Did China Tire Safeguard Save U.S. Workers?*

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Abstract

It has been well documented that trade adjustment costs to workers due to globalization are significant and that temporary trade barriers have been progressively used in many countries, especially during periods with high unemployment rates. Consequently, temporary trade barriers are perceived as a feasible policy instrument for securing domestic jobs in the presence of increased globalization and economic downturns. However, no study has assessed whether such temporary barriers have actually saved domestic jobs. To overcome this deficiency, we evaluate the China-specific safeguard case on consumer tires petitioned by the United States. Contrary to claims made by the Obama administration, we find that total employment and average wages in the tire industry were unaffected by the safeguard using the 'synthetic control' approach proposed by Abadie et al. (2010). Further analysis reveals that this result is not surprising as we find that imports from China are completely diverted to other exporting countries partly due to the strong presence of multinational corporations in the world tire market.

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"Over a thousand Americans are working today because we stopped a surge in Chinese tires, but we need to do more."

- President Barack Obama, State of the Union Address, Jan 24th, 2012.

"The tariffs didn't have any material impact on our North American business."

- Keith Price, a spokesman for Goodyear Tire & Rubber Co., Wall Street Journal, Jan 20th, 2012.

1 Introduction

While trade barriers have reached historically low levels, a growing number of countries are worried about job losses as a consequence of the trade liberalization. The concern is well epitomized in the recent U.S. trade policy agenda. The Obama administration has filed trade dispute cases with the World Trade Organization (WTO) at a pace twice as fast as that of the previous administration. Moreover, the Interagency Trade Enforcement Center (ITEC) was set up in February 2012 to monitor and investigate unfair trade practices.[1] During the 2012 presidential election, both candidates pledged to take even stronger actions to protect U.S. businesses and workers.[2]

The incentives to secure jobs by raising trade barriers are well explained in the literature. Political economy of trade policy theory explains that higher risk of unemployment makes individuals more protectionist, which induces them to demand more protection through voting or union lobbying activity. The politicians who seek re-election then protect industries with high unemployment rates (Wallerstein, 1987; Bradford, 2006; Matschke and Sherlund, 2006; Yotov, 2012). In addition to political economy considerations, there are other models that justify protectionism. Costinot (2009) derives a model where the aggregate welfare can improve when highly unemployed industries are protected. Davidson et al. (2012) emphasize fairness or altruistic concern toward displaced workers as another incentive for protection. Bagwell and Staiger (2003) argue that trade policies are preferred to domestic redistributive policies because they *beggar thy neighbor*: While domestic policies come at the expense of domestic residents, trade policies cost foreigners.

Surprisingly, however, the literature so far has ignored to check whether such protective trade policies can actually save domestic jobs. In fact, studies have only focused on the other

[1] See Rapoza (2012, January 25th) *Forbes*.

[2] In fact, ever-increasing imports from China were discussed as one of the greatest future threats to the national security of the U.S. in the debates for the 2012 presidential election.

direction, i.e., how trade liberalization affects employment or wages. Gaston and Trefler (1994) and Trefler (2004), for example, find that import competition due to tariff declines have negative effects on wages in the U.S. and employment in Canada. In recent studies, Autor et al. (2013a,b) estimate how much the import surge from China costs U.S. manufacturing employees, and find that the greater import competition causes higher unemployment, lower wages, less labor market participation, and greater chance of switching jobs and receiving government transfers. Roughly speaking, these costs account for one quarter of the aggregate decline in U.S. manufacturing employment. McLaren and Hakobyan (2012) also find a significant adverse effect of import exposure to Mexico on U.S. wage growth for blue-color workers after the implementation of the North American Free Trade Agreement (NAFTA).[3]

The evidences above seem to imply that re-imposing trade barriers would secure domestic jobs. However, most recent protection policies are enacted in the form of antidumping, countervailing duties, or safeguards, which are systematically different in their nature from the trade barriers such as Most-Favored-Nation (MFN) tariff rates and import quotas that have been lowered in recent decades. These policies, often collectively called temporary trade barriers (TTBs), are typically (i) contingent, (ii) temporary, and (iii) discriminatory in that duties are imposed for a limited time to a small set of products from particular countries.[4] Due to these characteristics, there are at least two channels that may divert trade flows and weaken the impact of a TTB on domestic markets. First, the temporary feature of TTBs leaves a room for targeted exporting firms to adjust their sales timing to either before or after the tariff intervention. Second, perhaps more importantly, the discriminatory feature can divert the import of subject products from the targeted country to other exporting countries. Thus, whether – and the degree to which – a TTB can secure domestic jobs remains an unanswered empirical question.

Despite the lack of empirical evidence, many WTO member countries have already been opting for TTBs, especially in domestic recession phases with high unemployment rates. Knetter and Prusa (2003) link antidumping filings with domestic real GDP growth to find their counter-cyclical relationship during 1980-1998 in the U.S., Canada, Australia, and the European Union. Irwin (2005) extends a similar analysis to the period covering 1947-2002 in the U.S. case, and finds that the unemployment rate is an important determinant of antidumping investigations. More recently, two companion studies by Bown and Crowley (2012, 2013) investigate thirteen emerging and five industrialized economies, respectively, and report evidence that a high unemployment rate is associated with more TTB incidents.

This paper aims to fill up the deficiency in the literature by evaluating a special safeguard

[3]Similar patterns are observed in developing countries, too. See Goldberg and Pavcnik (2005) for Columbia, Menezes-Filho and Muendler (2011) and Kovak (2013) for Brazil, Topalova (2010) for India.

[4]An exception to discriminatory feature is Global safeguard measure, since it is imposed to all countries.

case on Chinese tires (China Tire Safeguard or CTS, henceforth) that has received a great deal of public attention among recent TTB cases.[5] Under Section 421 China-specific safeguard, the U.S. imposed higher tariffs on certain Chinese passenger vehicle and light-truck tires for three years from the fourth quarter of 2009 to the third quarter of 2012. The safeguard duties were 35% ad valorem in the first year, 30% in the second, and 25% in the third on top of the MFN duty rates.[6] The case has triggered not only Chinese retaliation on U.S. poultry and automotive parts, but also a serious controversy on the actual effectiveness of the CTS for the U.S. tire industry.[7] Despite such controversy, the CTS has been cited as a paragon of successful trade policy for job security during the 2012 U.S. presidential campaign by both candidates.

The CTS provides a uniquely advantageous setting for answering the question of this paper. While the CTS is representative in that it bears all three TTB characteristics described above, one important distinction of the CTS is that the safeguard duties are exogenously determined. In antidumping cases, which are the most pervasive form of TTB, duties are endogenously determined to offset the dumping margin. Even after the duties are in place, they are recalculated over time to adjust the dumping behavior changes of exporting firms.[8] These endogenous tariff changes complicate the evaluation of a tariff imposition effect. Secondly, the change in the total import of subject Chinese tires before and after the safeguard initiation is considerably large in both levels and growth rates.[9] If TTBs have labor market outcomes, this dramatic change should allow us to observe it. Third, contrary to most trade disputes in which the producers filed a claim, the petition for the CTS was filed by the union representing employees. This implies that the petition is indeed intended for employees' benefits and thus labor market effects.[10]

Estimating the impact of the China Tire Safeguard brings some challenges that need to be addressed. Above all, the estimates may be confounded by macroeconomic trends. Since the U.S. economy has been in recovery after the great recession of 2008-09, one may capture a spuriously inflated labor market effects that would have occurred even without tariff changes. A typical identification strategy in this case is to compare the tire industry with similar industries who have not experienced tariff changes. However, there is no clear criterion for choosing appropriate control industries in our case. To circumvent this problem, we exploit the synthetic control method (SCM) designed by Abadie and Gardeazabal (2003) and Abadie et al. (2010).

[5] Prusa (2011, P. 55) describes the China Tire Safeguard as "one of the most widely publicized temporary trade barriers during 2005–9, garnering significant press attention both in the USA and in China."

[6] MFN duty rates are 4% for radial (or radial-ply) tires and 3.4% for other type (bias-ply) of tires.

[7] See also Bussey (2012, January 20th) in *Wall Street Journal*.

[8] This recalculation process is also called administrative review process. Many studies investigate the implication of the review process on exporting firm's pricing behavior. See, for example, Blonigen and Haynes (2002) and Blonigen and Park (2004).

[9] Detail statistics are provided in Section 3.

[10] Prusa (2011) argues that the last two features are the main reasons of receiving unusual public attention.

The core strategy of the SCM is to construct a "synthetic" industry by optimally weighting a group of potential controls so that its outcome resembles the outcome of the tire industry as close as possible during the pre-intervention period. Hence, the synthetic industry will mimic the counterfactual tire industry for the post-intervention period as well in the absence of the safeguard measuring.

The SCM estimates provide a striking result. Contrary to the Obama administration's claim that the safeguard measures had a positive effect on the labor market (see quote above), we find that total employment and wages in the tire industry show no different time trends from those in the synthetic industries. Our result is supported by another finding that the substantial drop in Chinese tire imports is completely offset by the increase in imports from other countries. This complete import diversion leaves little room for domestic producers to make an adjustment in their production, which in turn induces no change in the labor market. Thus, our study highlights that the discriminatory feature of TTB plays a crucial role for the negligible labor market effect.

To our best knowledge, there is no study that investigates the effect of a TTB on domestic labor market outcomes. Some papers have looked at the exporting firms' strategic responses to a TTB through price adjustments (Blonigen and Haynes, 2002; Blonigen and Park, 2004), quantity controls (Staiger and Wolak, 1992), or tariff-jumping investment (Blonigen, 2002; Belderbos et al., 2004). These firm behaviors alter the aggregate trade patterns, and these changes in trade patterns have been analyzed in the literature (Prusa, 1997; Brenton, 2001; Bown and Crowley, 2007). Other studies have turned their attention to TTB effects on domestic firms, with particular interests in output (Staiger and Wolak, 1994), markup (Konings and Vandenbussche, 2005), profit (Kitano and Ohashi, 2009), and productivity (Konings and Vandenbussche, 2008; Pierce, 2011).[11] Although these studies may have some implications for labor market outcomes, they are insufficient to draw definite conclusions on employment and wage effects.

We begin our study with an overview of the China safeguard and the U.S. tire industry in section 2. Section 3 describes data and time trends of Chinese tire imports and employment. Section 4 provides the empirical model and discusses the results. Section 5 reports and discusses the results, and section 6 explores a potential mechanism that has driven our results. Section 7 concludes with policy implications and the direction of future researches.

[11] These studies mostly deal only with antidumping cases. (Blonigen and Prusa, 2003) provide a comprehensive survey on the literature of antidumping.

2 Overview of China Safeguard and the U.S. Tire Industry

The U.S. Trade Act of 1974 describes conditions under which tariffs can be applied and which groups can file a petition. Once the petition is filed, the International Trade Commission (USITC) makes a recommendation to the president. The president then makes a decision whether to approve or veto the tariff. Two sections (Section 201 and 421) of the Trade Act of 1974 deal with the use of safeguard tariffs. Under Section 201 (Global Safeguard), USITC determines whether rising imports have been a substantial cause of "serious" injury, or threat thereof, to a U.S. industry. On the other hand, Section 421 (China-specific Safeguard or China Safeguard) applies only to China. China Safeguard was added by the U.S. as a condition to China's joining the WTO in 2001 and expired in 2013. Under Section 421, the USITC determines whether rising imports from China cause or threaten to cause a significant "material" injury to the domestic industry. Total seven China Safeguard cases had been filed, of which two were denied by the USITC and five were approved. Of these five approved cases, the president ruled in favor of only one, which is the tire case.

There are a number of noteworthy differences regarding Global Safeguard vs. China Safeguard. First, the term "serious" vs. "material" implies a significant difference. Simply put, China Safeguard can be applied under weaker conditions than Global Safeguard. For China Safeguard to be applied, rising imports do not have to be the most important cause of injury to the domestic industry, while this has to be the case for Global Safeguard. That is, the imports from China need not be equal to or greater than any other cause. Second, China Safeguard is discriminatory and allows MFN treatment to be violated.[12]

The U.S. tire industry has several characteristics to be considered for our analysis. First, tire production is dominated by a few large multinational corporations (MNCs) in both the U.S. and the world. As of 2008, ten firms produce the subject tires in the U.S., and eight of them are MNCs.[13] Production of the subject tires are so concentrated that five major MNCs (Bridgestone, Continental, Cooper, Goodyear, and Michelin) control about 95% of domestic production and 60% of worldwide production.[14] Except Continental, Seven MNCs of the ten domestic producers also have manufacturing facilities in China. Second, the subject tires are known to feature three distinct classes, flagship (high quality), secondary (medium quality),

[12]There are three other primary areas under the WTO in which exceptions to MFN-treatment for import restrictions are broadly permissible: (1) raising discriminatory trade barriers against unfairly traded goods under antidumping or countervailing duty laws; (2) lowering trade barriers in a discriminatory manner under a reciprocal preferential trade agreement; and (3) lowering trade barriers in a discriminatory manner to developing countries unilaterally, for example, under the Generalized System of Preferences (GSP). For an additional discussion of the China safeguard, see Messerlin (2004) and Bown (2010).

[13]The ten U.S. subject tire producers are Bridgestone, Continental, Cooper, Denman, Goodyear, Michelin, Pirelli, Specialty Tires, Toyo, and Yokohama. Eight firms except Denman and Specialty Tires are MNCs.

[14]Data source: Modern tire dealer (`http://www.moderntiredealer.com/stats/default.aspx`).

and mass market (low quality). The domestic producers have largely shifted their focus to higher-value tires since 1990s, leaving mass market tire productions to overseas manufacturers.

These characteristics explain why the petition was not welcomed by the U.S. tire producers. The temporary tariff protection may actually hurt the MNCs' global production strategies. Moreover, the CTS would not have any positive influence to their domestic facilities that mainly produce high and medium quality tires, given that those tires are not well substitutable for low quality Chinese tires.[15]

3 Data and Descriptive Statistics

Our data on quarterly imports from 1998Q1 to 2012Q3 are taken from the U.S. International Trade Commission. Import data are available up to Harmonized System (HS) 10-digit, and each 10-digit code is defined as a "product". Import value is measured by customs value that is exclusive of U.S. import duties, freight, insurance, and other charges. We also define an "industry" as the 6-digit industry in the North American Industry Classification System (NAICS). According to the definition, the tire industry is 326211, "Tire Manufacturing (except Retreading)", which comprises "establishments primarily engaged in manufacturing tires and inner tubes from natural and synthetic rubber". This corresponds to 62 tire-related products in the HS 10-digit level (with heading 4006, 4011, 4012, and 4013) among which 10 tire products are subject to the safeguard measures.

Data on employment and wages in U.S. tire industry covering the same time period are from the Bureau of Labor Statistics Quarterly Census of Employment and Wages (QCEW).[16] In fact, Bureau of Labor Statistics provides two different industry-level employment databases, the QCEW and the Current Employment Statistics (CES). We use the QCEW in this paper, because it provides total employment and wages statistics for all 6-digit industries, while the CES contains only part of them.[17] For industry-level characteristics, we use data taken from the Annual Survey of Manufactures.

Figure 1 plots time trends of the aggregate import value of the ten tire products subject to the CTS as well as total employment in the U.S. tire industry from 1998Q1 to 2012Q3. The import of Chinese tires starts to surge in 2001, just before China's accession to the WTO. It continues to grow dramatically until the activation of the CTS, except for a slight drop in

[15]Because of these characteristics of the U.S. tire industry, Prusa (2009) predicted that the effect of the CTS would be negligible.

[16]While wages are reported on a quarterly basis, employment data are produced monthly. We construct quarterly employment data by simply averaging of the monthly data.

[17]Both databases have employment data in the tire industry. We checked the discrepancy between the two data, but there was no systematic or significant difference.

early 2009 due to the global financial crisis.[18] Specifically, the import increases by 300 times during ten years from $5.2 million dollars in 1999 to $1.56 billion dollars in 2008. In terms of relative size, China alone accounts for a quarter of the U.S. total import of subject tires in 2008, with tire imports from the rest of the world (ROW) at $4.80 billion dollars in the same year. The value also amounts to 9.2% of gross value added of the U.S. tire industry in 2008, which stood at $16.98 billion dollars.

The punitive tariffs substantially discourage the rising trend, reducing total imports from China by 62% between 2009$Q3$ to 2009$Q4$. A sharp rise between $Q2$ and $Q3$ followed by the sharp decline between $Q3$ and $Q4$ indicates that some importers in the U.S. bought the subject Chinese tires in advance of the CTS to avoid the higher expected price after 2009$Q3$. After 2009Q4, tire imports from China are relatively flat, albeit at a much lower level compared to pre-CTS levels.

Interestingly, the trend of employment in the U.S. tire industry stands in sharp contrast to the trend of Chinese tire imports. It starts to fall when the Chinese tire imports start to rise in 2001. In particular, the decline of employment in 2002$Q1$ coincides with China's WTO accession. Another falloff in 2006$Q4$ is caused by the strike in the U.S. tire industry and is not relevant to the Chinese tire imports. In terms of growth, employment in the U.S. tire industry falls by 30.5% from 2002$Q1$ to 2009$Q3$.[19]

The activation of the CTS seems to not only stop further decline in employment (with some lags) but also prompt a slight recovery thereafter. As the Obama administration claims, total employment increases from 45,855 in 2009$Q3$ to 46,812 in 2011$Q4$, an increase of about one thousand workers. However, the employment trend around 2009 is obviously confounded by the economic recovery from the global financial crisis, and thus the time-series data alone do not allow us to identify the safeguard effect on employment in the U.S. tire industry.

4 Empirical Model

4.1 A Conceptual Framework

We conceptually sketch how domestic labor market can be affected by foreign competition to propose an appropriate empirical model for identifying the safeguard effect. If the labor market for an industry were competitive, domestic employment and wages would be simul-

[18]As Staiger and Wolak (1994) finds, subject tire imports may also fall because of the safeguard investigation started from April in 2009.

[19]Note that, however, there are many other industries that suffered from more severe employment losses than the tire industry over the same period. For example, we compare the employment growth rates of nine NAICS 6-digit industries in Table 2. The table shows that three out of nine industries have lower employment growth rates than the tire industry has.

taneously determined by its supply and demand elasticities. A change in foreign competition works as a product demand shifter in this model. For example, an increase in import competition would shrink the demand for domestic product and thereby decrease labor demand while wages adjust to soften the degree to which the demand decreases through labor supply elasticities (Freeman and Katz, 1991; Revenga, 1992).

In reality, however, industries in the U.S. are likely to face non-competitive labor market for a number of reasons. One important reason is the presence of labor union through which its members bargain with employers over terms and working conditions of employment. We indeed observe such behavior in the tire industry being expressed as a strike in 2006. In this case, the negotiated wage rate tends to be higher than the competitive rate and, in turn, reduces the demand for labor, although their magnitudes can be heterogeneous across industries depending on workers' bargaining power (Abowd and Lemieux, 1993; Revenga, 1997). Non-competitive wages and employment can also be driven by other factors including efficiency wages or factor immobility, but in any case the adjustment would arguably be made in the same direction (i.e., higher wages and lower employment than the competitive equilibrium). The non-competitive market structure would also induce some rigidities in wages and employment over time, because the terms and conditions of employment may hold at least for a few years.

That said, we benchmark the empirical model by Revenga (1997) where non-competitive wages are first negotiated between labor union and employers in the presence of foreign competition and then firms choose their employment level according to their own labor demand curves. More arguments are added to the model as necessary to explain some important features in our context. Consider the following wage equation:

$$w_{it} = \alpha_1 q_{it} + \alpha_2 k_{it} + \alpha_3 m_{it} + \alpha_4 r_{it} + \gamma_{it}^{w} D_{it} + \mu_i^{w} \lambda_t^{w} + \epsilon_{it} \tag{1}$$

where w_{it} is log of average weekly wages in industry i at time t. Firms that minimize their production cost for given factor prices (other than wages) and output level would set their wages at which marginal cost of labor equals marginal revenue product of labor. Hence, w_{it} is basically a function of output (q_{it}), cost of capital (k_{it}), and cost of materials (m_{it}) which are all taken logarithm. The level of industry foreign competition, a product demand shifter in this model, is proxied by (log of) import penetration ratio, r_{it}, which is equal to the ratio of import to market size (= output + import - export).[20]

When the government intervenes in product markets by imposing punitive tariffs to certain imported goods, its impact on industry wages is supposed to be captured by the coef-

[20] The lagged wage rate can be added to the equation to explain the rigidity in wages.

ficient γ_{it}^{w}. Thus, D_{it} is a simple treatment assignment indicator that is one if industry i is protected by the safeguard action at time t, and zero otherwise. Note that γ_{it}^{w} varies fully over time and across industries to give us a complete set of heterogeneous safeguard effects on all industries in all post-intervention periods. The time-varying safeguard effect reflects the declining schedule of the CTS by 5% annually, but it could also mean that the responses of industries may come with some lags or simply be transitory.

Eq. (1) contains the term for unobservables ($\mu_i^{w}\lambda_t^{w}$) as well as the error term (ϵ_{it}). The unobservables are made up of a vector of interactive fixed effects of which dimension is unknown, and the whole term captures the effects of an unknown number of common factors (λ_t^{w}) with heterogeneous factor loadings (μ_i^{w}) that may be jointly correlated with observables. This term is more flexible to control for unobserved heterogeneity than the conventional configuration of fixed effects.[21] Indeed, we observe several economy-wide shocks in the sample period that seems to have heterogeneous impacts on industry-level employment and wages across U.S. industries. As an example, we have no rationale to assume that the financial crisis in 2008 would affect all industries by an equal magnitude. Similarly, not all industries would receive an equal impact by the China's accession to WTO in 2001 or its currency manipulation over recent years. Perhaps, more relevantly, if wage bargaining is negotiated based on the "outside" or "alternative" wages available throughout the economy and different industries have different bargaining powers, then the negotiated wages will also be different across industries. All of these common factors and industry-specific factor loadings with their interactions may cause the petitions for protection and subsequent government interventions, in which case failing to control for such interactive effects would lead to biased estimates for γ_{it}^{w}. We assume that the error term is a white noise.

Once wages are set, firms now are assumed to choose employment level as much as they demand for the given factor prices (including wages) and output level. The conditional labor demand function can be estimated from the following equation:

$$n_{it} = \beta_1 q_{it} + \beta_2 k_{it} + \beta_3 m_{it} + \beta_4 r_{it} + \beta_5 w_{it} + \gamma_{it}^{n} D_{it} + \mu_i^{n}\lambda_t^{n} + v_{it}\,. \tag{2}$$

Log of employment, n_{it}, in industry i at time t is conditional on wages as well as other factor prices, output level, import penetration ratio, and the treatment assignment in a similar fashion to Eq. (1).[22] However, the structure of unobservables ($\mu_i^{n}\lambda_t^{n}$) in Eq. (2) can be different from the one in Eq. (1) in terms of its dimension, since there might be some common factors that affect employment but not wages and vice versa. The error term v_{it} follows a white noise

[21] By letting $\mu_i^{w} = \begin{bmatrix}\mu_{1i}^{w} & 1\end{bmatrix}$ and $\lambda_t^{w} = \begin{bmatrix}1 \\ \lambda_{1t}^{w}\end{bmatrix}$, the vector of interactive fixed effects reduces to the conventional two factors panel model with industry-specific effect and time effect.

[22] Again, the lagged employment can be added to the equation to explain the rigidity in employment.

process.

4.2 Estimation Strategy

A common approach to identify the treatment effect is the Difference-In-Differences (DID) design. In a conventional DID model, the treatment (tire) industry is compared with some control industries that have not experienced any trade policy change under the assumption that the treatment industry would have followed the same trend as control industries had the policy not changed. Therefore, the DID model requires a proper selection of a control group to satisfy the common trend assumption.

In our case study, however, there is no clear criterion which industries should be chosen as the control group. One choice may be a group of all manufacturing industries that filed no petition (hence no protection) during the sample period, but those industries may be too heterogeneous in their characteristics to have the same time trend in outcome variables. Alternatively, a group of manufacturing industries that did file petitions but failed to be accepted can be considered in the sense that the group would face more or less similar circumstances to the tire industry. Another possible control group consists of all industries (other than the tire industry) under the same NAICS 3-digit code, i.e., 326 Plastics and Rubber Product Manufacturing since they are classified within the same 3-digit code based on the similarity of industry characteristics. However, neither of these groups are convincing to satisfy the common trend assumption.[23]

The Synthetic Control Method (SCM), designed by Abadie and Gardeazabal (2003) and Abadie et al. (2010), is appealing to deal with the present problem. They provide a method to generate a synthetic industry as the optimally weighted average over the outcomes of potential control industries such that the average provides the best fit with the treatment industry's outcome for the pre-intervention period. In other words, the SCM chooses the best combination of any given control industries in the pre-intervention period to generate the missing counterfactual of the treatment industry, so called synthetic industry, in the post-intervention period, and thereby increases the likelihood of satisfying the common trend assumption. Thus, the method is less demanding when it comes to choosing the "proper" set of control industries.

There are two more big advantages to use the synthetic control method in our analysis. First, the SCM can estimate the time-varying heterogeneous effect of the CTS, while a conven-

[23] Another problem in the conventional DID method occurs if the number of controls are small, since it leads to an over-rejection of the null hypotheses of zero effect. Indeed, the suggested control groups above, except the group of manufacturing industries that filed no petition, have less than twenty industries. According to Bertrand et al. (2004), we need at least about 40 control industries (with one treatment industry) in order to avoid the over-rejection problem.

tional DID or panel fixed effect estimation can only provide an estimate for the time-invariant average treatment effect. Second, it allows that the dimension of the vector of interactive fixed effects is arbitrarily unknown. Given that unobservable (time-varying) macroeconomic or (time-invariant) industry-specific factors have differential effects on each industry and they are potentially related with the industry selection mechanism for trade remedies, this advantage is important to obtain consistent estimates for the safeguard effect.

However, the SCM has a notable caveat. In order for the SCM to work, we need all observables to be time-invariant in the model, i.e., the estimation equations should look like the following:

$$w_{it} = X_i^w \alpha + \gamma_{it}^w D_{it} + \mu_i^w \lambda_t^w + \epsilon_{it} \tag{3}$$

$$n_{it} = X_i^n \beta + \gamma_{it}^n D_{it} + \mu_i^n \lambda_t^n + v_{it} \,. \tag{4}$$

where X_i^w and X_i^n are the vectors of all observables in Eq. (1) and (2) that are restricted to be constant over time. Thus, X_i's should be interpreted as the pre-intervention industry characteristics to predict the post-intervention values of outcome variables. Although this requirement may appear restrictive, the SCM can instead have any (or combination of) available pre-intervention outcome variables in X_i, that is, X_i can include all values of dependent variables in the pre-intervention period as predictors. These lagged values obviously explain the time trend of dependent variables. Hence, they can account for rigidities in wages and employment in the pre-intervention period. Moreover, the problem of time-constant restriction on predictors would be minimized to the extent which each lagged values represent the industry characteristics at that period.

4.3 Implementation

Without loss of generality, let the tire industry be industry 1 among observable industries. For all $I-1$ potential control industries, a vector of weights, $\omega = [\omega_2, \omega_3, \cdots, \omega_I]$, is assigned such that

$$\sum_{i=2}^{I} \omega_i^\star y_{it} = y_{1t}, \forall t \leq 2009Q3 \quad \text{and} \quad \sum_{i=2}^{I} \omega_i^\star X_i = X_1 \,. \tag{5}$$

Here, the outcome and the vector of predictors, (y_{it}, X_i), is either (w_{it}, X_i^w) or (n_{it}, X_i^n) for all $i \in I$. The Eq. (5) implies that we can obtain the exact solution for $\omega^\star$ only if $(\{y_{1t}\}_{t\leq 2009Q3}, X_1)$ belongs to the convex hull of $[(\{y_{2t}\}_{t\leq 2009Q3}, X_2), \cdots, (\{y_{It}\}_{t\leq 2009Q3}, X_I)]$. If it is not the case, some weights have to be set negative to minimize the differences between variables in the left- and right-hand sides in Eq. (5), but the fit may be poor. To avoid such extrapolation problem, we choose all NAICS 6-digit manufacturing industries that filed no petition during the sample period as our potential control industries in the baseline analysis. This selection gives us 146 control industries.

Note that the optimal weight is obtained for the whole pre-intervention period. Abadie et al. (2010) show that, for a sufficiently long pre-intervention period, the outcome of the synthetic industry, $\sum_{i=2}^{I} \omega_i^{\star} y_{it}$, provides an unbiased estimator of the counterfactual y_{1t} for all t.[24] The estimated treatment effect on the tire industry is obtained by

$$\hat{\gamma}_{1t} = y_{1t} - \sum_{i=2}^{I} \omega_i^{\star} y_{it}, \quad \forall t \geq 2009Q4 \tag{6}$$

where $\hat{\gamma}_{1t}$ is for either wages or employment. Finally, we include the 2008 values of total value of domestic shipments, cost of capital, cost of materials, and import penetration ratio (additionally, wages for the employment equation) and each variable's three year growth rate from 2005 to 2008 as time-invariant pre-intervention characteristics. The sample period in the baseline analysis ranges from 2001Q1 to 2012Q3, and all values of outcome variables in this pre-intervention period could also be added in X_i's as predictors. However, with only a few selective values in the pre-intervention period, we can provide almost the same but more efficient estimate for the treatment effect. Therefore, we choose eight lagged values of employment and wages in 2001Q1, 2002Q2, 2003Q3, 2005Q1, 2006Q1, 2007Q3, 2008Q3, and 2009Q3 that are included in the estimation equations as additional predictors.

5 Estimation Results

5.1 Main Finding

After the synthetic industries for employment and wages are constructed, their industry characteristics and growth rates are compared to those of the tire industry as well as those of simple averages of all control industries in Table 1. All numbers indicate that the two synthetic industries are closer to the tire industry than the averages of all controls in both industry characteristics and growth rates. In particular, the change in employment/wages from 2001Q1 to 2009Q3 are almost identical between tire and synthetic industry giving strong support for the common trend assumption. At the same time, other industry characteristics of synthetic industry are much more similar to tire industry than the simple average. Thus, if tire industry had experienced the fundamental change in production structure such that technology or capital replaced labor and labor-intensive products were offshored, our synthetic industry is also likely to have such experiences. On the other hand, a conventional DID method would

[24]For more detail descriptions on estimation procedure and proofs, see Abadie et al. (2010).

use the simple average of controls as the counterfactual tire industry, and the common trend assumption is more likely to be violated.

Table 2 reports the list of control industries with strictly positive weights that construct the two synthetic industries. Since employment and wages do not exhibit the same time trend, we expect the optimal weights for each synthetic industry to differ, which turns out to be true. This again supports the superiority of the synthetic industry approach over the equally weighted average of 146 controls for both employment and wages.

Figure 2 compares the trends of employment and wages in the U.S. tire industry with those of the synthetic industries. In general, the synthetic industries mimic employment and wage trends of the tire industry quite well in the pre-intervention period. An exception is around 2006Q4 due to the strike in the U.S. tire industry. The Root Mean Squared Prediction Error (RMSPE) shown at the bottom of each figure measures the sum of discrepancies between outcomes in tire and in synthetic industries for the pre-intervention period. It will be used later as a criterion for whether a synthetic industry is constructed well enough to mimic the treatment industry. For the post-intervention period, we see no significant differences between the tire industry and the synthetic industries for both employment and wages.

To infer the significance of the treatment effects formally, the SCM suggests a set of placebo tests. A placebo test can be performed by choosing one of the control industries as the treated industry and the other 145 industries as untreated industries. Specifically, we drop the tire industry from the sample, and treat industry 2 as the treatment industry. Then, we follow the same SCM procedure described above to obtain estimates of $\hat{\gamma}_{2t}$ for $t \geq 2009Q4$ using the rest of industries 3 through 146 as control industries. This procedure is repeated for $i = 3, \cdots, 146$. Since all control industries are not protected during the sample period, their treatment effects, $\hat{\gamma}_{it}$ for $j = 2, \cdots, 146$, are expected to be zero. Hence, if the tire industry was affected by the safeguard measures, we should be able to observe significantly different $\hat{\gamma}_{1t}$'s from all other $\hat{\gamma}_{it}$'s.

The results of two sets of placebo tests for employment and wages are displayed in Figure 3. Because some industries have poor synthetic industries with high RMSPEs, we show the estimated treatment effects for industries whose RMSPE is less than 0.01 for employment and 0.02 for wages. The vertical axis shows the estimated treatment effects of the tire and placebo industries over the sample period. All of them are close to zero before the activation of CTS, with exception of 2006Q4 in the case of the tire industry. In particular, the treatment effects in the tire industry after the CTS are well bounded by other placebo treatment effects. This confirms that neither employment nor wages in the tire industry are significantly affected by the safeguard measures.

5.2 Robustness

We first conduct a couple of robustness checks for our findings with the same SCM estimation method. First of all, the results do not change when we drop the period of the tire industry strike (i.e., 2006Q4) from our sample period. Secondly, we use alternative control groups: (i) a group of 35 industries that filed a form of TTB at least once during the sample period, but failed to be protected at all, and (ii) a group of 14 industries under NAICS 326 Rubber and Plastic Product Manufacturing that are free of any TTB case during the sample period. The results do not change for both control groups. Finally, our findings still hold when employment and wages are measured in levels instead of log transforms.[25]

Next step is to employ alternative estimation methods to check whether our SCM results are robust to such different methods. First, we estimate the treatment effect using a traditional DID method. Specifically, we run the following regression equation:

$$y_{it} = \delta_i + \lambda_t + X_{it}\beta + \tau D_{it} + \epsilon_{it} \tag{7}$$

where y_{it} is either employment or wages in log term and X_{it} is the vector of corresponding covariates as in Eq. (1) and Eq. (2). δ_i and λ_t are industry and time fixed effects, respectively. This model is a typical difference-in-differences specification that assigns an equal weight to all control industries. The first column in Table 3 presents the estimation results. The sample period ranges from 2007Q3 to 2011Q4 so that we have nine quarters before and after the CTS activation in the sample.[26] Thus, the sample size is 18 quarters times 147 industries including the tire industry, which equals 2,646. The safeguard effect is shown to be negatively significant for employment at the 1% level, while it has no significant effect on wages.

Eq. (7) is often called as a random growth model if we add the industry-specific linear time trend of the dependent variable, $\rho_i t$, in the equation. This specification is particularly advantageous when the petition and the subsequent decision for the safeguard protection are made because of the overall time trend of employment or wages. Technically speaking, it allows industry-specific growth rates to be correlated with the treatment assignment, D_{it}, so that we can avoid the selection bias problem as long as the selection is based on the growth rates of the dependent variable. Estimation results are presented in the second column in Table 3. Again, the CTS effect on domestic employment is negatively significant. On the other hand, its impact on wages is now positive and significant even at the 1% significance level.

[25] We do not report results for the robustness checks to keep focusing on the main results. The results are available upon request.

[26] The truncation in the pre-intervention period excludes the impact of the strike in the U.S. tire industry. The truncation in the post-intervention period is simply due to the lack of data on industry characteristics in 2012. The estimation results are qualitatively same when we extend the pre-intervention periods.

The two estimations above are relying on the common trend assumption between the tire industry and the rest of 146 control industries. Obviously, this assumption is too restrictive for given heterogeneity across industries. To deal with the issue, we employ the Propensity Score Matching method to select control industries comparable to the tire industry in the third robustness check. Just like we matched industry characteristics in 2008 between the treatment and control groups for the SCM case, here we match observables in 2008 (i.e., from 2008Q1 to 2008Q4) and choose 10 nearest neighbors to the tire industry with replacement, based on the propensity scores.[27] Then, we run the weighted regression on the controls with unobserved heterogeneity and industry-specific linear time trend. Consequently, our sample size is as large as 4,680. Column (3) in Table 3 indicates that the treatment effect is neither significant on employment nor on wages.[28]

Fourth, we try to account for the cross-sectional dependence through common factors using the model developed by Pesaran (2006). The model specification is as follows:

$$y_{it} = X_{it}\beta_i + \tau_i D_{it} + \mu_i \lambda_t + \epsilon_{it} \,. \tag{8}$$

Eq. (8) is closer to the original equations for wages and employment than Eq. (7), since it allows the unknown vectors of industry- and time-specific unobserved effects to interact with each other ($\mu_i \lambda_t$). It also has an advantage that observable covariates can be time-varying, compared to the SCM specification in Eq. (3) and Eq. (4) where the observables are time-invariant. On the other hand, this model is less suitable than the SCM specification in the sense that the coefficient τ should be time-constant to provide an average treatment effect over the whole post-intervention period.

The intuition behind the estimation strategy in Pesaran (2006) is straightforward: To account for all biasing effects of the unobservable common factors (λ_t), the model includes the cross-sectional averages of dependent and independent variables (i.e., $\bar{y}_t$ and $\bar{X}_t$) as regressors in a similar spirit to a panel correlated random effect model. Estimation then is separately performed for each panel unit (i.e., each industry) so that the industry-specific unobserved effect (μ_i) as well as the treatment effect (τ_i) can also be estimated by construction.[29] We leave more discussions on the estimation procedure to Pesaran (2006) and present the results in the fourth column in Table 3. Clearly, we can see that there is no significant CTS effect, both statistically and economically, on domestic employment and wages in the tire industry.

[27] The selected control industries in terms of NAICS code are 311611, 312130, 321219, 334210, and 336111 for the employment equation and 322110, 324110, 327310, and 336111 for the wage equation.

[28] As mentioned earlier, small number of treatment and control industries may cause the over-rejection problem. In our case, the null hypothesis is already rejected, but we still provide Wild bootstrap P-values suggested by Cameron et al. (2008) to accurately test the statistical significance of estimates.

[29] Pesaran and Tosetti (2011) show that this estimated treatment effect is robust to the serial correlation in the error term which is a desired feature in our case.

As a final note, the industry that we analyzed (NAICS 326211) experienced more than one policy change. While Passenger Car and Light Truck Tires under NAICS 326211 were subject to China Safeguard from the 3rd quarter of 2009 for 3 years, Off-the-road Tires imported from China were subject to anti-dumping (AD) duties from the 3rd quarter of 2008 that are still effective. Since our treatment group (NAICS 326211) is contaminated by the AD duties, ignoring it might cast doubts on our empirical results. However, the domestic production of off-the-road tires is less than 5% whereas that of passenger car and light truck tires is about 80% out of the total production in the tire industry.[30] Hence, even if AD duties might have affected the employment and wages of the U.S. tire industry, its impacts would not be economically significant. Moreover, if one looks at the employment and wages trend around 2008 in Figure 2, the AD duties do not seem to matter for the domestic employment and wages.[31]

6 Potential Mechanism

Our evidence regarding the CTS raises the question of why there is no effect. In this section, we provide a potential mechanism through which the CTS had only a negligible impact on employment and wages in the U.S. tire industry. Specifically, we focus on the discriminatory nature of TTB as the key driving factor: Since the punitive tariff is imposed on a certain set of products made in only one or few countries, imports may be diverted to other non-tariffed countries who produce the same products. As Prusa (1997) argues, if this import diversion is complete in the sense that the import decline from the target countries is offset by the import increase from non-target countries, domestic producers have little room for any adjustment.[32] In our case, we indeed find a complete import diversion in terms of import value as well as volume (i.e., quantity). Obviously, however, not every TTB would produce the complete diversion as in our case, and we need to understand what determines the degree to which import is diverted. Although answering this question is beyond the scope of our study, we provide some theoretical and anecdotal evidence that MNCs play an important role for the

[30] Authors calculate the ratio using disaggregated production data from 2008 Annual Survey of Manufacturers. This ratio is similar to the report of Modern Tire Dealer in 2008. In terms of imports proportion, off-the-road tires were only 9% out of total Chinese new tire imports in 2008, while passenger car and light truck tires are about 75%.

[31] In fact, we attempt to investigate passenger car tires only. While the employment and wages data on passenger car tires are not available, the annual shipment data are available from Annual Survey of Manufacturers. We calculate the annual ratio of passenger car tire production out of total tire production and multiply this ratio to the employment data, assuming that the shipment ratio is proportional to the employment ratio. If there had been a change in employment of passenger car tires manufacturing, the shipment must have been reflected. The SCM results and traditional DID results using this weighted data produce the exactly same message: no impact of CTS on domestic labor market. Estimation results are available upon request.

[32] Konings and Vandenbussche (2005) empirically support this argument by showing that domestic firms do not change their mark-up when they experience a strong import diversion after their industry is protected by antidumping action.

complete diversion at the end of this section.

6.1 Trade Diversion

To formally assess how the total imports of subject tires from China and the RoW change before and after the CTS, we again exploit a random growth model used in the previous section. Subject tire imports were more rapidly increasing than the control tire imports both in level and percentage change terms, and the safeguard measures are selectively applied to some tire products based on the import growth rates. The random growth model deals with this selection bias.

In our DID design for the tariff effect on subject tire imports, a natural control group would comprise the other 52 tire-related products not subject to a tariff change. However, 13 tire products out of 52 are subject to anti-dumping duties as noted in section 5.2. Also, some tire products are either not imported for many years or highly volatile in their import volumes. After dropping such products out of the control group, we have 33 control units versus 10 treatment units.[33] Given these 43 tire-related products in our sample, clustering standard errors at the product level is reasonably safe to avoid the over-rejection problem as discussed in Bertrand et al. (2004) and Angrist and Pischke (2009). We also confine our sample period from 2006Q4 to 2012Q3 so that three years before and after the treatment can be compared, though extending the sample period does not change our results qualitatively.

In the model, the treatment effect, τ_j, is assumed heterogeneous across products but constant over time. Let the import value (or volume) of product j at time t (from either China or RoW), y_{jt}, be given by

$$y_{jt} = exp(\delta_j + \lambda_t + \rho_j t + \tau_j D_{jt})\epsilon_{jt} \tag{9}$$

where δ_j and λ_t are product and time fixed effects, respectively, $\rho_j t$ captures the product-specific (linear) growth rate, and ϵ_{jt} is the idiosyncratic shock with zero mean. A typical estimation approach is to transform Eq. (9) into log-linear form to obtain the fixed effect (FE) estimator. However, Santos Silva and Tenreyro (2006) argue that the log-linear transformation can cause a bias due to heteroskedasticity or zero trade values, and suggest a Poisson pseudo-maximum likelihood (PPML) estimator with the dependent variable in levels. Hence, we follow the PPML estimation method, although the FE estimates are not qualitatively different.

Estimation results are provided in the first two columns in Table 4. Since we have some zero trade values, the sample size is less than 1,032 (= 43×24). Panel A shows the average treatment effect (ATE) on the subject Chinese tire imports, which is also called the trade destruction effect by Bown and Crowley (2007). Trade destruction is both statistically and economically

[33] As emphasized in the main analysis, there is no clear criterion for selecting control unit. Our finding in this section is at least robust to the extent which it include the volatile products in the control group.

significant: The estimates show that safeguard measures reduced subject tire imports from China by around 62% more than non-subject Chinese tire product imports in total value and 52% in quantity.

Panel B shows trade diversion effect by estimating the ATE on the subject tire import from RoW. Trade diversion is also significant, with around a 17% increase in total value and a 38% increase in quantity. These increases are substantial, given that the total import value of subject tires from the RoW in the pre-intervention period are, on average, three-times that from China. To examine whether the trade diversion was actually complete, we estimate the ATE on the total U.S. import (including China) of subject tires (see Panel C). Statistically and economically insignificant estimates in Panel C imply that the total U.S. tire imports, whether they are measured by value or volume, are not affected by the CTS. Thus, we find that trade destruction is completely offset by trade diversion.

We look at how import unit values from China and the RoW change with the tariff in the last column. As Trefler (2004) notes, changes in unit values within an HS 10 digit is likely to reflect changes in prices. We use the same setup as Eq. (9) with import unit values as the dependent variable instead. The unit value is defined as the ratio of customs value to total quantity imported. Hence, it is the value prior to the import duty. The unit value of a tire product from RoW is the weighted average of each country's product unit value with its import share being used as the weight. Panel A of the table estimates the ATE in unit values of the subject Chinese tire products. The estimated effect is statistically insignificant. This implies that the safeguard measures are mostly passed through which in turn is consistent with the notion that the import destruction effect was substantial. Moreover, the estimation results for the RoW case in Panel B are equally insignificant. These results together imply that the reduction in tire imports from China is completely offset by a rise in RoW tire imports at the pre-TTB unit price.

6.2 The Role of MNCs

The potential mechanism described above implies that the labor market effect of a TTB would crucially depend on the degree to which an import diversion occurs. Although the existing literature has not provided a rigorous explanation for the degree of diversion, we can expect that factors such as the level of protection, industry structure, and substitutability between foreign and domestic goods would affect the magnitude of import diversion. In the CTS case, low substitutability between Chinese and domestic tires might stimulate the import diversion from China to other countries who produce similar quality tires. Also, as Konings et al. (2001) argue, high concentration of the subject tire market might increase the strategic rivalry which in turn offsets the effects of the safeguard measures.[34]

In our view, however, a more crucial reason for the 'complete' diversion is that the world market for subject tire productions is dominated by MNCs. If there were no MNCs and the tires were produced entirely by local exporters, trade diversion would induce the U.S. importers to look for new exporters from other countries. Certainly, the frictions in replacing trade partners make trade diversion costly. Not only that, even if trade partners are replaced, the (new) local exporters might not be able to fully meet the domestic demand because of their physical capacity constraints (Ahn and McQuoid, 2013; Blum et al., 2013) or credit constraints (Chaney, 2013; Manova, 2013). On the other hand, MNCs who have multiple production facilities across countries can substantially reduce such frictions, since they can not only reallocate tire productions along their horizontal production chains to circumvent capacity constraint, but also use internal capital markets linked with their parent firms to mobilize additional funds in case of liquidity constraint. In fact, recent studies by Alfaro and Chen (2012) and Manova et al. (2014) consistently find evidence that MNCs are more flexible to external shocks and react better than local exporters by exploiting their production and financial linkages.

Due to the lack of adequate data, we cannot formally test the hypothesis that trade diversion tends to be stronger in prevalence of MNCs. However, anecdotal evidence combined with the U.S. import data corroborates our argument. Table 5 lists the top 10 subject tire exporting countries to the U.S. in order of export percentage growth. All of these countries have manufacturing facilities of the world's major tire MNCs. For example, Thailand, the highest ranked country in the table, has production facilities of large MNCs such as Bridgestone, Goodyear, Michelin, Sumitomo, and Yokohama. The Japanese business magazine, Nikkei, reports that Thailand has become a key export base for these MNCs after the CTS activation.[35] Indonesia has the subject tire plants of Bridgestone, Goodyear, and Sumitomo. Particularly, Bridgestone in Indonesia has expanded its production capacity to meet increased demands in 2010.[36]

In terms of the dollar value of the net increase, it is South Korea who has benefited the most. There are two major MNCs headquartered in South Korea (Hankook and Kumho) which also have plants in China. These two MNCs shifted large shares of their productions from China to South Korea and other countries to circumvent the safeguard measures. Especially, Hankook Tire Co., the biggest foreign tire producers in China and the world's fastest-growing tire company, clearly reports that "the [America] regional headquarters diversified production

[34] Konings et al. (2001, p. 294-5) discuss a couple of possible reasons why the import diversions in the European Union are generally weaker than in the U.S. The reasons include lower duty level, lower market concentration, higher uncertainty in decision making process, and more tariff-jumping FDI.

[35] Article source: `http://www.thetruthaboutcars.com/2010/07/trade-war-watch-15-thai-tires-trump-chinese/`. The original article is available at `http://www.nikkei.com/article/DGXNASDD210AG_R20C10A7MM8000/`

[36] Article source: `http://www.bridgestone.com/corporate/news/2010051401.html`

sources to circumvent the additional 35 percent safeguard tariff on Chinese-made tires that was imposed from the fourth quarter of 2009." (Hankook Tire Annual Report 2010, p. 44).

In the case of Taiwan, Asia Times (2011, September 10th) reports that Bridgestone Taiwan, which in the past did not export tires to the U.S., began to export one million tires to the U.S. in 2009 in response to the tariff imposed on China. Furthermore, Cooper, headquartered in Ohio, did not start sourcing tires from its U.S. plants to replace the Chinese imports. Instead, the company switched to its partners in Taiwan and South Korea to supply the U.S. market. These pieces of evidence altogether support that the discriminatory tariff induced MNCs to switch productions from China to other countries.

Finally, it is noteworthy to compare our findings to another safeguard protection case, the tariff on imports of heavyweight motorcycles from Japan between 1983 and 1987. This case is often heralded as a great success of safeguard protection.[37] While the nature of the Japan safeguard is similar to the CTS in that it was temporary and discriminatory as well, there is a major difference between them: The major motorcycle companies at the time were not MNCs. Had Japanese or American (i.e., Harley-Davidson) firms been MNCs in the 80s with plants outside the U.S. and Japan, our analysis suggests that the impact of the safeguard would have been much weaker.

7 Concluding Remarks

Two branches in the trade literature independently document that trade adjustment costs to workers due to the globalization are significant and that TTBs have been progressively used across countries during periods of high unemployment rates. Our interpretation of these two phenomena is that temporary trade barriers are perceived as a feasible policy instrument for securing domestic jobs in the presence of increased globalization. Recent U.S. foreign trade policies are also in line with our interpretation. Particularly, during the recent presidential election in 2012, both candidates pledged stronger protection policies against China to save domestic jobs while citing the China-specific safeguard case on consumer tires as a successful example. This paper formally asks whether the CTS actually saved domestic jobs. Using the synthetic control method to estimate the impact of the CTS, we find that the U.S. tire industry experienced no gains in both employment and wages.

The negligible labor market effects are not surprising as further analysis reveals that imports from China were completely diverted to other exporting countries leaving the U.S. production unchanged. We also provide a potential reason for the complete import diversion.

[37]There is some controversy on whether the safeguard protection actually saved Harley-Davidson, the only heavyweight motorcycles maker in the U.S. at the time, but the safeguard surely gave some breathing room to Harley-Davidson on the brink of bankruptcy. See Feenstra (2004, Chapter 7) and Kitano and Ohashi (2009).

Since the world tire industry is dominated by a small number of multinational corporations with their own production and financial networks, the reallocation of production across countries is relatively frictionless. Since MNCs would diversify subject tire production to countries who have a comparative advantage in producing similar quality tires, countries such as Thailand, Indonesia, South Korea, Mexico, and Taiwan became the predominant beneficiaries of the discriminatory tariff policy, but not the U.S. Although we provide anecdotal evidence for the crucial role that MNCs played in making the complete trade diversion possible, a more systematic analysis with adequate data is left for future work.

Our study predicts that other TTBs that bear similar characteristics to the CTS should have little impact on domestic labor markets in industries where MNCs are major players. This prediction is particularly important given the remarkable trend in recent years toward the proliferation of massively networked MNCs. Hence, negligible TTB effect should be more pronounced in the future. Accordingly, an optimal trade policy design must take the presence of MNCs into account.

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Table 1: Predictors of Employment and Wages

Variables	Employment Tire	Employment Synthetic	Employment Average[a]	Wages Tire	Wages Synthetic	Wages Average[a]
ΔEmployment (n) / Wages (w)	-0.517	-0.513	-0.285	0.106	0.100	0.173
Wages	6.978	6.707	6.919	–	–	–
ΔWages	0.106	0.169	0.172	–	–	–
Output (q)	8.307	8.385	7.616	8.307	7.545	7.616
ΔOutput	0.075	0.038	0.149	0.082	0.051	0.149
Cost of Capital (k)	-2.910	-3.576	-3.734	-2.951	-3.449	-3.734
ΔCost of Capital	0.382	0.188	0.051	0.385	0.388	0.051
Cost of Material Inputs (m)	-0.437	-0.522	-0.658	-0.395	-0.546	-0.658
Δ Cost of Material Inputs	0.171	0.045	0.031	0.180	0.177	0.031
Import Penetration Ratio (r)	-2.017	-3.477	-3.516	-2.017	-2.304	-3.516
ΔImport Penetration Ratio	0.091	0.028	-0.093	0.085	0.030	-0.093

[a]The simple average of all potential control industries

Notes: All variables are log transformed. Growth rates for employment and wages are calculated as the % change from 2001Q1 to 2009Q3. Output, cost of capital, cost of material inputs, and import penetration ratio are 2008 values and each variable's growth rate is the % change from 2005 to 2008. Eight lagged values of employment (wages) included as predictors for the post-intervention employment (wages) are not reported here to save space.

Table 2: 6-digit manufacturing industries

Employment NAICS	Industry name	Weight	Growth[a]	Wages NAICS	Industry name	Weight	Growth[a]
Treatment Industry							
326211	Tire Manufacturing (Mfg)	n/a	-0.517	326211	Tire Manufacturing (Mfg)	n/a	0.106
Control Industries							
311213	Malt Mfg	0.009	-0.404	312111	Railroad Rolling Stock Mfg	0.046	0.123
311423	Dried and Dehydrated Food Mfg	0.016	-0.082	312130	Wineries	0.081	0.072
311611	Animal Slaughtering	0.391	-0.046	312140	Distilleries	0.081	0.312
313210	Broadwoven Fabric Mills	0.198	-1.373	321219	Reconstituted Wood Product Mfg	0.062	0.186
325120	Industrial Gas Mfg	0.158	-0.371	322110	Pulp Mills	0.047	0.221
333314	Optical Instrument and Lens Mfg	0.016	-0.286	324110	Petroleum Refineries	0.035	0.134
333515	Cutting Tool Mfg	0.094	-0.637	332992	Small Arms Ammunition Mfg	0.287	0.051
334412	Bare Printed Circuit Board Mfg	0.054	-1.300	334210	Telephone Apparatus Mfg	0.106	0.311
336510	Railroad Rolling Stock Mfg	0.065	-0.375	336330	Motor Vehicle Steering Mfg	0.252	-0.046
				336992	Military Armored Vehicle Mfg	0.003	0.062

[a]Growth rate is calculated as the average % change from 2001Q1 to 2009Q3.

Table 3: Robustness Checks

	(1)		(2)		(3)		(4)	
Dep. Variable	Employment	Wages	Employment	Wages	Employment	Wages	Employment	Wages
$\hat{\tau}$	-0.048**	-0.006	-0.029**	0.034**	-0.026	0.033	-0.000	0.001
	(0.009)	(0.005)	(0.007)	(0.003)	(0.015)	(0.021)	(0.000)	(0.001)
					[.204]	[.498]		
Observations	2,646	2,646	2,646	2,646	4,680	4,680	2,646	2,646
R-squared	0.995	0.960	0.998	0.964	0.999	0.955	–	–

Notes: The sample includes 147 industries with 18 quarter periods from 2007*Q*3 to 2011*Q*4. Robust standard errors for coefficients are clustered at the industry level in parentheses, and Wild bootstrap P-values are additionally provided in the bracket. **significant at 1%; *significant 5%.

Table 4: Impact of the U.S. Tariffs on Tire Import Flows

Dep. Variable	Import Value	Quantity	Unit Value
Panel A: Import from China			
$\hat{\tau}$	-0.962**	-0.709**	0.126
	(0.110)	(0.242)	(0.210)
% change	-62.03	-52.23	10.95
Observations	1,032	1,032	847
R^2	0.973	0.948	0.665
Panel B: Import from RoW			
$\hat{\tau}$	0.157**	0.328**	0.008
	(0.059)	(0.105)	(0.229)
% change	16.84	38.09	-1.80
Observations	1,032	1,032	1,026
R^2	0.994	0.982	0.731
Panel C: Total Import			
$\hat{\tau}$	-0.082	0.007	0.201
	(0.054)	(0.151)	(0.270)
% change	-8.01	-0.44	17.85
Observations	1,032	1,032	1,027
R^2	0.992	0.973	0.768

Notes: The sample includes 43 products with 24 quarter periods. All specifications include product-specific fixed effect and linear time trend, and time dummies. Robust standard errors for coefficients are clustered at product level in parentheses. Calculation of percentage changes are based on Kennedy (1981). **significant at 1%.

Table 5: Top 10 Subject Tire Exporting Countries to the U.S. by Export Percentage Growth

Country	Export to the U.S. (million $)		Net Increase	% Growth
	Before CTS	After CTS		
Thailand	418	1,457	1,038.58	248.33
Indonesia	489	1,220	731.08	149.53
Mexico	764	1,544	780.16	102.18
South Korea	1,941	3,876	1,935.49	99.73
U. K.	103	190	86.58	84.02
Taiwan	396	604	207.68	52.46
Germany	580	788	208.49	35.96
Canada	3,481	4,589	1,107.73	31.82
Costa Rica	256	327	70.92	27.72
Brazil	672	840	167.77	24.96

Notes: The total import volumes are calculated for 12 quarters before and after the CTS activation ranging from 2006Q4 to 2012Q3. Countries with export greater than hundred million dollars before the CTS activation are only listed.

Figure 1: Trends of subject tire imports and the U.S. tire industry employment during 1998Q1-2012Q3

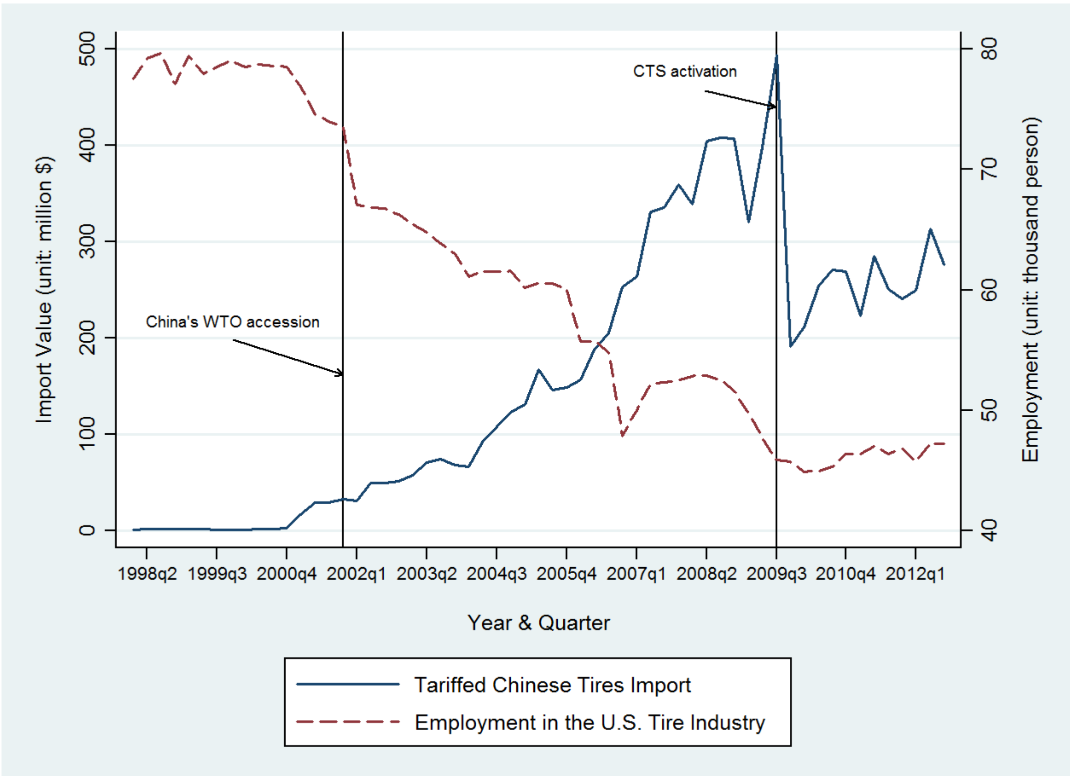
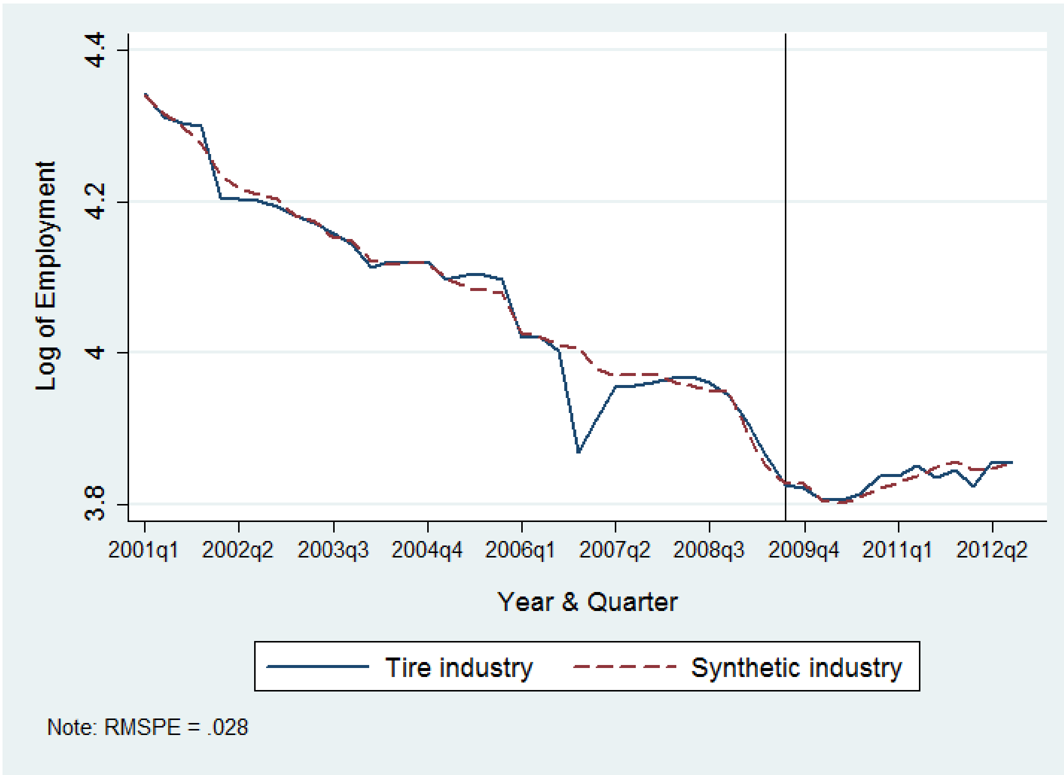


Figure 2: Trends in the U.S. Tire vs. Synthetic Industry during 2001Q1–2012Q3

(a) Total Employment



(b) Average Wage

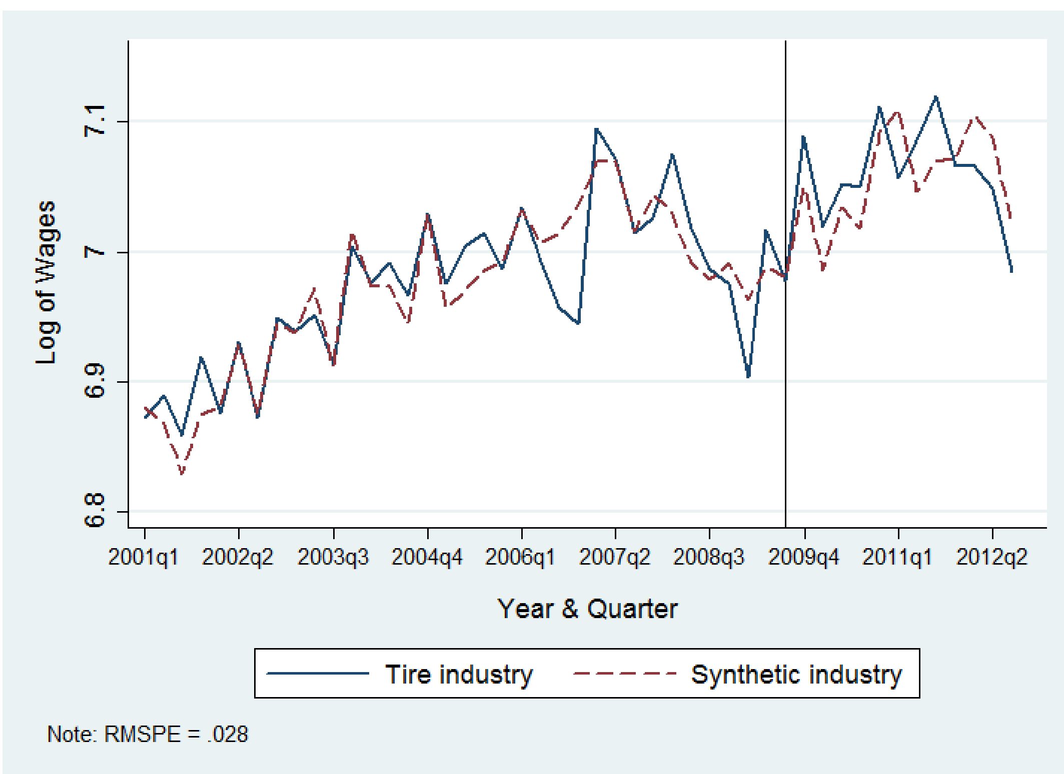
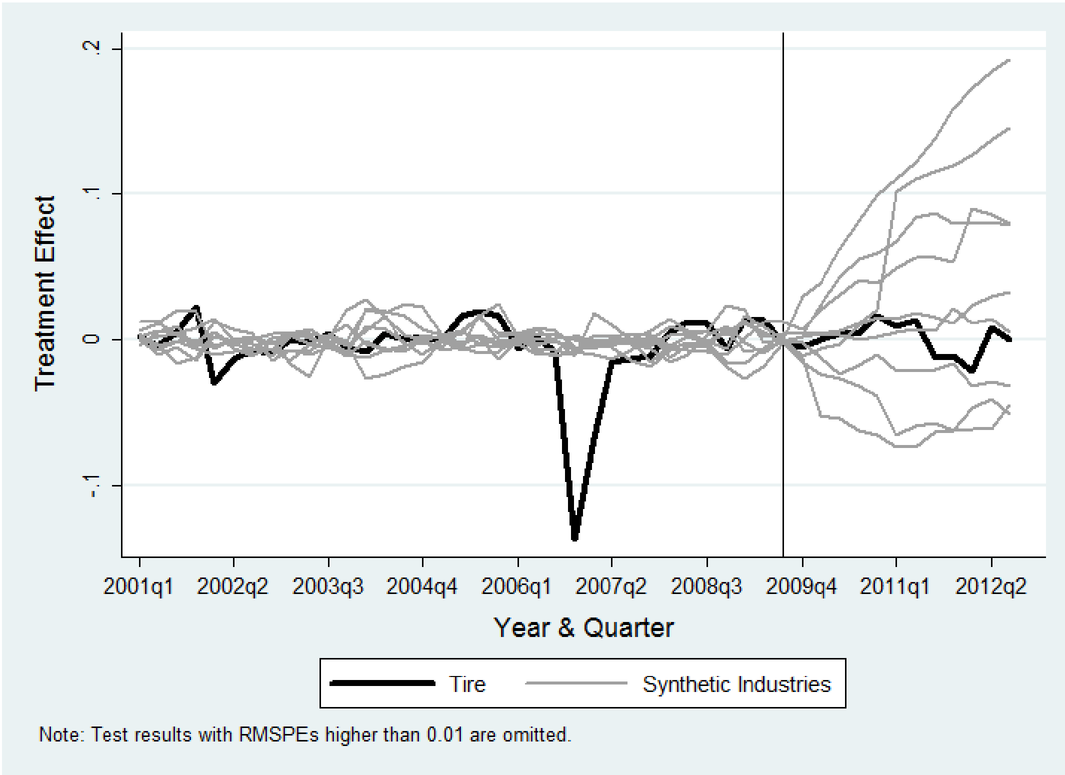


Figure 3: Placebo Tests for the CTS Effect on Labor Market Outcomes

(a) Total Employment



(b) Average Wage

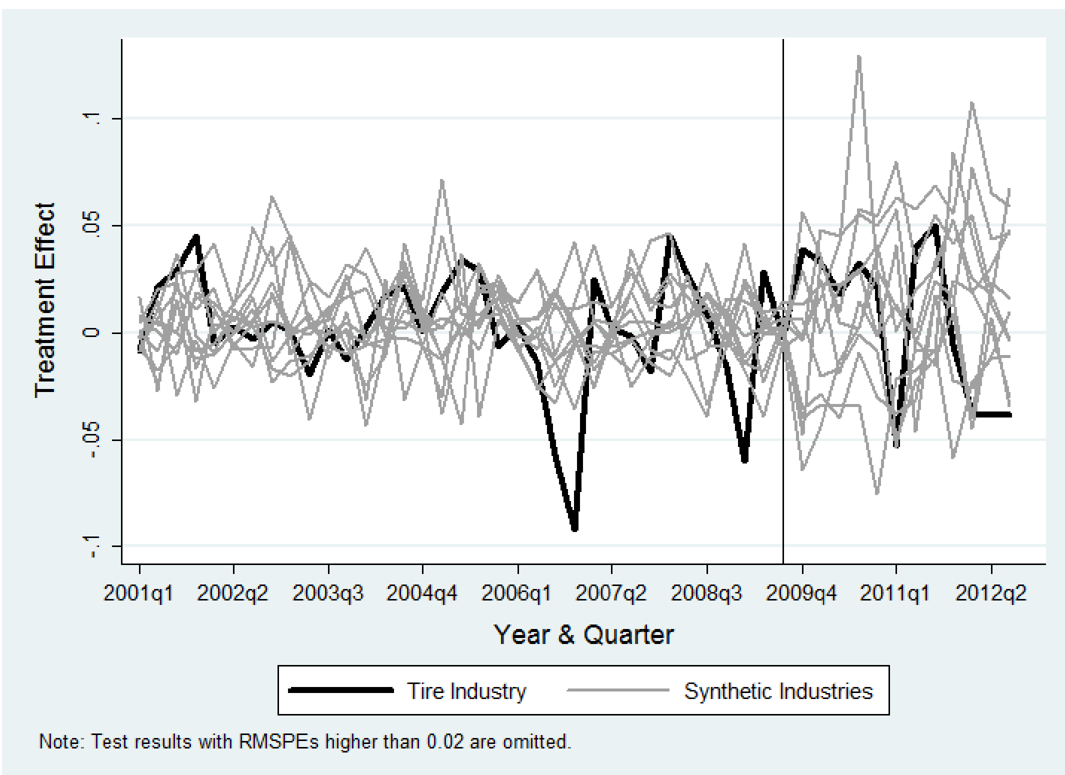


Figure 4: Trend in the U.S. Tire Import during 2001Q1-2012Q3