weighted average from the industry-level source data using employment weights from the 1990 census.[17]

We also control for policy changes in the U.S., including the time-varying NTR rate itself, for which we construct an industry-weighted county average. An additional important policy shift during this period was the elimination of textile and clothing import quotas in 2002 and 2005 as part of the global MFA. We employ data on MFA quotas from Khandelwal et al. (2013b), and follow their methodology to construct a measure of the degree to which industries' quotas were binding under the MFA by calculating the import-weighted average fill rate. The fill rates represent the ratio of actual imports to allowable imports under the quota; thus, a higher value indicates greater exposure to MFA quota reductions. Using these industry-level data, we construct a county-level MFA variable, where greater values represent greater exposure to quota reductions and thus greater benefits from the policy shift.

4 Empirical results

In this section, we first analyze the baseline specification focusing on pre-post differences. Next, we present evidence that counties with high and low NTR gaps are characterized by parallel trends prior to 2001, but diverging economic trajectories post-accession. We also demonstrate that the results are robust to a number of additional specifications, and draw on additional data from a survey of large-scale firms.

4.1 Baseline specification

First, we use a difference-in-difference specification to analyze the effect of reduced trade policy uncertainty on county-level economic outcomes. More specifically, we examine whether the trajectory of economic outcomes in counties characterized by relatively large gaps between NTR tariff rates and non-NTR rates is different following China's accession to the WTO in 2001. The sample includes annual county-level data from 1996 to 2013; all the dependent variables have the top and bottom 2% of observations trimmed from each year to eliminate outliers.[18]

[17] Since the industry categories for the export licensing and contract intensity variables are available for SIC categories, these categories are manually matched to the census employment categories. The industry classification for the import tariff data is available in ISIC Revision 3, the same source utilized to construct the NTR gap variable. Table A1 in the Appendix provides the details associated with the matching.

[18] This trimming process is implemented separately for urban and non-urban county units. The results are also consistent if only the top and bottom 1% are trimmed or if no observations are trimmed; the results for these specifications are reported in Table A9 in the Appendix. We also report in Panel C of this table results using the original sample but winsorizing the NTR gap at the 1st and 99th percentile; these results are likewise consistent.

We employ ordinary least squares (OLS) to estimate the following specification:

$$Y_{cfpt} = \beta_1 Post_t \times NTR\,Gap_{cfp} + \boldsymbol{X}'_{cfpt}\theta + \gamma_{pt} + \nu_f t + Urb_{cfp} \times (\gamma_{pt} + \nu_f t) + \delta_c + \epsilon_{cfpt} \quad (3)$$

The dependent variable is observed in county c in prefecture f in province p in year t. The independent variable is the interaction of the county-level NTR gap, standardized to have a mean of zero and a standard deviation of one, with a post–WTO dummy, equal to one for 2002 and subsequent years.[19]

The specification also includes a number of additional controls denoted $\boldsymbol{X}'_{cfpt}$. This includes the interaction of the post dummy and a time-invariant dummy capturing whether the county is characterized by industries with high contract intensity.[20] We also control for time-varying shocks: the industry-weighted MFA quota fill rate for county-produced goods, the industry-weighted domestic import tariff rate, the industry-weighted percentage of local firms licensed to export, and the industry-weighted NTR tariff rates. (All variables capturing other changes in trade policy during this period are also included in the specifications estimated in Pierce and Schott (2016b); we will demonstrate that the results are consistent when estimated without these additional controls.[21]) The specification also includes province-year fixed effects, prefecture-specific trends, and county fixed effects. The time-varying fixed effects are interacted with an urban dummy to allow for differential trends in urban areas, and standard errors are clustered at the county level.[22]

The results of estimating equation (3) are reported in Table 2; for concision, only the coefficient β_1 is reported. (The full set of coefficients is reported in Tables A6 through A8 in the Appendix, and will be discussed subsequently.) To analyze the magnitude of the effects, we will consider the effect of a county moving from the 25$^{\text{th}}$ to the 75$^{\text{th}}$ percentile of exposure to tariff uncertainty, an increase of .48 standard deviations in the standardized NTR gap. In Panel

[19] The county-level NTR gap is omitted, given the inclusion of county fixed effects; similarly, the post dummy is collinear with province-year fixed effects.

[20] Specifically, this dummy is equal to one if the weighted average of industry contract intensity is above the mean.

[21] There are some differences between our specification and that employed in Pierce and Schott (2016b). They include the contract intensity variable in linear form and use the import tariff and export licensing variables to construct differences over time that interact with the post–WTO dummy. They also include other control variables for baseline capital and skill intensity and the use of high-technology products that are unavailable in our data. We also interact the domestic tariff rate with the post dummy, given that most of the tariff reductions observed in China were implemented prior to its WTO accession.

[22] This dummy variable is equal to one if the county name includes the "shi" (i.e., city) suffix in 1990. Approximately 19% of the counties are designated as urban.

A, we observe that this increase would lead to an increase in exports of approximately 16% in the post–2001 period.[23] There is also evidence of a relative increase in secondary GDP of 35%, a relative increase in tertiary (non-tradable) output of 19%, a relative increase in total GDP of 15%, and a relative increase in per capita GDP of 5%. No significant effects are observed for primary output.[24]

Panel B reports the employment results; again, employment data are available for a relatively small sample, and the results are thus more noisily estimated. When comparing counties in the 25^{th} and 75^{th} percentiles of the NTR gap, we observe an increase in secondary employment of approximately 6%, and weak evidence of a decline in primary employment. Agricultural employment, a closely related measure reported for a larger sample, shows a significant decline of a magnitude symmetric to the increase in secondary employment. There is no shift in tertiary or total employment, but we observe a relative increase in population of approximately 3% in counties that were ex ante more exposed to tariff uncertainty, suggestive of in-migration to counties where export-driven manufacturing is growing. The population increase is also consistent with the previous evidence that the increase in GDP per capita is small relative to the increase in total GDP.

Finally, Panel C reports the results for agricultural investment and value added. We observe declines in the utilization of agricultural machinery, grain production, and value added in the primary sector of between 1% and 4%. (There is no effect observed for cash production, though this evidence should be interpreted cautiously given that cash crops include only meat and edible oils.) Secondary value added increases by 11%.[25] Given the small sample of sectoral employment, it is not possible to estimate results for value added per worker as a proxy for productivity; however, we will subsequently present results for value added per worker in the secondary sector using data from the large-scale firm survey.

Taken together, these results suggest a clear pattern. Counties with high concentrations of industries exposed to large gaps between NTR and non-NTR tariffs show evidence of significantly more expansion in the secondary sector following China's WTO accession—a pattern evident in increased employment, higher GDP, and higher value added—and this growth generates an increase in local GDP and GDP per capita. There is also some evidence of greater

[23] The magnitudes reported in this discussion are all calculated multiplying the observed coefficients by .48 and dividing by the reported mean at the bottom of the relevant panel.

[24] Unfortunately, the county-level data do not report any information on imports. Data on imports are provided at the provincial level; analyzing the effect of the post-NTR gap interaction in a parallel specification estimated with data at the province-year level reveals only weak evidence of an increase in imports.

[25] All of these estimates are consistent if province-year fixed effects are replaced with year fixed effects.

contraction in the agricultural sector as productive factors substitute into secondary production.

The coefficients for the full set of control variables are reported in Tables A6 through A8 in the Appendix. First, the coefficient for the interaction between the post dummy and the high contract intensity dummies is generally negative for measures of secondary investment and output. This finding suggests that industries characterized by more relationship-specific contracting for inputs benefit less from WTO accession, presumably because these industries had experienced more foreign investment ex ante (a comparative static that can be substantiated in this data). Second, there is more rapid growth in counties that benefit more from MFA quota reductions, and slower growth in counties more exposed to a decline in domestic tariff rates and an increase in competition from imports. However, the effects of import tariff reduction are observed primarily prior to 2001, consistent with the evidence previously presented around the timing of the tariff cuts. The coefficients on export licensing and the time-varying NTR rate vary in significance. These patterns are consistent with the hypothesis that, while other trade reforms in this period were relevant for the evolution of county-level outcomes, no other policy shift had a positive effect on county-level expansion of exports and secondary production as large as that produced by reduced uncertainty in the U.S. market.[26]

In Table 3, we re-estimate the NTR gap using a number of alternate strategies to evaluate the robustness of these results; for brevity, we focus only on exports and GDP. (In each case, the control variables calculated as county-level weighted averages are also re-estimated.) In Panel A, we construct the NTR gap utilizing the employment data reported in the 2000 census to construct employment weights rather than utilizing the 1990 weights. The results are generally comparable, although the estimated coefficients for exports, GDP and per capita GDP are larger. The use of 2000 employment weights introduces two potential sources of bias: areas already industrialized by 2000 will generally have larger NTR gaps, while industrialized areas that are more strategic in investing in industries characterized by less tariff uncertainty may have lower NTR gaps. The former phenomenon will lead to upward bias in the estimates of the NTR gap if already-industrialized counties continue to expand more rapidly, and this upward

[26]Two seeming anomalies can be observed in the signs of the control variables. First, the proportion of firms licensed to export is negatively correlated with GDP; second, the NTR tariff rate is positively correlated with GDP. In the cross-section, we observe the expected positive correlation between the proportion of firms exporting and county-level GDP prior to 2004 (when export licensing requirements were eliminated). However, when county fixed effects are included, counties that show larger increases over time in export licensing are, mechanically, those with initially lower levels of export licensing, given that the maximum value for this variable is one. These counties with low initial export license levels are also characterized by slower GDP growth. In addition, counties with a larger NTR gap are, on average, characterized by a higher NTR tariff rate (and an even higher non-NTR rate), producing the observed positive correlation between the NTR tariff rate and economic outcomes.

bias does seem to be evident in these specifications.[27]

In Panel C, we construct the NTR gap by weighting each subsector with respect to total employment, assigning a zero weight to the tertiary (non-tradable) sectors. In our main specification, we estimate the NTR gap without considering the relative size of the services sector, weighting employment with respect to total employment in tradable sectors; this methodology is recommended by Kovak (2013), though earlier papers in the trade liberalization literature assign the non-tradable sector a weight of zero.[28] Using this alternate strategy to re-calculate the NTR gaps and re-estimate equation (3) yields consistent results.

As previously noted, in general the gap between NTR tariffs and non-NTR tariffs is relatively low for agricultural products compared with that for industrial products; this raises the potential challenge that the observed growth in high NTR gap counties post–2001 may primarily reflect more rapid growth for already more heavily industrialized counties. Another related source of bias may stem from the fact some of the highest NTR gaps are observed for textiles and garment manufacturing, sectors that also benefited considerably from the relaxation of the MFA quotas. While the main specification includes controls for county-level variation in quotas, bias could be introduced by any shocks to textile production that are not captured by this variable.

We will address both points by implementing a similar strategy: including additional control variables for employment shares in different sectors interacted with year fixed effects. First, we calculate the share of employment in the secondary and tertiary sector as observed in the 1990 census, construct separate quartile dummy variables for each employment share, and include interactions between the quartile dummy variables and year fixed effects in the primary specification. Second, we use the employment shares in the five sectors characterized by the largest NTR gaps (textiles, garments, other manufacturing, medical and pharmaceutical products, and furniture manufacturing), again construct five sets of quartile dummy variables, and interact these variables with year fixed effects. (We use quartile dummy variables rather than the continuous variables to flexibly allow for non-linear effects of variation in employment shares; the results are also consistent if we simply employ the linear variable.) The results are reported in Panels C and D of Table 3, and are consistent and in fact somewhat larger in magnitude.

An alternate strategy would entail re-estimating the NTR gap while omitting certain sectors. For example, we can estimate a secondary-only NTR gap, excluding all agricultural subsectors

[27]The number of observations increases slightly, as some county codes can be matched to the 2000 census but cannot be matched to the 1990 census. These results are also consistent if we employ the mean of sector weights as observed in the 1990 and 2000 censuses.

[28]This strategy has been widely used; see, for example, Autor et al. (2013), McCaig (2011a), Topalova (2007), and Topalova (2010).

from the calculation of the NTR gap and calculating only the weighted average for secondary subsectors. In addition, we can estimate a "no high gap" NTR variable, excluding the five sectors characterized by the largest NTR gaps. The primary coefficients are also consistent if the main specification is re-estimated employing these alternate variables; these results are reported in Table A10 in the Appendix.

There is also substantial expansion in China's agricultural imports from the U.S. during this period, particularly in cotton and soybeans.[29] We can utilize data from the 2000 World Census of Agriculture (FAO/IIASA) to analyze the cross-sectional correlation between the NTR gap and the proportion of area sown in soybeans and cotton. In general, this correlation is negative, suggesting that areas experiencing more export-driven growth are less subject to competition from imports. If we re-estimate the main specification including an interaction term between high cotton and soybean production (a dummy for the fraction of sown area devoted to cotton and soybeans being above the median) and the NTR gap, the interaction terms are small in magnitude and generally insignificant, as reported in Panel F of Table 3.[30] Accordingly, competition from imports is not a channel that seems to be of first-order importance in generating the observed substitution away from agriculture.

Variation in sample size Again, the number of observations fluctuates in the main specifications because many provincial yearbooks do not report specific indicators of interest (particularly employment at the sectoral level and exports). We report in each panel the number of unique counties observed in the sample for each variable; the number of counties ranges between 1000 and 1700, with the exception of the employment results, for which the sample includes fewer than 400 counties. We will subsequently estimate results derived from a survey of large firms that will enable us to corroborate the observed patterns for secondary employment and exports for the full set of counties observed in the primary analysis.

In addition, we present in Section A1.1 in the Appendix a number of additional specifications exploring whether the results are robust to selection into the sample, including imposing a sample restriction to only county-years that report export data. We observe consistent results across a number of different specifications controlling for selection into the sample, suggesting that missing data is not a significant source of bias.

[29] Figure A3 in the Appendix shows the evolution of China's agricultural imports over time.

[30] The specification also includes interactions between dummies for each quartile of the cotton and soybean fraction variable, measured at the prefecture level, and year fixed effects.

4.2 Evidence about timing

Given that we attribute the observed patterns to the reduction in tariff uncertainty following China's accession to the WTO in 2001, a more demanding test of the assumptions of the difference-in-difference specification can be conducted by evaluating the correlation between the variables of interest and the NTR gap prior to 2001. To implement this test, we estimate a more complex specification, in which we interact the NTR gap with a series of dummy variables for two-year intervals. (A single dummy variable captures the three-year pre-treatment interval for the period 1997–1999.) Dummy variables for the years prior to 1997 are omitted, rendering 1996 and the small sample of pre-1996 observations the reference period. The specification of interest can thus be written as follows, including the same control variables reported in the simpler specification.

$$Y_{cfpt} = \sum_{y=1997}^{2013} \beta_{y1} 1\{y = t, t+1\} \times NTR_{cfp} \tag{4}$$
$$+ \boldsymbol{X}'_{cfpt}\theta + \gamma_{pt} + \nu_f t + Urb_{cfp} \times (\gamma_{pt} + \nu_f t) + \delta_c + \epsilon_{cfpt}$$

The results of estimating equation (4) are reported in Table 4, employing four of the main variables (exports, secondary output, total and per capita GDP). We observe that the coefficients for the NTR gap prior to 2002 are uniformly insignificant and generally small in magnitude. (Given the limited data reported for exports prior to 1997, the dummy variable for 1997–1998 is omitted in this specification.) In particular, the absence of any significant effect in 2000–2001 is consistent with the evidence presented in Handley and Limão (2017) that China's new tariff status was not implemented until 2002.

However, following China's WTO accession, the magnitudes of the coefficients for the NTR gap variable are generally increasing over the subsequent decade; the coefficients are positive and significant from 2004 onward, with the exception only of the coefficient for exports for 2012-13. This evidence is consistent with the hypothesis that the NTR gap is uncorrelated with any variation in county outcomes prior to China's WTO accession, but highly predictive of the economic trajectories observed in the same counties post–2001.[31]

The coefficients are presented graphically in Figure 5. Again, we can observe that no significant relationship exists between the NTR gap and the outcomes of interest prior to 2001

[31] No data for secondary and tertiary GDP are available after 2011; thus, the coefficients for the dummy variable for 2012–2013 are missing in the specifications using these variables.

and that the difference-in-difference coefficients increase steadily after 2001. The pattern of an effect that is consistently positive after 2001, but growing slowly in magnitude, is also consistent with the parallel evidence presented by Pierce and Schott (2016b) in Figure 4, showing a gradual decline in manufacturing employment in the U.S. over the same period. We can also test whether the estimated coefficients β_1 are equal when compared across the pre-treatment period (the dummy variables for 1997–1998 and 1999–2001) and the post–2001 period. While the coefficients for 2002–2003 are noisily estimated, the estimated coefficients for the post–2003 period are significantly different from the estimated coefficients for the two pre-treatment dummy variables in all but two cases.[32] The remaining 31 pairwise tests yield p-values that are significant at the 5% level, and all but two are significant at the 1% level.

To sum up, these results are consistent with the hypothesis that the observed divergence in economic trajectories of counties subject to different gaps between NTR and non-NTR tariffs following China's WTO accession is primarily due to increased access to the U.S. market, leading to an increase in exports. These patterns first emerge in the early part of the post–2001 period, but they become steadily more pronounced over the subsequent decade.

4.3 Alternate specifications

We report a number of alternate specifications evaluating the robustness of these results in Table A11 in the Appendix. In Panel A, we estimate the baseline specification including only province-year and county fixed effects and prefecture-specific trends. In Panel B, we include the full set of controls and weight each county observation by its 1990 population.[33] In Panel C, a full set of interactions between year fixed effects and a dummy variable for each quartile of initial GDP are added.

In Panel D, we characterize counties based on the proportion of the population in 1990 reported to have post-primary education (on average, only a third), generate dummy variables for counties in each quartile of initial education, and include the interactions between these education quartile dummy variables and year fixed effects. In Panel E, we calculate a Herfindahl index capturing initial concentration in the tradable (primary and secondary) sectors and include interactions between dummy variables for each quartile of the Herfindahl index and year

[32] In fact, the estimated coefficients for 2002–2003 are significantly different from the pre-treatment coefficients for secondary GDP, although the corresponding tests for exports, GDP, and GDP per capita fail to reject equality. Of the coefficients estimated post–2003, the two cases in which the tests fail to reject compare the coefficients estimated for exports for 2012–2013 to 2001–2002 (p-value .222) and GDP per capita for 2004–2005 to 2000–2001 (p-value .13).

[33] A small number of observations are missing population data. The results are also consistent if each county observation is weighted with respect to the initial total employment or GDP.

fixed effects. The results are uniformly consistent.

An additional robustness check explores whether the reform of state-owned enterprises (SOEs) could be an alternate channel for the observed pattern. In addition to the market liberalization implemented in this period linked to WTO accession, a major restructuring of SOEs was implemented starting in the mid-1990s and accelerating in the latter part of the decade (Naughton, 2007). Unfortunately, no county-level data are available on SOE employment. However, we can construct a county-level proxy using data on SOE employment in broad sectors (agriculture, mining and manufacturing) in each province as a percentage of total sector employment in that province in 1996 (the first year in the sample). We then use the 1990 employment weights by sector to construct a county-level average.[34] Cross-county variation in the imputed baseline share of SOE employment is thus generated by variation across counties in the salience of agriculture, mining and manufacturing, and variation across provinces in the relative importance of SOE employment in these three sectors. We then construct dummy variables for counties in each quartile of the initial imputed SOE fraction, and interact these dummies with year fixed effects in the main specification. The results are reported in Panel F of the same table, and they are entirely consistent with the main specifications.

Finally, we re-estimate the results employing as the dependent variable the average night lights index within county borders as a proxy for the intensity of local economic activity. This addresses the potential challenge introduced by measurement error or selective misreporting in county yearbook data. We observe a high correlation between the night lights index and reported county-level GDP. When the primary specification is re-estimated using the night lights index as a dependent variable, the estimated relationship is significant and positive at the one percent level, and suggests that a county moving from the 25^{th} to the 75^{th} percentile of the NTR gap shows evidence of a 5% relative increase in night brightness post-2001.

4.4 Firm-level outcomes

The county-level data previously used do not include data on some key outcomes of interest: particularly, capital investment, foreign investment and wages. In addition, the data on sectoral employment and exports are very limited. As an additional source of evidence, we utilize the large-scale industrial survey collected from 1998 to 2008, a data source described in detail in

[34]These employment data are drawn from the national statistical yearbooks; data on SOE employment in the highly disaggregated subsectors reported in the census are unavailable until much later, in the post–WTO period. Unsurprisingly, SOE employment is close to zero in agriculture (averaging 2%) and near universal in mining (averaging 91%). The SOE share in manufacturing employment is variable, with a mean of 38% and a standard deviation of 13%.

Brandt et al. (2012). The data are collected in annual surveys conducted by the National Bureau of Statistics, and they include all state-owned industrial firms (in mining, manufacturing, and public utilities) and all non-state firms in the same sectors with sales above 5 million yuan. For this analysis, we restrict the sample to manufacturing firms.

A variety of firm-level outcomes are observed. Employment and the total wage bill are directly reported, enabling us to estimate the average wage per worker. The perpetual inventory method is used to estimate the capital stock, as the firm's founding year is also reported; the average growth rate observed at the province-sector level over the sample years is used to estimate average annual investment rates. We also use the estimate of the capital stock to calculate firm-level capital intensity (the ratio of the capital stock to total employment), and a define a dummy variable equal to one if the firm reports any foreign-owned capital. For export values, sales, value added and exports, we use the deflators constructed by Brandt et al. (2012) to construct constant-price estimates.

The firms can be geographically linked only to the prefecture, as county indicators are unavailable. Accordingly, we perform this analysis at the prefecture level; the dependent variables are calculated as the sum of the relevant firm-level variables within the prefecture and year, to capture the total size of the large-scale manufacturing sector. (For capital intensity, the wage, and value-added per worker, the mean is employed.) The NTR gap is calculated as the mean of the NTR gap across all constituent counties in the prefecture and is denoted Y_{fpt} for the NTR gap in prefecture f and province p. The same control variables are also included and are calculated as the prefecture-level mean, and prefecture and province-year fixed effects are included.[35]

$$Y_{fpt} = \beta_1 Post_t \times NTRGap_{fp} + \boldsymbol{X}'_{fpt}\theta + \gamma_{pt} + \nu_f + \epsilon_{cfpt} \tag{5}$$

The results are reported in Table 5; again, the coefficients and means reported correspond to prefecture-level aggregates of the firm data. The first two columns in Panel A show that an increase in tariff uncertainty from the 25$^{\text{th}}$ to the 75$^{\text{th}}$ percentile of the prefecture NTR gap is associated with a 11% increase in large-scale manufacturing employment in the prefecture post–2001. The real capital stock shows a 10% increase. The mean probability that a firm reports any foreign capital increases by 10%. Given that the expansions of capital and labor

[35]In the primary results, we do not construct a weighted mean; however, the results are also consistent if we construct means at the prefecture-year level that are weighted with respect to county population. These results are reported in Table A13 in the Appendix.

are of roughly equal magnitude, there is no significant shift in capital intensity, as reported in Column (4). Finally, in Columns (5) and (6), we observe that the total wage bill increases by 23%, corresponding to a 2% increase in the average wage per worker.

In Panel B, we report results for additional outcomes: total exports, sales, value added, value added per worker and profits of the sampled firms at the prefecture level. We observe that a prefecture moving from the 25^{th} to the 75^{th} percentile of the NTR gap will experience an increase in exports of 21% and increases in sales, value added and profits of between 25% and 51%. Value added per worker increases by 3%. These results are generally somewhat larger than those employing county-level data, suggesting that the effects of reduced tariff uncertainty may be larger for above-scale firms.[36]

Moreover, the previous results were estimated only for a subsample of counties reporting export data, while these data include all prefectures, thus enabling us to verify that the increase in exports is observed consistently across the larger sample. Similarly, value added per worker can be calculated only for a small sample in the county-level data, given the limited number of observations reporting both employment and value added. However, the evidence of an increase in value added per worker is consistent with the previously reported evidence from county-level data that an increase in the NTR gap from the 25^{th} to the 75^{th} percentile generates a 5% increase in secondary employment and a larger, 9% increase in secondary value added. We can also verify using a different source of data the effects observed in the county-level data, including a modest increase in secondary employment and substantial increases in exports, sales, profits, and value added in the secondary sector.

As corroborating evidence for the observed increase in foreign investment here, we also estimate parallel specifications using a small sample of counties that report FDI data, as well as provincial-level data on FDI. The results are reported in Table A12 in the Appendix, and show an increase in FDI at both the county and the provincial level. The county-level data suggest that a county moving from the 25^{th} to the 75^{th} percentile of the NTR gap would show an increase of around 40% in contracted FDI.

[36]In addition, 20% of the firms in this sample are state-owned or collective firms; on average, the level of exports observed in these firms is approximately one-sixth the level of exports observed for non-state firms. The reported increase in exports, sales and value added (among other variables) is not observed in the subsample of SOE firms. Thus the main results seem to be driven by firms outside the state sector.

4.5 Mechanisms

Returning to the conceptual framework, it is useful to highlight the mechanisms that generate the observed patterns of accelerated structural transformation post-WTO accession in counties more exposed to tariff uncertainty ex ante. First, we observe both a substantial increase in exports and an increase in foreign direct investment. Both effects are evident in county-level data, as well as data derived from a survey of large firms.

Second, as previously noted, there is fairly robust evidence of substitution of productive factors out of agriculture in counties characterized by higher ex ante NTR gaps following WTO accession. The effects previously reported were of relatively small magnitude; a shift from the 25th to the 75th percentile of the NTR gap generated a relative decline in agricultural investment and value added post-WTO of no more than 1-3%. However, the sample does include some urban counties; approximately 5% of counties reported in the 1990 census that less than one-fifth of the population was engaged in the primary sector. If we restrict the sample to exclude these counties, the observed substitution out of the primary sector roughly doubles in magnitude. In addition, we observe increased investment and output in both the secondary and tertiary sectors, although the effects are larger in the secondary sector.

The growth of the secondary sector as the primary sector shrinks is consistent with both the reallocation and the local demand channels. However, the fact that non-tradable (tertiary) production is expanding suggests that the local demand effect dominates the reallocation effect for the tradable sector. In addition, we can document that the reduction in tariff uncertainty seems to generate an increase in returns to factors in the medium-term, as evident in the persistent increase in wages and value added per worker observed in the firm data. This is consistent with the hypothesis that there are barriers to full mobility of capital and labor that slow the equalization of factor returns across counties. Alternatively, there may be positive agglomeration effects in export production that lead to persistently more rapid growth in counties that benefit from the reduction in tariff uncertainty post-WTO.

5 Additional robustness checks

In this section, we present additional robustness checks, including placebo tests that corroborate the hypothesis that the main effects are driven by reduced uncertainty in the U.S. market; analysis of cross-country spillovers; and finally, evidence of heterogeneous effects.

5.1 Placebo analysis

Throughout this analysis, we have assumed that the discontinuous shock experienced by China at the point of its WTO accession is a decrease in tariff uncertainty in the U.S. market. Here, we implement a placebo analysis to evaluate this assumption. As previously noted, the EU endowed China with permanent NTR status in 1980, long before the latter's accession to the WTO, and other trading partners (excluding the U.S.) followed suit. Accordingly, China faced no tariff uncertainty in non-U.S. markets during the period of interest here.

We conduct two placebo tests. The first uses data from the UNCOMTRADE database reporting China's exports to all destinations at the 2-digit product level from 1995 to 2013. We then estimate a simple regression in which the dependent variable is exports of products p to destination country d in year t, and the independent variables are a post dummy interacted with the U.S. NTR gap at the product level and a dummy for the U.S., and the post-NTR interaction interacted with a dummy for the other four top export destinations (the EU, Japan, Korea, and Taiwan). The specification also includes controls for the product-specific tariff imposed by each of the five major destinations on each product, summarized $\boldsymbol{X}_{pdt}$, and country-year, product-year, and country-product fixed effects. Standard errors are clustered at the product level.[37]

$$\begin{aligned} Exp_{pdt} = \beta_1 NTR_{pt} \times US_d \times Post_t + \beta_2 NTR_{pt} \times Otherdestin_d \times Post_t \\ + \boldsymbol{X}_{pdt} + \omega_{dt} + \xi_{pt} + \mu_{dp} + \epsilon_{dpt} \end{aligned} \tag{6}$$

We hypothesize that β_1 will be positive and significant, and β_2 should not be significantly different from zero: products characterized by a larger NTR gap exhibit a disproportionate increase in exports to the U.S. post-WTO accession, but there should be no significant increase in exports to other major destinations. The results are reported in Panel A of Table 6, and we observe exactly the postulated pattern; in Columns (3) and (4), quadratic controls for tariffs are also included. β_1 is positive and β_2, while positive, is insignificant and approximately one-tenth the magnitude of β_1. The final row of the table shows that the hypothesis that the coefficients are equal in magnitude can be rejected at the one percent level. This evidence is again consistent with the assertion that the key immediate shock experienced with WTO accession was a reduction in trade uncertainty in the U.S. market, not a shock in other major export destinations.

Second, we conduct a placebo test by constructing an artificial "EU gap", comparing the

[37] Similar results are observed if standard errors are clustered at the partner level.

EU tariff rates imposed on countries subject to relatively high tariffs to the tariff rates imposed on Chinese goods. Since the EU does not specify a non-NTR set of countries, we simply identify for each industry represented in the Chinese data the five trading partners on which the EU imposes the highest tariffs for that industry and calculate a "maximum tariff" that is the mean of these tariffs. We then calculate a placebo "EU gap" equal to the difference between these high tariffs and the tariff imposed on Chinese goods, and follow the same procedure previously utilized to construct a county-level EU gap that varies across counties and over time.

To conduct the placebo analysis, we estimate the following specification, regressing county-level outcomes on the EU placebo gap, using the same control variables and fixed effects included in the main specification. We also control flexibly for the EU high tariff rate EU_{cfpt}.[38]

$$Y_{cfpt} = \beta_1 EU\,Gap_{cfpt} + EU_{cfpt} + \boldsymbol{X}'_{cfpt}\theta + \gamma_{pt} + \nu_f t + Urb_{cfp} \times (\gamma_{pt} + \nu_f t) + \delta_c + \epsilon_{cfpt} \quad (7)$$

The results are reported in Table 6, and the estimated coefficients are small in magnitude, insignificant and varying in sign. This suggests that there is no evidence that tariff variation orthogonal to China's export expansion predicts cross-county variation in economic outcomes.

5.2 Spillovers from one county to another

Thus far, the analysis has ignored any possible spatial spillovers in the positive shocks to export production following China's WTO accession. A positive shock to the export sector in one county may have positive effects on the economies of neighboring counties through several channels. First, increased income may generate positive demand shocks for goods and services produced in adjacent counties. Second, productive factors may shift across county lines in response to more rapid growth. Third, if there are positive agglomeration effects in exporting industries, growth in secondary exports may directly stimulate exporting in adjacent counties.

We focus on the prefecture as a unit capturing the local region. Our objective is to match each county to other counties in the same prefecture within certain specified geographic ranges (0–25 kilometers, 26–50 kilometers, and 51–75 kilometers), where straight lines between the county centroids are used to calculate these distances. If multiple counties fall within a specified distance range, the closest county is employed as the match. (Counties in different prefectures are not included for the purpose of this analysis.)[39]

[38] Specifically, we generate a set of dummy variables for each two-percent range in the distribution of the high tariff rate (50 dummy variables in all) and include these variables, as well as their interaction with the post dummy.

[39] These results are also consistent if estimated focusing on the nearest county within the same province, rather

We then estimate a series of specifications, regressing the outcomes of interest on the interaction of the post dummy and the own-county NTR gap and the interaction of post and the neighboring county gap. The specification of interest can be written as follows, where the neighboring county gap is denoted $NTRNeigh_{cfp}$. The control variables include the previously specified variables measured for the main county and for the adjacent county.

$$\begin{aligned} Y_{cfpt} = \beta_1 Post_t \times NTRGap_{cfp} + \beta_2 Post_t \times NTRNeigh_{cfp} \\ + \boldsymbol{X}'_{cfpt}\theta + \gamma_{pt} + Urb_{cfp} \times (\gamma_{pt}) + \delta_c + \epsilon_{cfpt} \end{aligned} \tag{8}$$

The results of estimating equation (8) are reported in Table 7. There is some evidence of positive spillovers in export production and the associated expansion in secondary, tertiary and total GDP, especially for counties that are located relatively close to one another. However, the coefficients for the estimated spillovers are uniformly smaller than those for the own-shock effects, and they generally decrease as the distance from the neighboring county increases. In the final row of each panel, we report the p-value for a test of the hypothesis $\beta_1 = \beta_2$, and this hypothesis is generally rejected, except for the specifications employing export data.

5.3 Heterogeneous effects

We also present some evidence regarding heterogeneous effects, identifying counties concentrated in industries that should show a more robust response to the reduction of tariff uncertainty. In particular, we focus on counties concentrated in industries that are more capital-intensive, counties concentrated in industries that export a higher proportion of their output to the U.S., and counties that include preferential export zones.

Heterogeneity with respect to baseline capital intensity The tariff uncertainty faced by exporting firms in China prior to WTO accession presumably had a more significant effect on capital utilization vis-a-vis labor utilization, given that capital investments are generally irreversible. While the county-level panel does not include any detailed information about capital investment that would allow for a direct test of this hypothesis, we can examine heterogeneous effects with respect to capital intensity of the industries observed in the county at baseline.

Using the same capital intensity variable constructed from the firm-level survey, we calculate average capital intensity at the industry level and construct a county-level proxy for capital

than within the same prefecture.

intensity in the secondary sector using the 1990 employment weights. (Information about capital intensity in the primary sector is not available, and thus it is excluded from this analysis.) We standardize this variable to have mean zero and standard deviation one, and interact it with the post-NTR gap interaction in the main specification of interest, equation (3).

The results are reported in Panel A of Table 8. We observe that the β_1 coefficients show the familiar pattern. In addition, the interaction terms are positive and significant for exports and total GDP. This suggests that, consistent with theoretical predictions, a one standard deviation increase in ex ante estimated capital intensity in the secondary sector at the county level yields an increase in GDP post-WTO accession that is around 30% larger in relative terms.

Heterogeneity with respect to the U.S. share of exports Unfortunately, the export data available at the county level do not report the destination of these exports. Accordingly, we have used the NTR gap as a proxy for tariff uncertainty in the U.S. market without taking into account how important that tariff uncertainty is for a particular industry.

However, we can use the available UNCOMTRADE data on Chinese exports at the product-destination level to calculate the proportion of exports destined for the U.S. by industry in 1996. We then generate a county-specific weighted average, construct a dummy variable for a county characterized by a U.S. export share above the median, and interact this dummy with the post-NTR interaction in our main specification. The intuition is that counties concentrated in industries characterized by a high NTR gap that nonetheless export a significant fraction of output to the U.S. will exhibit the greatest degree of export-driven expansion post-2001.

The results are reported in Panel B of Table 8. Again, we observe that the main effects are consistent with the previously estimated coefficients. In addition, the interaction terms including the high U.S. export dummy variables are also generally significant and positive (with the exception of per capita income), suggesting that as expected, the most meaningful benefits of WTO accession are experienced by counties and industries that are both facing significant tariff uncertainty and export disproportionately to the U.S.

Heterogeneity with respect to export processing zones Throughout the reform period, China has established various geographically defined zones that offer benefits for foreign and/or exporting firms. The earliest of these were the five Special Economic Zones established in Hainan, Guangdong, and Fujian between 1980 and 1984. More recently, dedicated export processing zones have been established in 26 urban areas where overwhelmingly foreign enterprises

benefit from a range of preferential policies, including rebates of value-added taxes and duties imposed on any imported components. The EPZs were first established in 2001 and continued to expand in subsequent years, though enterprises in official export zones still account for a relatively small fraction of overall exports (Wang and Wei, 2010).

Given that the EPZs focus exclusively on exporting, and particularly on processing exports that are targeted to higher-income markets like the U.S., it is plausible to assume that there might be particularly large effects of WTO accession for these areas. To evaluate heterogeneous effects along this dimension, we re-estimate our primary specification including an interaction with an export zone dummy, as well as the zone dummy as a linear control.[40] The results are reported in Panel C of Table 8. We can observe that in general the effects of the reduction in tariff uncertainty are larger for areas including an EPZ, though the difference is significant only for exports and secondary production.[41] However, the positive effects are clearly not restricted to these zones and remain substantial in the broader sample.

5.4 Aggregate productivity and growth

Finally, it may be useful to present some simple back-of-the-envelope calculations that quantify the contribution of the reduction in trade uncertainty generated by WTO accession to shifts in aggregate productivity and growth in China over this period. First, we can quantify the contribution of labor reallocation across sectors (from agricultural production to non-agricultural production) to aggregate productivity, following McCaig and Pavcnik (2014b). A growing literature has documented that value added per worker is significantly higher in non-agricultural compared to agricultural production in developing countries (Gollin et al., 2014), and we can replicate this stylized fact using the county-level data employed here; value added per worker in the secondary sector is approximately 6.5 times value added per worker in the primary sector. Given that the results reported in Table 2 suggest that around 5% of the agricultural labor force shifted into non-agricultural production following WTO accession, this suggests an increase of nearly 30% in aggregate productivity driven by this reallocation alone.[42]

We can also explore the importance of WTO accession in overall growth in county-level

[40] We follow the list of export zones provided in Table 2A.2 in Wang and Wei (2010), and identify the counties in our sample that share the same prefecture-city code provided in that source as counties that are part of the export zone. This does not necessarily mean that the entire area of the county falls within the zone, but there is some overlap.

[41] There is also a negative interaction term observed for primary GDP.

[42] This calculation ignores any possible labor reallocation into the tertiary sector, for two reasons. First, there was no significant evidence of an increase in tertiary sector employment in the primary results, although these results may be limited by the small sample. Second, it is not possible to estimate value added per worker in the tertiary sector, as value added in this sector is not generally reported.

GDP during this period; more details about how these calibrations are conducted can be found in Appendix A1.2. The average county in this sample shows 227% growth in county-level GDP from 2002 to 2013 (i.e., in the post-WTO period). Our results suggest that for a county characterized by an NTR gap at the median prior to WTO accession, the reduction in tariff uncertainty in the U.S. market results in an increase in GDP of 32%. Accordingly, export-driven growth enhanced by WTO membership accounts for approximately 15% of overall GDP growth. (A similar calculation for secondary GDP suggests that growth driven by the WTO accession shock accounts for approximately 25% of overall secondary growth from 2002 to 2010, the final year in which secondary GDP is observed for a substantial sample.)

Turning to employment, the average county in our sample that reports detailed employment data exhibits growth in secondary employment of 78% in total from 2002 to 2010; about 11 percentage points of this growth is attributable to the export shock captured here.[43] Using data on average secondary employment at baseline in 2002, we can conservatively estimate that the number of additional positions created in the secondary sector as a result of export expansion to the U.S. is roughly 9.6 million in the sampled counties. According to the 2000 census, the counties included in the sample account for 75% of total secondary employment in China in that year; under the assumption that the effects of the NTR shock are identical in the counties not represented in our sample, we estimate that total secondary employment created equals 12.9 million nationwide. This compares to an estimate of 1.5 million manufacturing positions lost in the U.S. as a result of Chinese export expansion, as reported in Autor et al. (2013). Thus we can conclude that while WTO accession is certainly not the only phenomenon generating rapid economic expansion in China during this period, its importance is non-trivial.

6 Conclusion

In this paper, we use a new panel of county-level data to present the first evidence of the effect of China's accession to the WTO in 2001—a policy shift that removed uncertainty over the tariff rates that Chinese exporters would face in the U.S. market—on structural transformation and growth. The identification strategy exploits variation across industries in the size of the gap between the MFN tariffs and the higher tariffs that Chinese producers risked exposure to prior to WTO accession, as well as variation across counties in the baseline composition of employment in the secondary sector. We then evaluate whether counties with a high concentration of industries

[43] Again, 2010 is the last year in which a substantial number of counties report data on secondary employment. More details about these calculations are reported in Appendix A1.2.

characterized by large tariff gaps show more rapid growth post–2001.

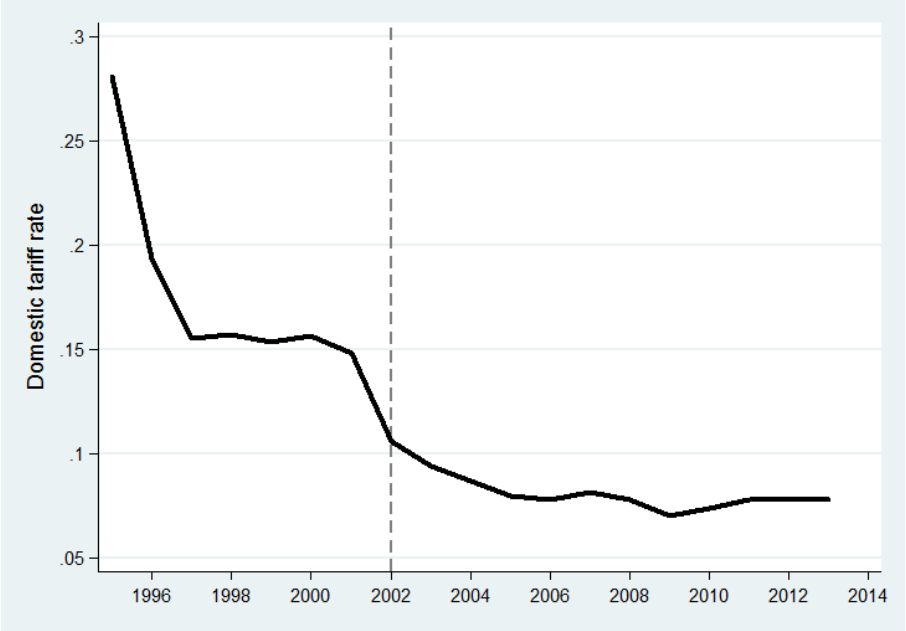
Our results suggest that counties that benefited most from the reduced tariff uncertainty show substantial expansion post–2001. Employment, GDP, and value added in the secondary sector all increase, while the agricultural sector contracts. We also observe a substantial increase in GDP per capita. Moreover, these patterns are observed only after WTO accession, suggesting that they do reflect the hypothesized channel of reduced tariff uncertainty, and are not evidence of ex ante differences in observable characteristics comparing across counties with larger and smaller NTR gaps.

This paper is the first to present evidence on the impact of the reduction in tariff uncertainty on structural transformation at the local level in China, and joins a relatively small literature analyzing the effects of enhanced trade access in stimulating growth in developing countries. These results highlight the importance of securing access to developed country markets for developing countries that pursue export-driven growth strategies. Understanding the implications of U.S. trade for Chinese growth may contribute to a more complete understanding of the global impact of rising U.S.–China bilateral trade and China's rise as a global manufacturing powerhouse over the past two decades.

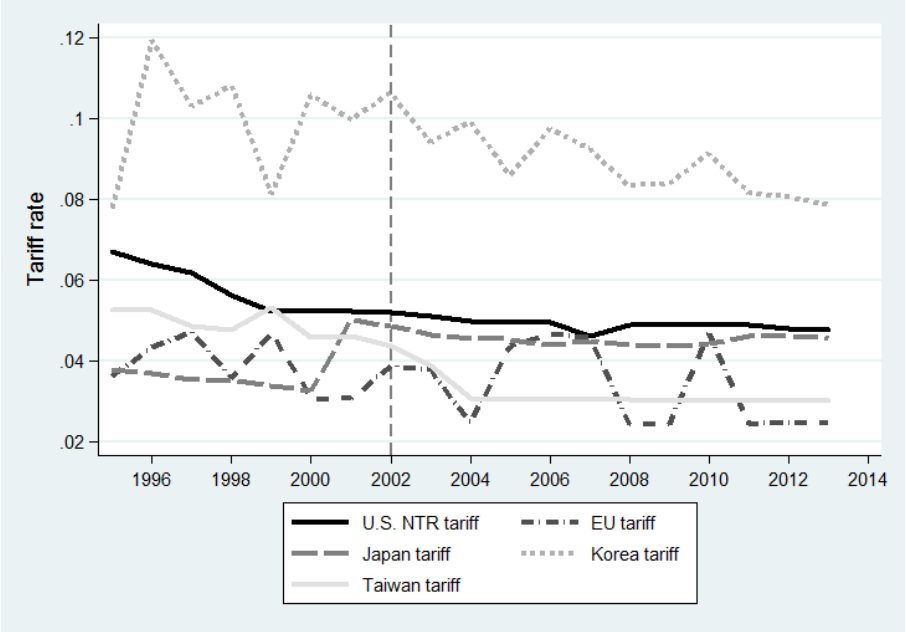
7 Figures and Tables

FIGURE 1: VARIATION IN TARIFF POLICY OVER TIME

(A) China's Import Tariffs Over Time



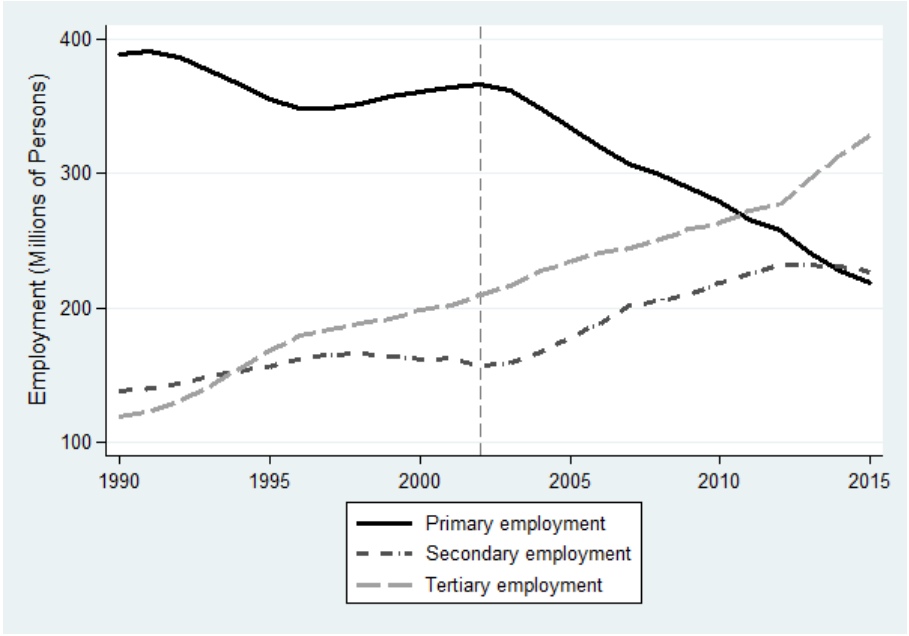
(B) Major Trading Partners' Tariffs Over Time



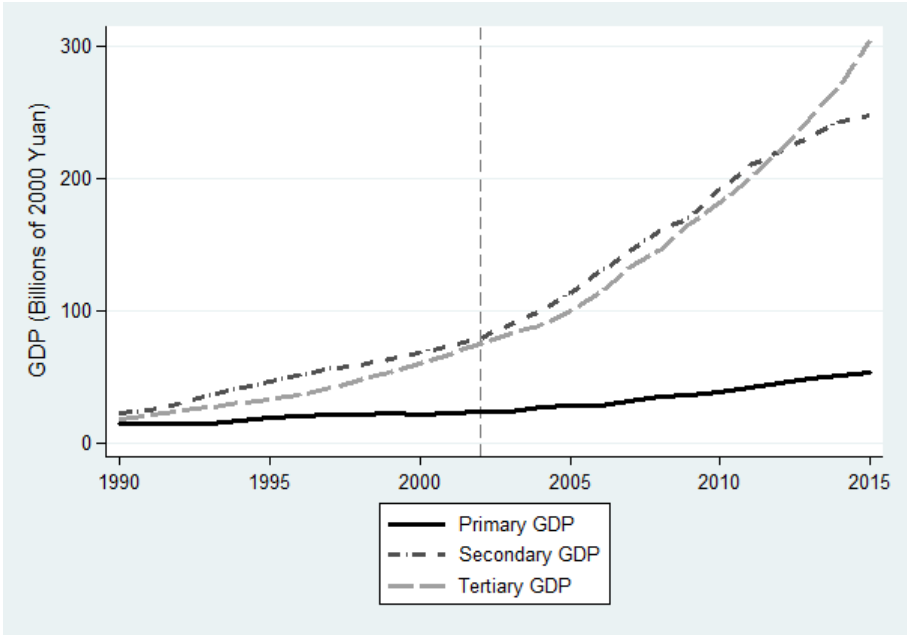
Notes: The first subfigure shows China's average domestic import tariff, calculated as the weighted average of industry-level tariffs and utilizing as weights the share of total Chinese imports constituted by each industry's imports. The second subfigure shows the mean tariff imposed on Chinese exports by major trading partners from 1996 to 2013. For each trading partner, we again calculate the weighted average of industry-level tariffs, utilizing as weights the share of total Chinese exports constituted by each industry's exports. Tariff data is obtained from the WITS-TRAINS database.

Figure 2: Composition of Employment and GDP in China

(a) Employment

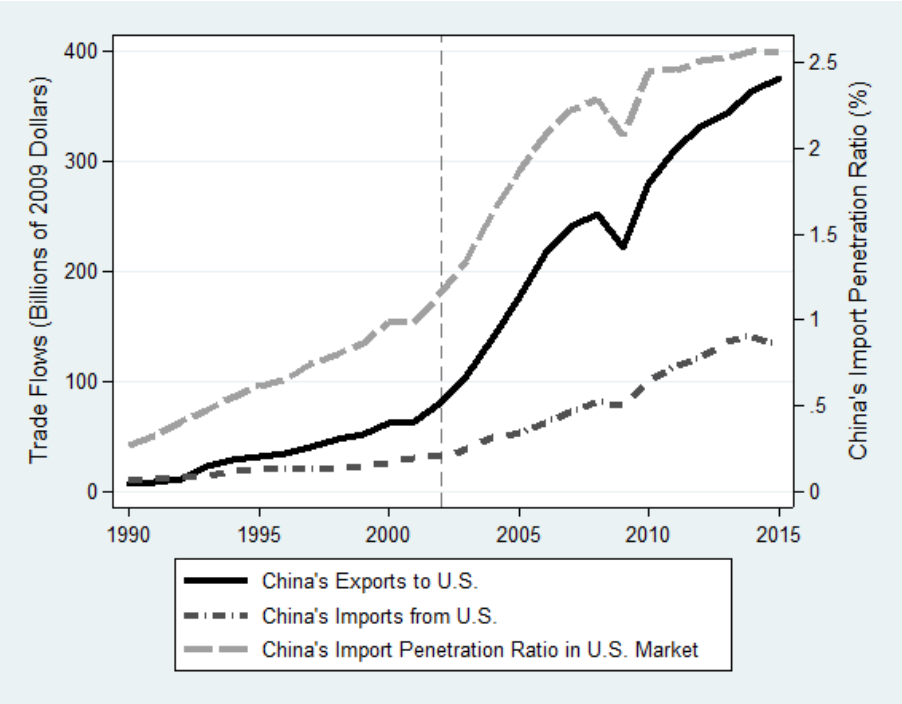


(b) GDP



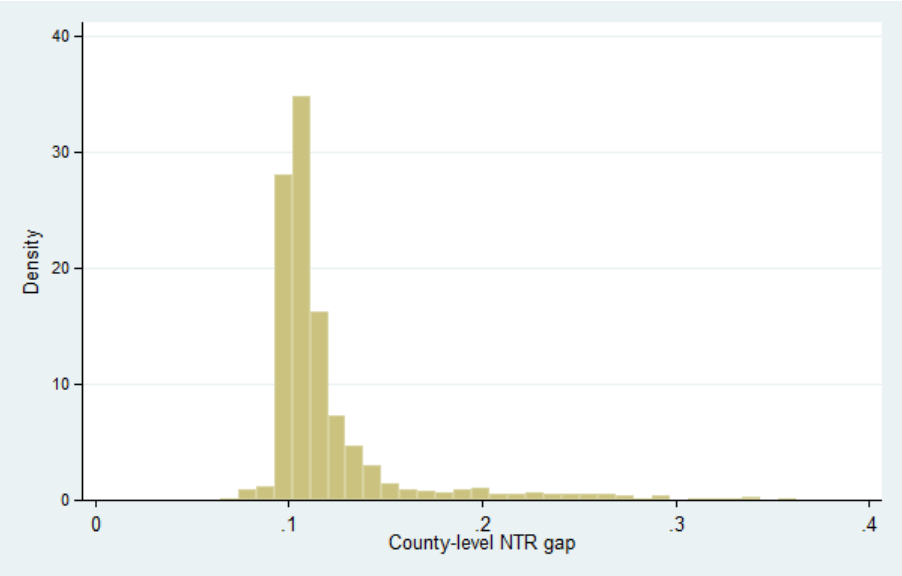
Notes: This graph presents aggregate statistics for China as a whole from 1990 to 2015, employing data from the National Bureau of Statistics. The primary sector includes agriculture, forestry and fishing, the secondary sector includes manufacturing and mining, and the tertiary sector includes services. GDP is reported in billions of constant 2000 yuan. Employment is reported in millions of persons.

Figure 3: Bilateral Trade Flows and China's Import Penetration in the U.S.



Notes: The bilateral trade data is drawn from the IMF's Direction of Trade Database. Import and exports are deflated to 2009 U.S. dollars using the PCE price index. China's import penetration in the U.S. market is defined as U.S. imports from China divided by total US expenditure on goods, measured as U.S. gross output plus U.S. imports minus U.S. exports. The latter three series are drawn from the World Development Indicators.

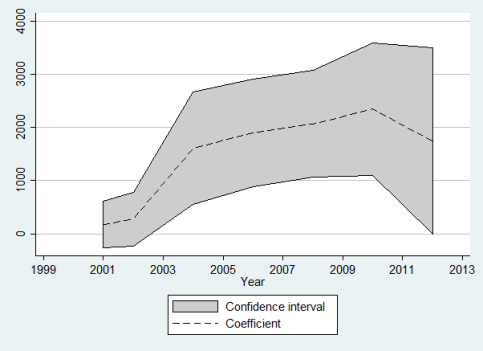
Figure 4: NTR Gap at the County Level



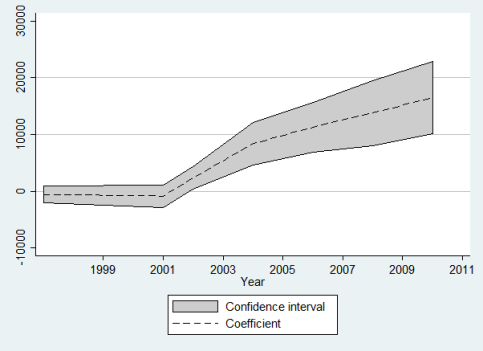
Notes: The figure is a histogram of the gap between normal trade relations (NTR) tariffs and non-NTR tariffs, calculated at the county level utilizing industry employment shares as reported in the 1990 census as weights.

FIGURE 5: ESTIMATED DIF-IN-DIF COEFFICIENTS AND 90% CONFIDENCE INTERVALS

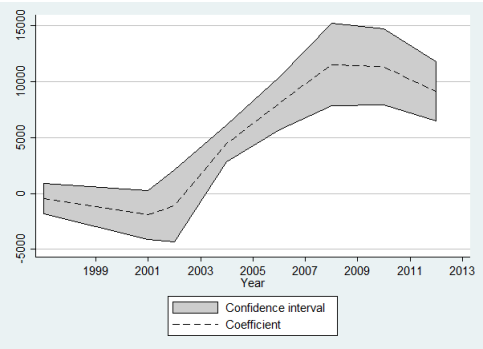
(A) Exports



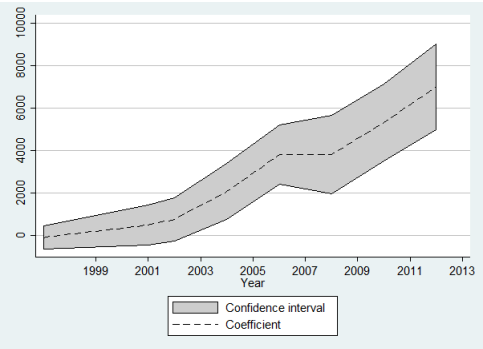
(B) Secondary



(C) GDP



(D) GDP per capita



Notes: These graphs report the coefficients on the interaction of dummy variables for each two-year interval and the county-level gap between NTR tariffs and the non-NTR rates, standardized to have mean zero and standard deviation one. The specification also includes a number of control variables: an interaction of the post-reform indicator variable and a time-invariant dummy capturing whether the county is characterized by high contract intensity industries, the industry-weighted MFA quota fill rate for county-produced goods, the industry-weighted national tariff rate for imports of county-produced goods and the tariff rate interacted with the post dummy, the industry-weighted percentage of firms licensed to export, and the industry-weighted time-varying NTR rate. Province-year and county fixed effects and prefecture-specific trends are included, and the time-varying trends are interacted with an urban dummy. Standard errors are estimated employing clustering at the county level.

Table 1: Summary Statistics

Variable	Mean	St. dev.	Min.	Max.	Obs.	Num. counties
Total population	509.04	463.9	37	6850.02	27802	1602
Total emp.	250.00	164.24	8.20	1544.40	19210	1419
Primary employment share	.56	.17	.01	.95	2906	345
Second employment share	.20	.13	0	.71	2906	345
Tertiary employment share	.24	.09	.04	.83	2906	345
Exports	752.81	1915.17	.07	23653.74	5105	1005
GDP	8332.22	33312.19	83.16	596015.48	28355	1655
GDP per capita	9666.65	13146.19	821.19	239396.95	26316	1595
Primary GDP share	.29	.16	0	.98	12262	1432
Secondary GDP share	.39	.15	.02	1	12430	1430
Tertiary GDP share	.32	.09	.03	.91	12340	1430
Sown area	61.54	53.88	0	942.78	8019	966
Grain production	230.22	202.63	.17	2581.5	27184	1600
Cash production	42.34	44.33	.02	391.43	25779	1559

Notes: This table reports the mean, standard deviation, minimum, maximum, number of observations and number of counties reporting any observations for key variables. Total population and employment is reported in thousands of person; the employment shares report the percentage of total employment constituted by employment in the specified sector. Exports and GDP are reported in millions of yuan and GDP per capita in yuan, deflated to 2000 constant prices; the GDP shares report the percentage of total GDP constituted by the specified sector. Sown area and grain area are reported in thousands of hectares, and grain production and cash crop production are reported in thousands of tons.

Table 2: Primary Results

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Exports and GDP						
	Exports	Primary	Secondary	Tertiary	GDP	Per capita
Post x NTR gap	248.261	42.915	4613.042	1875.907	2655.506	955.651
	(131.466)*	(32.992)	(1254.208)***	(870.109)**	(744.508)***	(400.357)**
Mean dep. var.	752.808	1010.083	6371.597	4642.585	8332.215	9666.646
Counties	1005	1465	1458	1455	1655	1595
Obs.	5105	13034	13053	12922	28355	26316
Panel B: Employment						
	Primary	Secondary	Tertiary	Agri.	Total emp.	Total pop.
Post x NTR gap	-5.006	7.678	-1.327	-7.860	-.557	35.040
	(6.941)	(4.784)	(3.122)	(4.220)*	(2.713)	(12.241)***
Mean dep. var.	173.968	66.366	72.675	217.098	250.002	509.042
Counties	353	398	399	1305	1419	1602
Obs.	3127	3376	3501	20634	19210	27802
Panel C: Agriculture and value added						
	Sown area	Agri. machine	Grain	Cash	Primary value added	Secondary value added
Post x NTR gap	.152	-3.068	-8.078	-1.400	-2.615	51.358
	(.964)	(1.585)*	(4.772)*	(1.007)	(1.463)*	(19.680)***
Mean dep. var.	61.54	33.838	230.222	42.341	86.375	223.996
Counties	966	1621	1600	1559	1574	1560
Obs.	8019	27277	27184	25779	27054	27126

Notes: The primary independent variable is the interaction of a dummy variable equal to one for the post–2001 period and the county-level gap between NTR tariffs and the non-NTR rates, standardized to have mean zero and standard deviation one. The specification also includes a number of control variables: an interaction of the post-reform indicator variable and a time-invariant dummy capturing whether the county is characterized by high contract intensity industries, the industry-weighted MFA quota fill rate for county-produced goods, the industry-weighted national tariff rate for imports of county-produced goods and the tariff rate interacted with the post dummy, the industry-weighted percentage of firms licensed to export, and the industry-weighted time-varying NTR rate. Province-year and county fixed effects and prefecture-specific trends are included, and the time-varying trends are interacted with an urban dummy. Standard errors are estimated employing clustering at the county level.

In Panel A, the dependent variables include exports at the county level; primary, secondary, tertiary and total GDP; and per capita GDP. Exports and GDP are reported in millions of yuan deflated to 2000 constant prices; per capita GDP is reported in yuan, similarly deflated. In Panel B, the dependent variables include employment in the primary, secondary and tertiary sectors, total employment, and population, all reported in thousands of persons. In Panel C, the dependent variables include sown area reported in thousands of hectares, agricultural machinery reported in 10,000 kilowatts, grain and cash crop production reported in thousands of tons, and primary and secondary value added reported in millions of yuan deflated to 2000 constant prices. Asterisks indicate significance at the ten, five and one percent level.

Table 3: Robustness Checks

	Exports (1)	Primary (2)	Secondary (3)	Tertiary (4)	GDP (5)	Per capita (6)
Panel A: NTR gaps estimated using 2000 employment weights						
Post x NTR gap	318.819	50.079	2347.465	839.859	1702.840	1427.298
	(148.609)**	(32.792)	(543.962)***	(445.581)*	(394.809)***	(288.117)***
Obs	5130	13387	13406	13277	28769	26584
Panel B: NTR gaps estimated assigning non-tradables zero weights						
Post x NTR gap	207.145	20.648	2901.603	1364.624	834.090	541.618
	(94.166)**	(27.721)	(733.017)***	(507.601)***	(647.102)	(229.470)**
Obs.	5105	13034	13053	12922	28355	26316
Panel C: Main specification controlling for the share of non-primary employment						
Post x NTR gap	340.394	49.207	4899.748	2022.489	3021.323	1011.088
	(154.676)**	(34.178)	(1332.319)***	(920.674)**	(782.134)***	(427.384)**
Obs.	5105	13034	13053	12922	28355	26316
Panel D: Main specification controlling for the share of high gap employment						
Post x NTR gap	662.396	33.080	5322.362	2259.664	3075.183	1478.209
	(241.783)***	(35.298)	(1607.042)***	(1137.114)**	(932.773)***	(485.119)***
Obs.	5105	13034	13053	12922	28355	26316
Panel E: Heterogeneity with respect to import competition						
Post x NTR gap	259.677	47.008	4421.264	1864.949	2674.020	946.560
	(137.453)*	(30.492)	(1178.399)***	(817.705)**	(726.542)***	(388.232)**
High import int.	-85.652	13.529	-1011.705	-119.101	-14.467	-400.319
	(73.675)	(21.190)	(488.629)**	(362.105)	(468.540)	(256.720)
Obs.	5105	13034	13053	12922	28355	26316

Notes: The primary independent variable is the interaction of a dummy variable equal to one for the post–2001 period and the county-level gap between NTR tariffs and the non-NTR rates, standardized to have mean zero and standard deviation one. The specification also includes a number of control variables: an interaction of the post-reform indicator variable and a time-invariant dummy capturing whether the county is characterized by high contract intensity industries, the industry-weighted MFA quota fill rate for county-produced goods, the industry-weighted national tariff rate for imports of county-produced goods and the tariff rate interacted with the post dummy, the industry-weighted percentage of firms licensed to export, and the industry-weighted time-varying NTR rate. Province-year and county fixed effects and prefecture-specific trends are included, and the time-varying trends are interacted with an urban dummy. Standard errors are estimated employing clustering at the county level. The dependent variables are exports at the county level; primary, secondary, tertiary and total GDP; and per capita GDP.

In Panel A, the NTR gap at the county level is estimated using employment weights from the 2000 census. In Panel B, the NTR gap is estimated using employment weights from the 1990 census and assigning the services or non-tradable sector a zero weight. In Panel C, the specification includes a full set of interactions between dummies for quartiles of initial secondary and tertiary employment as a fraction of total employment and year fixed effects. In Panel D, the specification includes a full set of interactions between dummies for quartiles of employment in each of five high NTR gap industries as a fraction of total employment and year fixed effects. In Panel E, the post-NTR interaction is interacted with a dummy equal to one for districts who are above the median of soybeans and cotton as a fraction of total sown area, and we also include interactions between quartiles of this fraction and year fixed effects. Asterisks indicate significance at the ten, five and one percent level.

Table 4: Estimating the Effect of the NTR Gap over Time

	Exports (1)	Secondary (2)	GDP (3)	Per capita (4)
NTR gap x 97-98		-555.328	-468.512	-96.020
		(889.739)	(816.436)	(342.157)
NTR gap x 99-01	169.953	-829.094	-1913.869	492.171
	(266.857)	(1208.239)	(1336.734)	(569.309)
NTR gap x 02-03	280.018	2379.107	-1112.166	755.269
	(309.379)	(1225.792)*	(1951.345)	(621.685)
NTR gap x 04-05	1606.207	8406.023	4457.992	2061.496
	(645.787)**	(2268.483)***	(1007.391)***	(801.503)**
NTR gap x 06-07	1902.506	11304.270	8062.079	3800.560
	(618.678)***	(2697.777)***	(1443.048)***	(849.838)***
NTR gap x 08-09	2066.532	13786.760	11521.510	3812.086
	(614.017)***	(3515.696)***	(2255.627)***	(1121.989)***
NTR gap x 10-11	2344.534	16556.580	11302.720	5315.567
	(759.210)***	(3906.195)***	(2084.389)***	(1109.795)***
NTR gap x 12-13	1749.813	18445.150	9108.340	6998.901
	(1069.573)	(3924.502)***	(1619.350)***	(1235.621)***
Obs.	5105	13053	28355	26316

Notes: The independent variables are the interaction of dummy variables for each two-year interval and the county-level gap between NTR tariffs and the non-NTR rates, standardized to have mean zero and standard deviation one. The specification also includes a number of control variables: an interaction of the post-reform indicator variable and a time-invariant dummy capturing whether the county is characterized by high contract intensity industries, the industry-weighted MFA quota fill rate for county-produced goods, the industry-weighted national tariff rate for imports of county-produced goods and the tariff rate interacted with the post dummy, the industry-weighted percentage of firms licensed to export, and the industry-weighted time-varying NTR rate). Province-year and county fixed effects and prefecture-specific trends are included, and the time-varying trends are interacted with an urban dummy. Standard errors are estimated employing clustering at the county level. The dependent variables are exports at the county level; primary, secondary, tertiary and total GDP; and per capita GDP. Asterisks indicate significance at the ten, five and one percent level.

Table 5: Factor utilization and other firm outcomes

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Factor utilization						
	Emp.	Capital	Foreign capital dummy	Cap. intensity	Wages	Wages per worker
Post x NTR gap	20.010	591.271	.013	-1.154	507.123	.258
	(9.469)**	(229.141)***	(.006)**	(1.780)	(191.224)***	(.135)*
Mean dep. var.	116.35	3655.667	.077	61.848	1354.195	9.416
Obs.	2403	2004	2426	1981	2426	2403
Panel B: Other firm outcomes						
	Exports	Sales	Value added	Profits	VA per worker	
Post x NTR gap	1128.778	10290.790	2589.090	1776.065	2.891	
	(570.918)**	(3170.815)***	(688.696)***	(544.468)***	(1.269)**	
Mean dep. var.	3354.639	24658.011	5212.273	2143.398	51.59	
Obs.	2426	2426	2213	2426	2189	

Notes: The primary independent variable is the interaction of a dummy variable equal to one for the post–2001 period and the prefecture-level gap between NTR tariffs and the non-NTR rates, standardized to have mean zero and standard deviation one. The specification includes the same control variables described in the notes to Table 2, all calculated as the average at the prefecture-year level, as well as province-year and prefecture fixed effects. All standard errors are estimated employing clustering at the prefecture level.

The dependent variables in Column (1) include total employment in sampled firms, the total wage bill in sampled firms, mean wage per worker, total capital stock in sampled firms, and mean capital intensity. The dependent variables in Column (2) include total exports, sales, value added and profits in sampled firms, as well as mean value added per worker. Asterisks indicate significance at the ten, five and one percent level.

Table 6: Placebo Tests

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Chinese exports to all destinations						
		Exports				
Post x NTR Gap x U.S.		8.891	8.893			
		(.303)***	(.303)***			
Post x NTR Gap x Other four		1.936	1.946			
		(1.407)	(1.408)			
Test $\beta_1 = \beta_2$		.000	.000			
Obs.		866857	866857			
Panel B: EU NTR Gap						
	Exports	Primary	Secondary	Tertiary	GDP	Per capita
EU NTR gap	-145.020	1.603	545.063	-263.574	293.795	222.871
	(207.788)	(15.931)	(415.354)	(625.505)	(259.916)	(145.574)
Obs.	5105	13034	13053	12922	28355	26316

Notes: In Panel A, the independent variables are the U.S. NTR gap at the product level interacted with post interacted with a dummy for the U.S., and the post-NTR interaction interacted with a dummy for the other four top export destinations (the EU, Japan, Korea, and Taiwan). The dependent variable is China's exports to all destinations at the 2-digit product level from 1995 to 2013, as reported in the UNCOMTRADE database. The specification also includes controls for the product-specific tariff imposed by each of the five major destinations on each product, and country-year, product-year, and country-product fixed effects; in the second specification, quadratic controls for product-specific tariffs are added. Standard errors are clustered at the product level.

In Panel B, the independent variable is the interaction of a dummy variable equal to one for the post–2001 period and the gap between the highest EU tariff observed for a given industry and the tariff imposed on Chinese exports of that industry's output to the EU, standardized to have mean zero and standard deviation one. The specification also includes a number of control variables: an interaction of the post-reform indicator variable and a time-invariant dummy capturing whether the county is characterized by high contract intensity industries, the industry-weighted MFA quota fill rate for county-produced goods, the industry-weighted national tariff rate for imports of county-produced goods and the tariff rate interacted with the post dummy, the industry-weighted percentage of firms licensed to export, and the industry-weighted time-varying NTR rate). Province-year and county fixed effects and prefecture-specific trends are included, and the time-varying trends are interacted with an urban dummy. We also control flexibly for the high EU tariff (the average tariff imposed on the five trading partners characterized by the highest tariff rates) by constructing fifty dummy variables corresponding to different percentiles of the EU tariff distribution, generating dummy variable fixed effects, and also interacting those fixed effects with the post dummy. Standard errors are estimated employing clustering at the county level. The dependent variables are exports at the county level; primary, secondary, tertiary and total GDP; and per capita GDP. Asterisks indicate significance at the ten, five and one percent level.

Table 7: Estimating Effects of Spillovers

	Exports (1)	Primary (2)	Secondary (3)	Tertiary (4)	GDP (5)	Per capita (6)
Panel A: Neighboring counties within 25 kilometers						
Post x NTR gap	599.028	-38.835	1154.935	538.699	1587.102	3108.549
	(274.605)**	(28.203)	(258.994)***	(171.498)***	(619.140)**	(987.168)***
Post x NTR gap neighbor	228.002	34.798	388.286	122.400	440.122	1080.828
	(132.373)*	(17.814)*	(180.108)**	(106.263)	(260.716)*	(365.186)***
Test $\beta_1 = \beta_2$	.180	.075	.014	.029	.083	.086
Obs.	3415	8298	8309	8272	19258	18612
Panel B: Neighboring counties within 50 kilometers						
Post x NTR gap	639.604	-31.570	1254.132	630.973	2206.660	3702.587
	(362.001)*	(22.901)	(284.955)***	(165.196)***	(700.847)***	(947.026)***
Post x NTR gap neighbor	142.073	36.683	589.542	263.226	652.256	244.298
	(126.646)	(13.986)***	(286.909)**	(152.923)*	(350.236)*	(332.926)
Test $\beta_1 = \beta_2$	.239	.035	.065	.083	.034	.001
Obs.	3703	8693	8710	8687	19665	18947
Panel C: Neighboring counties within 75 kilometers						
Post x NTR gap	1040.096	-49.021	1324.951	619.096	2449.197	3716.560
	(282.241)***	(25.894)*	(343.528)***	(217.150)***	(745.283)***	(1050.409)***
Post x NTR gap neighbor	105.155	10.967	113.833	73.402	67.499	-398.609
	(131.588)	(20.421)	(199.041)	(115.858)	(296.505)	(381.389)
Test $\beta_1 = \beta_2$	.006	.141	.001	.02	.003	0
Obs.	3110	7264	7282	7254	17526	16938

Notes: The primary independent variables are the interaction of a dummy variable equal to one for the post–2001 period and the gap between NTR tariffs and the non-NTR rate, standardized to have mean zero and standard deviation one; and the same post-NTR interaction for a neighboring county. The neighboring county is identified as the closest neighboring county within the same prefecture in the specified distance range (0–25 kilometers, 26–50 kilometers, and 51–75 kilometers), where distance is calculated as the straight-line distance between the county centroids. The specification also includes a number of control variables: an interaction of the post-reform indicator variable and a time-invariant dummy capturing whether the county is characterized by high contract intensity industries, the industry-weighted MFA quota fill rate for county-produced goods, the industry-weighted national tariff rate for imports of county-produced goods and the tariff rate interacted with the post dummy, the industry-weighted percentage of firms licensed to export, and the industry-weighted time-varying NTR rate). Province-year and county fixed effects and prefecture-specific trends are included, and the time-varying trends are interacted with an urban dummy. Standard errors are estimated employing clustering at the county level. The dependent variables are exports at the county level; primary, secondary, tertiary and total GDP; and per capita GDP. Asterisks indicate significance at the ten, five and one percent level.

Table 8: Heterogeneous Effects

	Exports (1)	Primary (2)	Secondary (3)	Tertiary (4)	GDP (5)	Per capita (6)
Panel A: Heterogeneity with respect to baseline capital intensity						
Post x NTR gap	230.190	48.796	4521.833	1698.167	2539.418	953.746
	(127.969)*	(32.618)	(1264.955)***	(901.822)*	(697.220)***	(400.407)**
Post x NTR gap x Baseline capital intensity	194.301	-24.197	331.853	656.337	719.340	-49.289
	(115.922)*	(21.267)	(400.033)	(433.018)	(331.275)**	(177.073)
Obs.	5105	13034	13053	12922	28355	26316
Panel B: Heterogeneity with respect to the proportion of exports directed to the U.S.						
Post x NTR gap	195.729	-39.874	1534.967	464.867	1347.789	2533.753
	(104.671)*	(43.884)	(548.618)***	(379.103)	(601.449)**	(544.889)***
Post x NTR gap x High US exports	60.885	86.813	3229.706	1486.869	1479.826	-1903.951
	(126.330)	(45.977)*	(976.256)***	(676.696)**	(568.501)***	(564.000)***
Obs.	5105	13034	13053	12922	28355	26316
Panel C: Heterogeneity with respect to export zones						
Post x NTR gap	133.152	83.475	2934.297	1483.208	2308.695	881.882
	(100.254)	(27.864)***	(975.610)***	(617.541)**	(675.818)***	(386.779)**
Post x NTR gap x Export zone	835.802	-132.990	5261.475	1616.162	3021.898	539.058
	(455.256)*	(50.643)***	(1110.446)***	(1005.991)	(3214.047)	(941.209)
Obs.	5105	13034	13053	12922	28355	26316

Notes: The primary independent variable is the interaction of a dummy variable equal to one for the post–2001 period and the gap between NTR tariffs and the non-NTR rate, standardized to have mean zero and standard deviation one. The control variables and fixed effects included are identical to those reported in the notes to Table 2. Standard errors are estimated employing clustering at the county level. The dependent variables include exports at the county level; primary, secondary, tertiary and total GDP; and per capita GDP.

In Panel A, an interaction with estimated capital intensity calculated in 1998 at the county-level is included. In Panel B, an interaction with a dummy variable equal to one if the estimated proportion of exports directed to the U.S., as calculated using the UNCOMTRADE data from 1996, is above the median is included. In Panel C, an interaction with a dummy for export zones is included, and the export zone dummy also enters linearly given that it is time-varying. Asterisks indicate significance at the ten, five and one percent level.

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A1 Appendix - for online publication

A1.1 Missing data

Data can be missing from the county-level panel for two reasons: counties cannot be matched between the census and the provincial yearbooks, and counties are matched to the yearbooks but specific indicators are not available. First, some counties that are observed in the census do not appear in provincial yearbooks at all; these are disproportionately counties that are part of the urbanized areas of larger, prefecture-level cities, as some provinces omit data for these areas. To provide more systematic evidence about the characteristics of these missing counties, we estimate the following specification at the county level in which county covariates as observed in the 1990 census are regressed on a dummy variable equal to one if the county is missing due to a failure to match between the census and the provincial yearbooks, as well as province fixed effects. Standard errors are clustered at the province level.

$$Y_{ifp}^{1990} = \beta Missing_{ifp} + \omega_p + \epsilon_{ifp} \tag{9}$$

The results are reported in Table A1, employing six covariates: total population, the number of households including children, the percentage of households including elderly, the percentage of individuals who received a post-primary education, the percentage of individuals with an agricultural registration, and the percentage of individuals working in the non-primary (secondary and tertiary) sectors. We can observe that counties missing from the sample are characterized by larger populations, higher levels of education, and a greater concentration of labor outside of agriculture, consistent with the hypothesis that these are more urbanized counties.

Second, for those counties observed in provincial yearbooks, different provinces in different years opt to report different indicators at the county level in their yearbooks. As a result, the number of observations varies significantly for different variables, as evident from the summary statistics. Thus (for example) Guangdong consistently reports employment data by sector for all counties for all years; Shanxi does not report employment data by sector for any county in any year. It is never the case that in the same yearbook (corresponding to a single province-year), a particular indicator is reported for some counties and not for others. The indicators that are reported most infrequently include employment at the sector level and exports, while indica-

tors reported near-universally include gross domestic product, total employment, population, primary and secondary value added, and agricultural inputs and production.

Again, to provide more systematic evidence, we estimate the following specification, in which the dependent variable is the number of observations for a particular variable observed for a particular county, and the independent variables include the same county-level covariates as observed in the 1990 census.

$$Obs_{ifp} = \xi X_{ifp}^{1990} + \omega_p + \epsilon_{ifp} \tag{10}$$

For counties that are missing, the number of observations is set at zero. The results are reported in Table A2, and we again observe that the number of observations is in general lower for more populous counties, and higher for those that are more agricultural and have a lower proportion of employment outside the primary sector. This is consistent with more urban and industrialized counties being generally underrepresented in the sample.

In the bottom of the table, we also report the average number of observations per county for each variable, conditional on reporting any data. The main years represented in the sample are the eighteen years from 1996 to 2013 inclusive, though a very small number of counties report data for 1994 and 1995. The average number of observations per county is considerably lower for all outcomes other than GDP and secondary value added, for which the average is 16-17 years per county. However, conditional on reporting any data, counties generally report at least eight years of data for the key variables of interest, excluding only exports.

Finally, we turn to the question of whether selection into the sample is a source of bias in the primary results. In Panel A of Table A3, we restrict the sample to county-years that report export data. In Panel B, we include for each variable only the subset of counties that reports at least eight observations for that variable, to avoid bias due to the entry and exit of counties from the sample. In Panel C, we characterize each county and each variable according to the number of observations, construct quartiles for the number of observations included, and add observation quartile-year fixed effects. In all three cases, the results are robust. The only exception is the coefficient for exports in Panel B, which is positive but not significant; however, the sample has contracted dramatically in this specification. The consistency across a range of specifications suggests that selection into the sample is not a significant source of bias.

Table A1: Counties missing from the provincial yearbooks

	Pop.	Hh incl. children	Hh incl. elderly	Post primary educ.	Prop. agri.	Prop. non-prim. empl.
	(1)	(2)	(3)	(4)	(5)	(6)
Missing counties	226877.700	-.0006	.010	.119	-.217	.229
	(63938.950)***	(.007)	(.005)*	(.016)***	(.052)***	(.057)***
Mean dep. var.	516645.34	.25	.21	.34	.83	.28
Obs.	2104	2101	2101	2102	2100	2102

Notes: The dependent variables are variables reported in the 1990 census: county population, the percentage of households including children age 0-7, the percentage of households including elderly members, the proportion of adults with post-primary education, the proportion of the population designated as agricultural, and the proportion of the population working in the secondary and tertiary sectors. The independent variable is equal to one if the county is missing from the provincial yearbooks; all specifications include province fixed effects and standard errors clustered at the province level. Asterisks indicate significance at the ten, five and one percent level.

Table A2: Number of observations and initial county characteristics

	Number of observations						
	GDP	Primary	Secondary	Tertiary	Export	Emp.	Secondary va
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Pop.	-.002	-.0006	-.0006	-.0006	-.00004	-.0005	-.002
	(.0003)***	(.0002)***	(.0002)***	(.0002)***	(.0001)	(.0001)***	(.0003)***
Prop. children	7.346	-1.216	.324	.315	-7.478	3.851	6.329
	(5.492)	(3.084)	(3.094)	(3.050)	(2.791)***	(1.897)**	(5.798)
Prop. elderly	.934	.214	-.254	-.917	5.394	-.859	6.746
	(8.322)	(4.673)	(4.688)	(4.622)	(4.230)	(2.874)	(8.785)
Post.-primary	3.743	.829	1.996	1.992	7.702	-1.352	-.342
	(2.077)*	(1.166)	(1.170)*	(1.153)*	(1.056)***	(.717)*	(2.193)
Prop. agri.	5.533	3.226	.961	.783	7.247	1.000	7.125
	(2.159)**	(1.213)***	(1.216)	(1.199)	(1.098)***	(.746)	(2.280)***
Prop. non-prim.	-14.775	-4.395	-6.778	-7.118	-.941	-.189	-13.759
	(1.911)***	(1.073)***	(1.077)***	(1.062)***	(.971)	(.660)	(2.018)***
Mean (obs. > 0)	16.52	8.31	8.36	8.33	5.07	8.3	17.12
Obs.	2100	2100	2100	2100	2100	2100	2100

Notes: The dependent variable is the number of observations observed at the county level for the specified variable. The independent variables are a series of county characteristics observed at baseline: the fraction of the population engaged in primary employment, the total population, and the fraction of the population with post-primary education (all observed in the 1990 census); GDP in the first year in which the county is observed in a provincial yearbook; and a dummy for an urban county. All specifications include prefecture fixed effects. Asterisks indicate significance at the ten, five and one percent level.

Table A3: Main specifications controlling for selection into the sample

	Exports (1)	Primary (2)	Secondary (3)	Tertiary (4)	GDP (5)	Per capita (6)
Panel A: Sample reporting export data						
Post x NTR gap	248.261	-8.361	268.547	128.211	431.175	1097.220
	(131.466)*	(15.890)	(91.398)***	(58.774)**	(169.113)**	(293.562)***
Mean dep. var.	751.069	1032.968	2582.935	1767.613	5863.137	9135.708
Obs.	5105	2741	2761	2780	4959	4862
Panel B: Sample of counties including at least eight observations						
Post x NTR gap	83.973	15.569	2479.892	1240.035	1244.824	1298.070
	(118.063)	(32.449)	(705.281)***	(1040.152)	(650.375)*	(389.925)***
Obs.	3060	10800	10883	10754	27983	26072
Panel C: Including observation number quartile - year fixed effects						
Post x NTR gap	238.277	39.231	4018.797	1581.600	2811.291	936.339
	(130.700)*	(34.705)	(844.659)***	(980.363)	(728.368)***	(390.499)**
Obs.	5105	13034	13053	12922	28355	26316

Notes: The primary independent variable is the interaction of a dummy variable equal to one for the post–2001 period and the county-level gap between NTR tariffs and the non-NTR rates, standardized to have mean zero and standard deviation one. The specification also includes a number of control variables: an interaction of the post-reform indicator variable and a time-invariant dummy capturing whether the county is characterized by high contract intensity industries, the industry-weighted MFA quota fill rate for county-produced goods, the industry-weighted national tariff rate for imports of county-produced goods and the tariff rate interacted with the post dummy, the industry-weighted percentage of firms licensed to export, and the industry-weighted time-varying NTR rate). Province-year and county fixed effects and prefecture-specific trends are included, and the time-varying trends are interacted with an urban dummy. Standard errors are estimated employing clustering at the county level. The dependent variables include exports at the county level; primary, secondary, tertiary and total GDP; and per capita GDP.

In Panel A, the sample is restricted to county-year observations reporting export data. In Panel B, the sample for each variable is restricted to the subset of counties that report at least eight observations for this variable. In Panel C, we characterize each county by the number of observations reported for each variable, and construct quartiles for the number of observations reported; the specification then includes quartile-year fixed effects. Asterisks indicate significance at the ten, five and one percent level.

A1.2 Calibrations for aggregate effects

In order to conduct a simple back-of-the-envelope calculation estimating the contribution of the export shock captured by the NTR gap to total growth over this period, we must first make some assumptions about the magnitude of the decrease in uncertainty experienced by the average county between the pre and the post period. In theory, uncertainty captured by the NTR gap is reduced to zero in the post-WTO period. In practice, some residual uncertainty may have been perceived. In addition, given that the minimum level of the NTR gap observed in the pre-WTO period is .064, calculating effects for a reduction in the NTR gap to zero is an out-of-sample calculation that may be hard to defend. Accordingly, we assume that the median county experiences a reduction in the NTR gap to the minimum level of the gap observed ex ante, or a decrease of one standard deviation in the NTR gap.

We can then calculate the implied increase in GDP (32%), secondary GDP (72%), and secondary employment (11%) predicted for the median county in the post-WTO period, and compare these implied increases to the median overall growth in each measure observed in the sampled counties in this period. We calculate the median growth rates across all counties that report the indicators of interest; the median county shows growth in total GDP of 227%, in secondary GDP of 201%, and in secondary employment of 78%. The ratio of the first measure to the second is the proportion of total growth generated by the reduction in tariff uncertainty.

For employment, we additionally convert this estimate of growth into an estimate of the absolute increase in employment, using median secondary employment observed at the county level in the 2000 census and focusing on the 1805 counties observed in the sample. Since secondary employment is not universally observed in 2002, we impute median employment in 2002 (the first post-WTO year) using the 2000 census data and the average annual growth rate in secondary employment observed in the sample. The number of new positions created by the reduction in tariff uncertainty post-WTO in the sampled counties is then calculated using 2002 estimated employment and the estimated growth rate of 11%.[44] Given that the sampled counties account for 74.7% of total secondary employment in the 2000 census, with the remaining quarter attributable to counties not observed in the sample, we then adjust this estimate upward accordingly.

[44] More specifically, the calculation is $48397 * .11 * 1805$, where 48397 is estimated average secondary employment per county in 2002, .11 is the estimated growth generated by the NTR shock, and 1805 is the number of counties.

It should be noted that these estimates reflect a number of underlying assumptions and should be considered merely illustrative. However, they do suggest that the effects of export expansion driven by the reduction in uncertainty are non-trivial in magnitude.

A1.3 Night lights data

To generate county-level averages of night lights data, high-resolution data on light density measured by satellites at night was downloaded from `http://ngdc.noaa.gov/eog/dmsp/downloadV4composites.html`. ArcMAP was used to process the files. They were converted from raster to GRID files, and averaged across the two sets of data available for each year.[45]

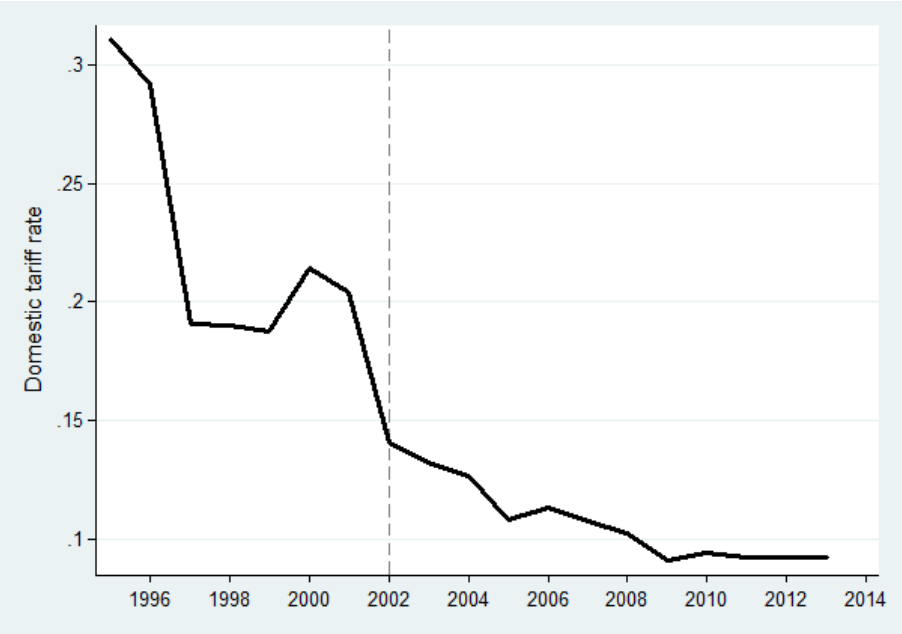
Next, gas flares were removed by using the China gas flares shapefile, downloaded from `https://www.ngdc.noaa.gov/eog/data/web_data/gasflares_v2/country_vectors_20090618/Flares_China_1.tgz`. The erase function in ArcMap was used to remove the gas flares from the dataset. The average night light intensity observed within each county boundary was then calculated using the zonal statistics function and the shape file corresponding to the 2010 county boundaries. The night lights variable ranges from 0 to 63 across counties for each year, based on the highest and lowest brightness captured on the satellite images.

[45]This excludes only 2007, given that only one dataset is available.

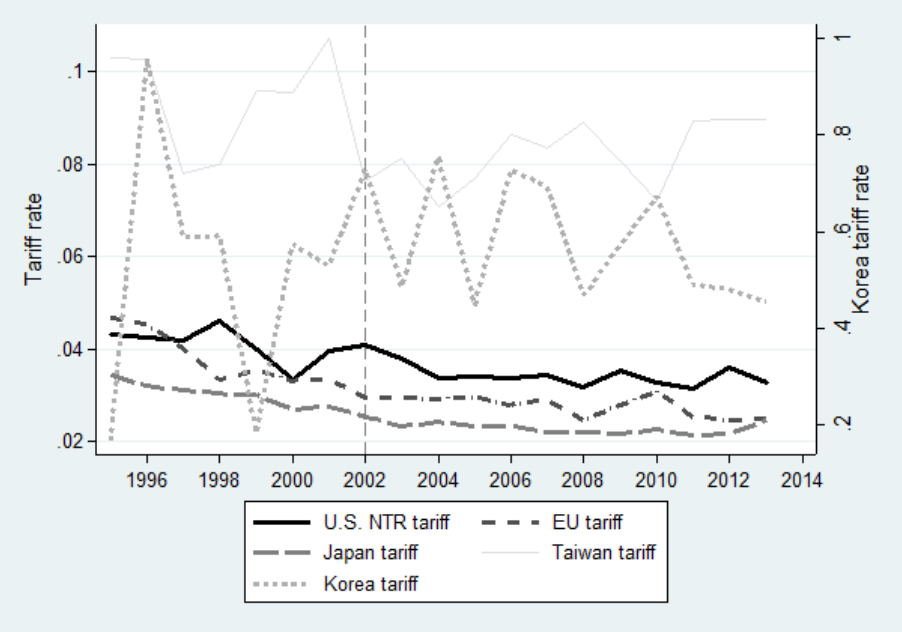
A1.4 Appendix Figures and Tables

FIGURE A1: VARIATION IN TARIFF POLICY ACROSS COUNTIES AND OVER TIME

(A) China's Import Tariffs Over Time

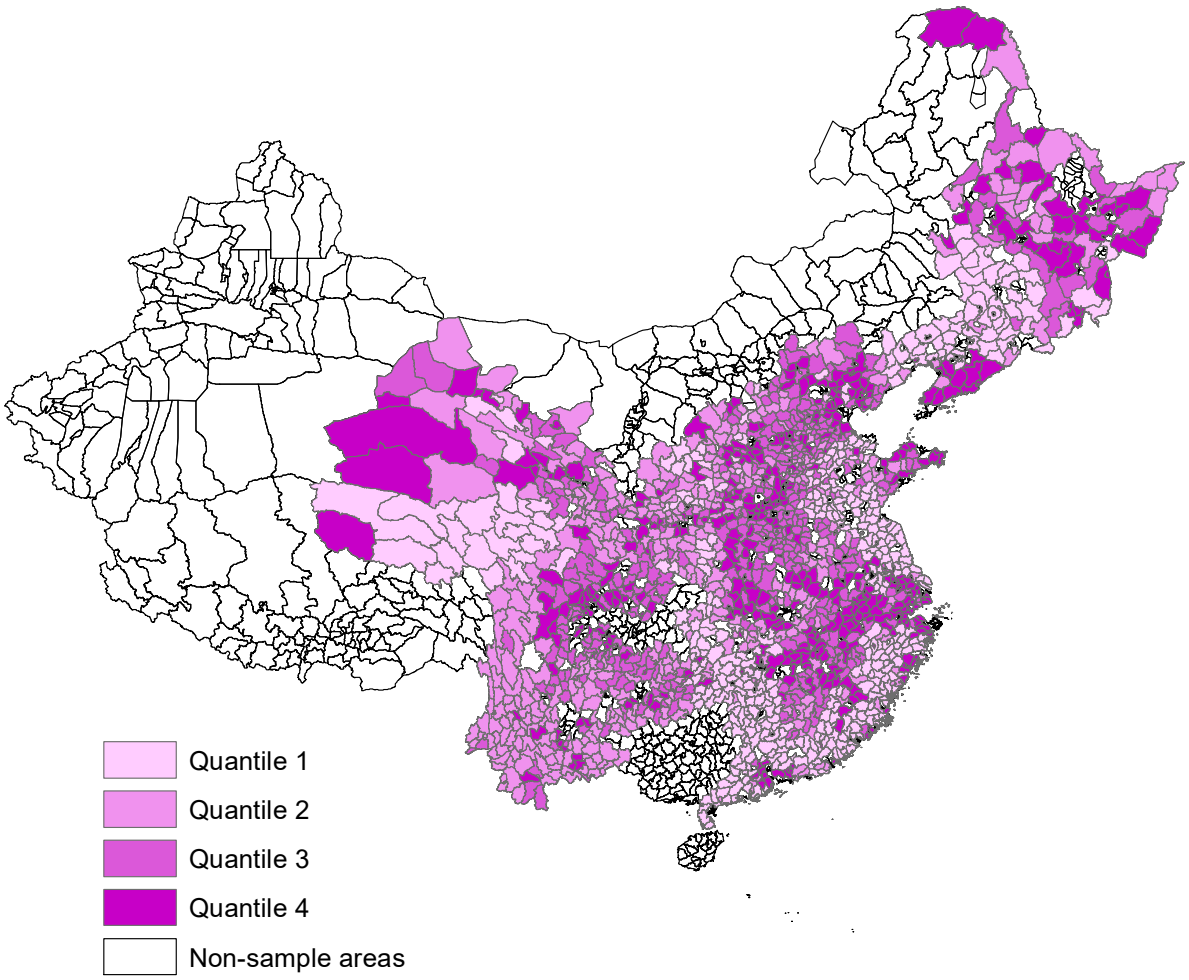


(B) Major Trading Partners' Tariffs Over Time



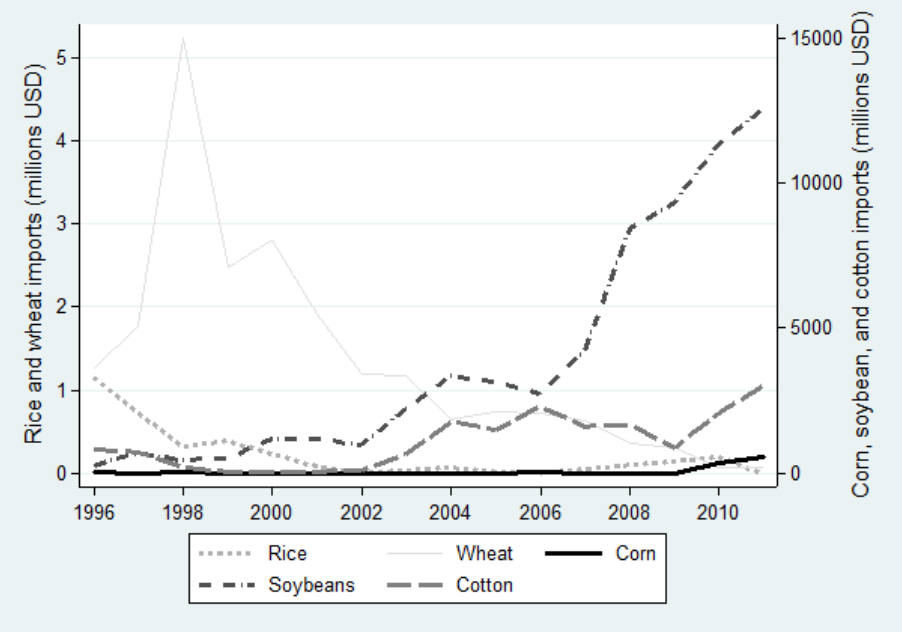
Notes: The first subfigure shows the average domestic import tariff and the second subfigure shows the mean tariffs imposed on Chinese exports by major trading partners from 1996 to 2013. For each variable, we calculate the average county-level weighted average tariff, using tariffs by industry and employing as weights the county-level employment share of each industry as reported in the 1990 census. We then report the mean weighted tariff over all counties in each year. Tariff data is obtained from the WITS-TRAINS database.

Figure A2: NTR Gap by County



Notes: This figure shows the NTR gap at the county level, utilizing the residuals from the gap regressed on provincial fixed effects. Areas not shaded are out of sample. This includes the autonomous regions (Inner Mongolia, Guangxi, Ningxia, Tibet, and Xinjiang) and counties that cannot be matched between the county-level census data and the provincial yearbooks.

FIGURE A3: CHINA'S AGRICULTURAL IMPORTS FROM THE U.S.



Notes: This figure shows the evolution of Chinese imports of agricultural products from the U.S. during the period of interest in the primary analysis.

Table A4: Concordance between Chinese Census Industry Categories, ISIC and SIC

Chinese Census Industry:		*ISIC Revision 3:*		*SIC:*	
Codes	Labels	2-Digit	3-Digit	2-Digit	3-Digit
90136	Farming		11	1	
90137	Forestry	2		8	
90138	Animal Husbandry		12	2	
90139	Fishery	5		9	
90140, 90141	Agricultural Services		11	7	
90142	Coal Mining and Dressing	10		12	
90143	Extraction of petroleum and Natural Gas	11		13	
90144	Mining and Dressing of Ferrous Metals	12			101
90145	Mining and Dressing of Nonferrous Metals	13			102, 103, 104, 105, 106, 107, 108, 109
90146	Mining and Dressing of Nonmetal Minerals		141		141
90147	Mining and Dressing of Other Minerals		142		142, 143, 144, 145,
90148					146, 147, 148, 149
90149	Logging and Transport of Wood and Bamboo	2			241
90151	Food Processing		151, 152, 153, 154		201, 202, 203, 204, 205, 206, 207, 209
90152	Beverages		155		208
90153	Tobacco	16		21	
90155	Textiles	17		22	
90156	Garments and Other Fiber Products	18		23	
90157	Leather, Furs, Down and Related Products	19		31	
90158	Timber Processing, Bamboo, Cane, Palm Fiber and Straw Products	20		24	
90159	Furniture Manufacturing		361	25	
90160	Paper-making and Paper Products	21		26	
90161	Printing and Record Medium Reproduction	22		27	
90165, 90166	Petroleum Processing and Coking	23		29	
90167	Raw Chemical Materials and Chemical Products		241, 242		281, 283, 284, 285, 286, 287, 288, 289
90168	Medical and Pharmaceutical Products	33			384
90169	Chemical Fiber		243		282
90170	Rubber Products		251		301, 302, 303, 304, 305, 306
90171	Plastic Products		252		308
90172	Nonmetal Mineral Products	26		32	
90173	Smelting and Pressing of Ferrous Metals		271		331, 332
90174	Smelting and Pressing of Nonferrous Metals		272		333, 334, 335, 336, 337, 338, 339
90175	Metal Products	28			341, 342, 343, 344, 345, 346, 347, 349
90176	Ordinary Machinery		291, 293		351, 352, 353, 354
90177	Transport Equipment	34, 35		37	
90178	Electric Equipment and Machinery	31			361, 362, 363, 364, 365
90179	Electronic and Telecommunications Equipment	32			366, 367, 368, 369
90180	Instruments, Meters, Cultural, and Office Machinery	30		38	
90181	Other Manufacturing		369	39	

Notes: This table reports the industry categories and their labels in the 1990 Chinese Census that can be matched to ISIC Revision 3 codes and SIC codes. Three-digit codes represent more disaggregated industry categories compared to two-digit codes. All industry categories reported in the Chinese Census are matched to two- or three-digit codes in ISIC or SIC codes. The category of cultural, educational, and sporting goods (90162, 90163) does not match to the ISIC or SIC codes, and is therefore excluded.

Table A5: NTR gap by industry

Subsectors	*NTR gap*
Coal Mining and Dressing	.000
Mining and Dressing of Ferrous Metals	.000
Fishery	.012
Extraction of petroleum and Natural Gas	.059
Mining and Dressing of Nonferrous Metals	.061
Animal Husbandry	.076
Petroleum Processing and Coking	.088
Farming	.096
Agricultural Services	.096
Forestry	.123
Logging and Transport of Wood and Bamboo	.123
Mining and Dressing of Other Minerals	.128
Food Processing	.134
Mining and Dressing of Nonmetal Minerals	.175
Smelting and Pressing of Ferrous Metals	.199
Beverages	.201
Timber Processing, Bamboo, Cane, Palm Fiber and Straw Products	.206
Rubber Products	.217
Transport Equipment	.222
Smelting and Pressing of Nonferrous Metals	.231
Printing and Record Medium Reproduction	.242
Raw Chemical Materials and Chemical Products	.269
Leather, Furs, Down and Related Products	.283
Papermaking and Paper Products	.284
Cultural, Educational and Sports Goods	.305
Nonmetal Mineral Products	.309
Tobacco	.317
Instruments, Meters, Cultural and Office Machinery	.321
Electric Equipment and Machinery	.334
Electronic and Telecommunications Equipment	.338
Ordinary Machinery	.363
Metal Products	.3835
Chemical Fiber	.383
Plastic Products	.420
Furniture Manufacturing	.424
Medical and Pharmaceutical Products	.425
Other Manufacturing	.426
Garments and Other Fiber Products	.457
Textiles	.523

Notes: This table reports the NTR gap by industry for each tradable subsector reported in the 1990 Chinese county census.

Table A6: Exports and GDP, Full Results

	Exports (1)	Primary (2)	Secondary (3)	Tertiary (4)	GDP (5)	Per capita (6)
Post x NTR gap	248.261	42.915	4613.042	1875.907	2655.506	955.651
	(131.466)*	(32.992)	(1254.208)***	(870.109)**	(744.508)***	(400.357)**
Post x Contract	-19.836	-34.934	-3892.620	-1511.175	-1978.065	369.808
	(110.808)	(31.414)	(1033.102)***	(796.223)*	(568.893)***	(429.311)
MFA	-175.185	-18.735	1407.584	972.672	1089.513	866.114
	(239.296)	(12.358)	(638.449)**	(412.872)**	(624.229)*	(277.518)***
Tariff	-135.534	64.794	8131.321	10534.280	6086.603	2769.207
	(706.651)	(67.326)	(2823.478)***	(3344.719)***	(1803.809)***	(852.823)***
Post x Tariff	-849.507	-25.902	-3926.651	6928.947	-2661.801	-2633.559
	(588.077)	(140.953)	(1623.368)**	(3834.144)*	(1974.211)	(1453.923)*
License	57.074	3.605	-289.058	414.795	-793.522	-1609.757
	(82.422)	(31.002)	(666.677)	(465.293)	(446.943)*	(396.940)***
NTR rate	412.644	-38.980	597.889	173.387	322.218	510.778
	(110.401)***	(34.966)	(481.107)	(387.893)	(291.409)	(178.350)***
Mean dep. var.	752.808	1010.083	6371.597	4642.585	8332.215	9666.646
Counties	1005	1465	1458	1455	1655	1595
Obs.	5105	13034	13053	12922	28355	26316

Notes: The primary independent variable is the interaction of a dummy variable equal to one for the post–2001 period and the county-level gap between NTR tariffs and the non-NTR rates, standardized to have mean zero and standard deviation one. The specification also includes a number of control variables: an interaction of the post-reform indicator variable and a time-invariant dummy capturing whether the county is characterized by high contract intensity industries, the industry-weighted MFA quota fill rate for county-produced goods, the industry-weighted national tariff rate for imports of county-produced goods and the tariff rate interacted with the post dummy, the industry-weighted percentage of firms licensed to export, and the industry-weighted time-varying NTR rate. Province-year and county fixed effects and prefecture-specific trends are included, and the time-varying trends are interacted with an urban dummy. Standard errors are estimated employing clustering at the county level.

The dependent variables include exports at the county level; primary, secondary, tertiary and total GDP; and per capita GDP. Exports and GDP are reported in millions of yuan deflated to 2000 constant prices; per capita GDP is reported in yuan. Asterisks indicate significance at the ten, five and one percent level.

Table A7: Employment, Full Results

	Primary (1)	Secondary (2)	Tertiary (3)	Agri. (4)	Total emp. (5)	Total pop. (6)
Post x NTR gap	-5.006	7.678	-1.327	-7.860	-.557	35.040
	(6.941)	(4.784)	(3.122)	(4.220)*	(2.713)	(12.241)***
Post x Contract	3.585	-1.363	3.447	-.558	-5.426	-23.229
	(6.259)	(4.698)	(3.029)	(2.677)	(3.249)*	(9.221)**
MFA	-3.102	1.150	-1.964	8.859	2.870	-5.077
	(4.938)	(2.070)	(1.769)	(3.980)**	(1.687)*	(4.161)
Tariff	3.036	3.911	-3.248	-4.067	1.299	-17.887
	(4.961)	(3.436)	(2.577)	(2.506)	(5.296)	(21.065)
Post x tariff	11.917	-4.693	-.294	18.459	-5.241	-84.198
	(10.032)	(6.921)	(6.449)	(6.655)***	(7.521)	(40.378)**
License	1.336	2.035	1.472	-3.255	-7.936	-7.601
	(6.477)	(4.666)	(5.167)	(3.083)	(3.135)**	(4.228)*
NTR rate	.663	-.792	.123	-2.795	.836	-15.835
	(1.662)	(1.375)	(1.051)	(1.137)**	(1.987)	(14.339)
Mean dep. var.	173.968	66.366	72.675	217.098	250.002	509.042
Counties	353	398	399	1305	1419	1602
Obs.	3127	3376	3501	20634	19210	27802

Notes: The primary independent variable is the interaction of a dummy variable equal to one for the post–2001 period and the county-level gap between NTR tariffs and the non-NTR rates, standardized to have mean zero and standard deviation one. The specification also includes a number of control variables: an interaction of the post-reform indicator variable and a time-invariant dummy capturing whether the county is characterized by high contract intensity industries, the industry-weighted MFA quota fill rate for county-produced goods, the industry-weighted national tariff rate for imports of county-produced goods and the tariff rate interacted with the post dummy, the industry-weighted percentage of firms licensed to export, and the industry-weighted time-varying NTR rate. Province-year and county fixed effects and prefecture-specific trends are included, and the time-varying trends are interacted with an urban dummy. Standard errors are estimated employing clustering at the county level.

The dependent variables include employment in the primary, secondary and tertiary sectors, total employment, and population; all variables are reported in thousands of persons. Asterisks indicate significance at the ten, five and one percent level.

Table A8: Agricultural Investment and Value added, Full Results

	Sown area (1)	Agri. machine (2)	Grain (3)	Cash (4)	Primary va (5)	Secondary va (6)
Post x NTR gap	.152	-3.068	-8.078	-1.400	-2.615	51.358
	(.964)	(1.585)*	(4.772)*	(1.007)	(1.463)*	(19.680)***
Post x Contract	-2.192	1.628	10.215	2.606	3.836	-7.542
	(2.020)	(1.315)	(4.978)**	(1.366)*	(1.958)*	(18.672)
MFA	-.192	-.344	-6.636	-.145	-.984	28.220
	(.555)	(.666)	(1.264)***	(.489)	(.589)*	(19.265)
Tariff	1.019	-9.170	-51.022	-4.213	-9.922	104.800
	(3.871)	(2.310)***	(9.900)***	(1.457)***	(2.332)***	(21.434)***
Post x Tariff	-3.703	7.539	-62.175	12.410	2.275	-64.288
	(7.274)	(5.530)	(20.595)***	(3.256)***	(4.899)	(39.796)
License	2.465	-.963	-1.143	-1.336	3.652	-75.757
	(1.401)*	(1.357)	(4.782)	(1.683)	(2.008)*	(15.349)***
NTR rate	.516	.361	-5.612	-1.506	-.432	19.224
	(.867)	(.917)	(3.330)*	(.607)**	(.851)	(7.648)**
Mean dep. var.	61.54	33.838	230.222	42.341	86.375	223.996
Counties	966	1621	1600	1559	1574	1560
Obs.	8019	27277	27184	25779	27054	27126

Notes: The primary independent variable is the interaction of a dummy variable equal to one for the post–2001 period and the county-level gap between NTR tariffs and the non-NTR rates, standardized to have mean zero and standard deviation one. The specification also includes a number of control variables: an interaction of the post-reform indicator variable and a time-invariant dummy capturing whether the county is characterized by high contract intensity industries, the industry-weighted MFA quota fill rate for county-produced goods, the industry-weighted national tariff rate for imports of county-produced goods and the tariff rate interacted with the post dummy, the industry-weighted percentage of firms licensed to export, and the industry-weighted time-varying NTR rate. Province-year and county fixed effects and prefecture-specific trends are included, and the time-varying trends are interacted with an urban dummy. Standard errors are estimated employing clustering at the county level.

The dependent variables include sown area in thousands of hectares, agricultural machinery employed in 10,000 kilowatts, grain and cash crops in thousands of tons, and primary and secondary value added in millions of yuan deflated to 2000 constant prices. Asterisks indicate significance at the ten, five and one percent level.

Table A9: Alternate Trimming

	Exports (1)	Primary (2)	Secondary (3)	Tertiary (4)	GDP (5)	Per capita (6)
Panel A: Baseline specification without trimming						
Post x NTR gap	566.767	39.720	4402.248	1417.568	4340.623	736.496
	(374.532)	(33.277)	(1249.551)***	(1010.877)	(1458.594)***	(514.382)
Obs.	5360	13533	13544	13444	29508	27340
Panel B: Baseline specification with trimming at the 1/99 percentiles						
Post x NTR gap	749.983	39.711	4397.729	1416.080	4337.329	736.496
	(293.664)**	(33.263)	(1249.808)***	(1010.426)	(1458.913)***	(514.382)
Obs.	5152	13231	13242	13094	28756	26654
Panel C: NTR Gap Winsorized at 1/99 percentile						
Post x NTR gap	559.012	42.859	3767.659	1126.670	2310.271	1240.756
	(222.371)**	(29.625)	(1276.323)***	(787.331)	(820.626)***	(423.256)***
Obs.	5105	13034	13053	12922	28355	26316

Notes: The primary independent variable is the interaction of a dummy variable equal to one for the post–2001 period and the county-level gap between NTR tariffs and the non-NTR rates, standardized to have mean zero and standard deviation one. The specification also includes a number of control variables: an interaction of the post-reform indicator variable and a time-invariant dummy capturing whether the county is characterized by high contract intensity industries, the industry-weighted MFA quota fill rate for county-produced goods, the industry-weighted national tariff rate for imports of county-produced goods and the tariff rate interacted with the post dummy, the industry-weighted percentage of firms licensed to export, and the industry-weighted time-varying NTR rate. Province-year and county fixed effects and prefecture-specific trends are included, and the time-varying trends are interacted with an urban dummy. The dependent variables are exports at the county level; primary, secondary, tertiary and total GDP; and per capita GDP. Standard errors are estimated employing clustering at the county level.

In Panel A, the dependent variables are not trimmed; in Panel B, observations above (below) the 99th (1st) percentile in each year for urban and non-urban counties respectively are trimmed. (The trimming procedure does not eliminate observations with a value of zero if the first percentile of the variable is zero; for this reason, the number of export observations dropped is relatively low, given that the first percentile of exports is zero in a number of cells.) In Panel C, the original sample is employed for the dependent variables, and the NTR gap is winsorized at the 1st and 99th percentiles. Asterisks indicate significance at the ten, five and one percent level.

Table A10: Alternate NTR Gaps

	Exports (1)	Primary (2)	Secondary (3)	Tertiary (4)	GDP (5)	Per capita (6)
Panel A: NTR gaps estimated excluding the agricultural sector						
Post x NTR gap	1521.185	81.810	19278.950	10249.430	12455.450	4149.234
	(467.125)***	(89.186)	(5016.792)***	(3505.490)***	(2722.344)***	(1149.468)***
Obs.	5105	13034	13053	12922	28355	26316
Panel B: NTR gaps estimated excluding high-gap subsectors						
Post x NTR gap	403.751	20.852	4799.112	2256.003	2620.819	851.515
	(165.998)**	(21.219)	(1474.057)***	(983.504)**	(780.454)***	(406.433)**
Obs.	5105	13034	13053	12922	28355	26316

Notes: The primary independent variable is the interaction of a dummy variable equal to one for the post–2001 period and the county-level gap between NTR tariffs and the non-NTR rates, standardized to have mean zero and standard deviation one. The specification also includes a number of control variables: an interaction of the post-reform indicator variable and a time-invariant dummy capturing whether the county is characterized by high contract intensity industries, the industry-weighted MFA quota fill rate for county-produced goods, the industry-weighted national tariff rate for imports of county-produced goods and the tariff rate interacted with the post dummy, the industry-weighted percentage of firms licensed to export, and the industry-weighted time-varying NTR rate. Province-year and county fixed effects and prefecture-specific trends are included, and the time-varying trends are interacted with an urban dummy. The dependent variables include exports at the county level; primary, secondary, tertiary and total GDP; and per capita GDP. Standard errors are estimated employing clustering at the county level.

In Panel A, the NTR gap is re-estimated excluding the agricultural sector. In Panel B, the NTR gap is re-estimated excluding the five subsectors (textiles, garments, other manufacturing, medical and pharmaceutical products, and furniture manufacturing) characterized by the highest NTR gaps. Asterisks indicate significance at the ten, five and one percent level.

Table A11: Alternate Specifications

	Exports (1)	Primary (2)	Secondary (3)	Tertiary (4)	GDP (5)	Per capita (6)
Panel A: Baseline specification without controls						
Post x NTR gap	233.762	106.314	4390.154	2956.292	4876.070	2059.562
	(110.911)**	(30.109)***	(634.128)***	(855.871)***	(1054.134)***	(400.849)***
Obs.	5133	13551	13570	13441	28942	26595
Panel B: Population-weighted standard errors						
Post x NTR gap	448.531	18.804	5107.279	2363.045	3177.225	526.810
	(233.164)*	(45.259)	(1608.439)***	(1122.092)**	(1030.619)***	(413.230)
Obs.	5102	13028	13047	12916	28340	26301
Panel C: Baseline GDP quartile - year fixed effects						
Post x NTR gap	244.223	43.991	4632.707	1878.242	2614.256	919.508
	(130.629)*	(33.322)	(1261.550)***	(874.446)**	(753.774)***	(403.419)**
Obs.	5105	13034	13053	12922	28355	26316
Panel D: Baseline education quartile - year fixed effects						
Post x NTR gap	284.565	46.911	4602.560	1818.345	2711.616	1008.400
	(131.891)**	(32.906)	(1236.040)***	(893.673)**	(745.461)***	(404.710)**
Obs.	5105	13034	13053	12922	28355	26316
Panel E: Baseline concentration - year fixed effects						
Post x NTR gap	350.467	48.444	4901.302	2026.189	3046.716	1096.813
	(148.868)**	(34.204)	(1328.597)***	(915.199)**	(786.442)***	(430.659)**
Obs.	5105	13034	13053	12922	28355	26316
Panel F: SOE employment-quartile fixed effects						
Post x NTR gap	318.807	45.442	5004.815	2031.854	2834.238	1152.447
	(132.080)**	(33.102)	(1332.208)***	(913.927)**	(725.690)***	(407.144)***
Obs.	5105	13034	13053	12922	28355	26316

Notes: The primary independent variable is the interaction of a dummy variable equal to one for the post–2001 period and the county-level gap between NTR tariffs and the non-NTR rates, standardized to have mean zero and standard deviation one. In all panels except Panel A, the control variables and fixed effects included are identical to those reported in the notes to Table 2. The dependent variables include exports at the county level; primary, secondary, tertiary and total GDP; and per capita GDP.

In Panel A, the specification is estimated including only county and province year fixed effects and prefecture-specific trends. In Panel B, the observations are weighted with respect to the 1990 county population. In Panel C, a full set of interactions between year fixed effects and dummy variables for each quartile of initial GDP are added. In Panel D, a full set of interactions between year fixed effects and dummy variables for each quartiles of initial post-primary education are added. In Panel E, a full set of interactions between year fixed effects and dummy variables for each quartile of the initial Herfindahl index are added. In Panel F, a full set of interactions between year fixed effects and dummies for each quartile of estimated baseline fraction of SOE employment are added. Asterisks indicate significance at the ten, five and one percent level.

Table A12: Foreign Direct Investment

	County-level data		Provincial-level data		
	Contractual FDI	Foreign capital used	Total foreign capital	Foreign loans	Direct FDI
	(1)	(2)	(3)	(4)	(5)
Post x NTR gap	31.552	109.961	1027.118	261.453	850.359
	(30.316)	(47.449)**	(505.318)**	(102.664)**	(661.606)
Mean dep. var.	133.463	120.757	2354.97	336.663	2108.981
Obs.	5436	5540	279	213	376

Notes: In Columns (1) and (2), the dependent variables are contractual FDI and foreign capital used calculated in millions of yuan reported at the county level. The primary independent variables are the interaction of a dummy variable equal to one for the post–2001 period and the county-level gap between NTR tariffs and the non-NTR rates, standardized to have mean zero and standard deviation one. The specification also includes a number of control variables: an interaction of the post-reform indicator variable and a time-invariant dummy capturing whether the county is characterized by high contract intensity industries, the industry-weighted MFA quota fill rate for county-produced goods, the industry-weighted national tariff rate for imports of county-produced goods and the tariff rate interacted with the post dummy, the industry-weighted percentage of firms licensed to export, and the industry-weighted time-varying NTR rate). Province-year and county fixed effects and prefecture-specific trends are included, and the time-varying trends are interacted with an urban dummy. Standard errors are estimated employing clustering at the county level.

In Columns (3) through (5), a parallel specification is estimated at the province-year level. The NTR gap and all other control variables are calculated as the mean variable across counties in the specified province and year. Province and year fixed effects are included, and standard errors are estimated employing clustering at the province level. Asterisks indicate significance at the ten, five and one percent level.

Table A13: Firm Outcomes: Specifications Using Weighted Means

Panel A: Factor utilization

	Emp.	Capital	Foreign capital dummy	Cap. intensity	Wages	Wages per worker
	(1)	(2)	(3)	(4)	(5)	(6)
Post x NTR gap	44.543	1356.890	.010	-2.029	950.066	.264
	(19.514)**	(432.914)***	(.006)*	(1.921)	(321.223)***	(.148)*
Mean dep. var.	116.35	3655.667	.077	61.848	1354.195	9.416
Obs.	2423	2020	2446	1997	2446	2423

Panel B: Other firm outcomes

	Exports	Sales	Value added	Profits	Value-added per worker
Post x NTR gap	2747.186	17025.090	3979.107	1662.164	.561
	(1062.459)***	(4553.016)***	(1027.445)***	(379.734)***	(1.873)
Mean dep. var.	3354.639	24658.011	5212.273	2143.398	51.59
Obs.	2446	2446	2231	2446	2207

Notes: The primary independent variable is the interaction of a dummy variable equal to one for the post–2001 period and the county-level gap between NTR tariffs and the non-NTR rates at the prefecture level, standardized to have mean zero and standard deviation one. The specification includes the same control variables described in the notes to Table 2, all calculated as the average at the prefecture-year level, as well as province-year and prefecture fixed effects. All standard errors are estimated employing clustering at the prefecture level.

The dependent variables in Panel A include total employment in sampled firms, the total wage bill in sampled firms, mean wage per worker, total capital stock in sampled firms, and mean capital intensity. The dependent variables in Panel B include total exports, sales, value added and profits in sampled firms, as well as mean value added per worker. Asterisks indicate significance at the ten, five and one percent level.