

The Unequal Reallocation of Trade-Induced Job Losses: Evidence from the U.S. Trade Adjustment Assistance

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January 2017

Abstract

Administrative data on the U.S. Trade Adjustment Assistance (TAA) for workers reveals that locations with more trade-induced displacements not only shed more of their existing jobs but also create fewer new jobs to absorb these losses. Across locations, one extra TAA trade-displaced worker is associated with the employment falling by about two workers: the more trade displaces, the less reallocation takes place. This finding is robust to industry-mix import penetration at the commuting-zone level, suggesting a role for within-industry heterogeneity. A multi-location heterogeneous-firms trade model with variable markups arising from head-to-head foreign competition can endogenize such unequal reallocation across locations. In the medium run following an unexpected trade liberalization, employment and earnings collapse in the least productive locations through both increased trade-induced job losses and reduced job creation. Employment increases in the aggregate despite muted population mobility while inequality in earnings rises and prompts “trade adjustment” transfers across locations.

Keywords: foreign competition, import penetration, trade adjustment, TAA, reallocation, endogenous variable markups, unemployment, inequality, China shock.

JEL classification: F16, F66, G64

I thank Cristina Arellano, Tim Kehoe, and Fabrizio Perri for their continued, patient, and illuminating advice. I am deeply grateful to my discussants – George Alessandria, Max Dvorkin, Joel Rodrigue, and John Stevens – as well as my colleagues and seminar participants at the Cleveland Fed, Minneapolis Fed, Board, Minnesota, Clemson, Drexel, Northwestern, NUS, American, Pittsburgh, Penn, Vigo, UVa Darden, Miami U, Midwest Trade at MSU, SED in Seoul, RMEIT in Banff, USITC, BLS, U.S. Department of Labor Office of Trade Adjustment Assistance, U.S. Census Bureau, Econometric Society in Minneapolis, and the Barcelona GSE Summer Forum. I thank Robert Tamura for the U.S. state productivity data. I gratefully acknowledge the University of Minnesota Doctoral Dissertation Fellowship for financial support. The views expressed herein are those of the author alone and not necessarily those of the Board of Governors or the Federal Reserve System. All shortcomings are mine alone. This paper is a major revision – especially in the empirical section – of the previously circulated manuscript titled “Trade Reforms, Foreign Competition, and Labor Market Adjustments in the U.S.” [†]Email: kondo@illenin.com. First version under previous title: November 15, 2011.

1 Introduction

With each new round of trade negotiations and national elections, policymakers and economists grapple with the labor market effects of trade reforms. Economists rightly advance the consensus view that freer trade provides overall economic gains. However it is also widely acknowledged that gains from trade are likely to be unequally distributed, with certain workers and industries benefiting while others lose as a result of trade liberalization. Understanding these unequal effects are particularly relevant at the geographic level due to limited worker mobility across locations.

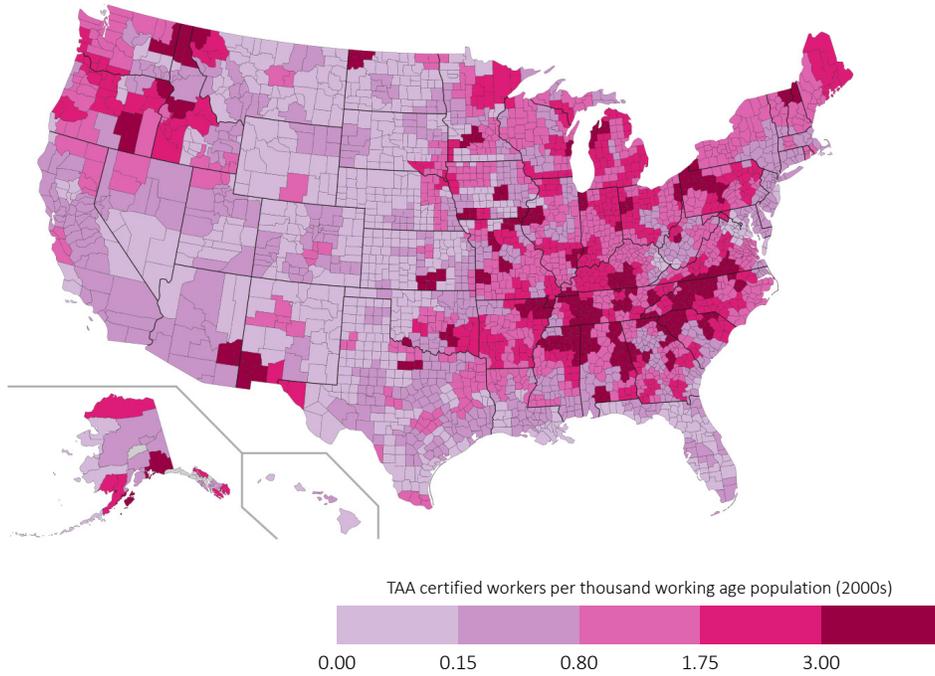
Using the unprecedented surge in Chinese imports at the turn of the century, [Autor et al. \(2013\)](#) construct an insightful measure to trace out the local effects of the “China shock”. They document an array of important results depicting the worsening of local outcomes in the U.S. in response the China shock (see [Autor et al. 2016](#) for an excellent review). Their seminal findings, together with the literature exploiting differences in industry composition across locations, point to the need to refine our understanding and treatment of how trade-displaced workers are reallocated, not just across firms or industries but also across locations. This paper contributes to both the theory and the measurement of the labor market effects of international trade across local labor markets.

The paper presents and rationalizes new evidence on trade, unemployment, and job flows using data from the U.S. Trade Adjustment Assistance (TAA) programs for workers. The TAA program for workers aims to facilitate the professional transition of trade-displaced workers and was unveiled when the United States geared in 1962 for unprecedented trade negotiations later known as the “Kennedy round” of GATT multilateral trade negotiations. In his 1962 *Special Message to Congress on Foreign Trade Policy*, President Kennedy laid the foundation of modern U.S. foreign trade policy and framed the Trade Expansion Act of 1962: “*the most important international piece of legislation, I think, affecting economics since the passage of the Marshall plan*” according to him. Along with urging extraordinary trade openness, President Kennedy then argued that “*there is an obligation to render assistance to those who suffer as a result of national trade policy*” and that “*prompt and effective help can be given to those suffering genuine hardship in adjusting to import competition, moving men and resources of uneconomic production into efficient production and competitive positions.*”¹

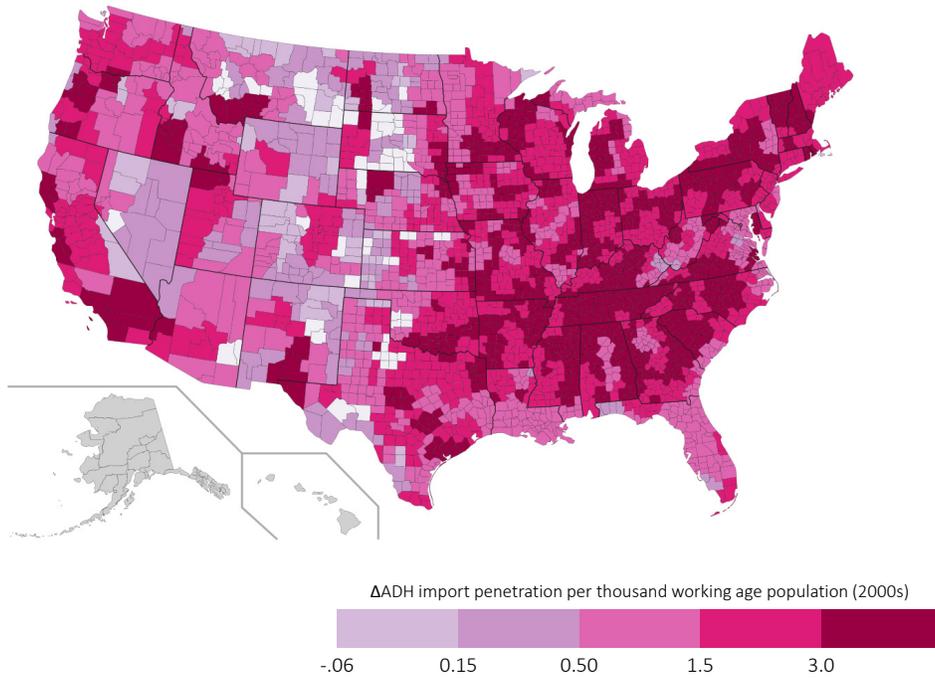
The current form of eligibility criteria and the operations of the TAA program for workers were defined in the Trade Act of 1974. Firms, unions, state unemployment agencies, or groups of three or more workers can file a petition on behalf of a subset of workers at a given establishment.

¹In his 1962 *Special Message to Congress on Foreign Trade Policy* (see [Kennedy 1962](#)), President Kennedy requested sweeping and wide-ranging negotiating authority: a general authority to reduce existing tariffs by 50 percent and a special authority to reduce or eliminate bilateral tariffs with the growing European Economic Community (EEC). The TAA program continues to be a critical segment of U.S. trade policy and was an important part of the “Trade Preferences Extension Act of 2015” signed in anticipation of the Trans-Pacific Partnership (TPP) trade agreement.

Figure 1: TAA trade-induced job losses and import penetration proxy



(a) TAA certifications across commuting zones in the 2000s



(b) Import penetration across commuting zones in the 2000s

To determine the eligibility of the petitioning workers, federal investigators with subpoena power must find evidence, using confidential firm-level data, that these workers were separated because of (a) import competition that led to decline in sales or production, (b) a shift in production to another country with which the United States has a trade agreement, or (c) the loss of business as an upstream supplier or downstream producer for another producer that is TAA-certified.

The data used in this paper is the universe of nearly 46,000 establishment-level TAA petitions from 1989 to 2009.² In principle, the TAA data could directly identify trade-induced job losses at a given point in time and space. This data allows for a direct “ground-truth”, albeit endogenous and noisy, measure of local trade-induced shocks. Typically, the import penetration has been used to infer such impact based on national industry-level imports of locally produced goods. The two measures should therefore be correlated but they are also different and complementary.

Figure 1 shows a map of the TAA certifications at the commuting-zone level in the 2000s and contrasts it with a map of an import penetration measure constructed by Autor et al. (2013). For instance, in the 2000s, the textile-dependent commuting zone surrounding Gaston, NC was in the top-10 of TAA displacements per capita but not in the top-100 according to the import penetration proxy. Meanwhile, the nearby commuting zone surrounding Catawba, NC was in the top-20 of both metrics. Similar examples of the differences between the two measures abound as reflected in Figure 1. In fact, the “China shock” is silent on within-industry channels by virtue of its industry-level Bartik-style nature: it assigns the same value to two locations with the same industry mix. In contrast, the TAA certification data can capture differences across locations concentrated in the same import-competing industry.

The TAA petitions data yields novel facts on the reallocation of trade-displaced workers. Job gains are precisely lower in the places that shed more existing jobs due to trade. Across locations, one extra trade-displaced worker is associated with the employment falling by about two extra workers: the more trade displaces, the less reallocation takes place. This *reallocation elasticity* controls for various attributes including the “China shock”, local unionization rates, non-tradable economic activity, location indicators and time indicators. It is also robust to both spatial and temporal aggregation: the findings are strikingly similar when using a yearly panel at the state level from 1989 and 2009 and when using a decadal panel at the commuting zone level as in Autor et al. (2013). Unlike Autor et al. (2013), this paper does not make any causal inference from the estimated elasticity. Instead, it argues that the estimated reallocation elasticity is endogenous.³

²The certification process was drastically revamped in the early 1980s under the Reagan administration which even sought to eliminate the TAA program altogether. The baseline data therefore starts in 1989.

³Monarch et al. (2014) used the underlying TAA petition data to study the employment effects of offshoring at the firm-level. Yotov (2007) and Uysal and Zylkin (2015) previously used the underlying TAA petition data for industry-level and firm-level predictions. Margalit (2011) also used the TAA petition data in the political science literature to understand voting behavior and trade.

The paper offers a simple theoretical explanation for such endogenous reallocation elasticity based on within-industry competitive effects of trade. This is motivated by the robustness to the estimated reallocation elasticity to the inclusion of the import penetration proxy, a measure of differences in industrial composition. Following the seminal contributions of [Bernard et al. \(2003\)](#) and [Melitz \(2003\)](#), trade economists have extensively explored *within-industry* reallocation using models with heterogeneous firms. However, in existing models, mobility frictions and segmented locations are typically absent (see [Caliendo et al. 2015](#) for a recent and insightful advance).⁴

This paper specifically argues that pro-competitive effects absent in the standard models can critically shape the reallocation elasticity of trade displacements across locations. In fact, recent empirical and theoretical work also highlights the importance of variable markups in the adjustment of firms to trade reforms (see, for example, [de Blas and Russ 2015](#); [Edmond et al. 2015](#); [De Loecker et al. 2016](#)). Using a stylized heterogeneous-firms trade model with variable markups, this paper traces how the pro-competitive effects of trade percolate from the firm level into local labor market outcomes, and then connects these outcomes to local trade-induced displacements – the model-consistent TAA statistic – arising from increased head-to-head foreign competition.

The paper builds a multi-location heterogeneous-firms trade model with head-to-head foreign competition that delivers an endogenous elasticity of local employment to trade-induced job losses. In the model, trade-induced job losses are only a symptom of lower local productivity. Such lower local productivity is also associated with reduced competitiveness of surviving local firms when the national economy becomes more open. Therefore, the model delivers that increased trade-induced job losses are associated with reduced job reallocation through increased job destruction and reduced job creation. Head-to-head competition and segmented locations are crucial to generate changes at the extensive margin and in variable markups that percolate into firm selection, job flows, local wages, employment and other labor market outcomes. In the medium run, when workers cannot move but can only get local new jobs, earnings inequality rises across locations and triggers temporary transfers across locations.

The Ricardian trade model proposed here nests labor markets segmented across locations in the spirit of [Lucas and Prescott \(1974\)](#) with a Ricardian trade model of heterogeneous firms producing differentiated goods, some of which face head-to-head foreign competition (see [Dornbusch et al. 1977](#); [Bernard et al. 2003](#)). Head-to-head competition provides a clear model counterpart for the data on TAA job losses attributed to the foreign competition. Such model TAA “statistic” would not exist in [Melitz \(2003\)](#) and [Melitz and Ottaviano \(2008\)](#) where firms shut down due to lower economy-wide prices and not direct firm-specific competition as in [Bernard et al. \(2003\)](#).

⁴Existing models are not well-equipped to capture this elasticity of local unemployment to TAA trade-induced displacements either because they cannot identify job losses from direct foreign competition – as opposed to lower economy-wide prices – or simply because they do not feature segmented labor markets.

The model also encapsulates a simple trade variant of [Dixit and Stiglitz \(1977\)](#) in order to sharply highlight how endogenous variable markups affect labor market outcomes. Transitional population dynamics after a trade reform are captured by restricting worker mobility across, but not within, locations. This assumption follows [Helpman and Itskhoki \(2010\)](#) and is consistent with the data.⁵

In this Ricardian model, productivity differences across locations drive the heterogeneous competitive effects of trade reforms on unemployment and inequality. Specifically, locations are assumed to differ in the productivity of their local firms.⁶ Within each location, each firm produces a unique differentiated variety and competes head-to-head with a foreign competitor if any. The firm's foreign competitor has a productivity that is randomly drawn. Firms with the same productivity therefore face competitors that can be more or less productive. Thus, a firm in a more productive location is more likely to outcompete its foreign rival. The heterogeneity in the foreign rival's productivity also means there can be worker reallocation across firms within a given location even if workers don't migrate. Local nonemployment is obtained using random Leontief matching within each labor market and collective Nash bargaining.⁷ Workers direct their search across locations. So, workers are allocated such that they are indifferent among these locations *ex ante*.⁸ In the medium run following an unexpected trade reform, workers are allowed to switch firms within their home labor markets but they cannot migrate.

Productivity differences across locations endogenously influence trade-induced job losses, trade-induced job gains, wages, population size, and unemployment across locations. Both cross-sectional productivity differences and variable markups are crucial to explain the endogenous elasticity of local unemployment to trade-induced displacements across locations. More productive locations have larger firms, exhibit higher markups, have higher population, pay higher wages, and also feature higher unemployment rates in the long run. These long-run spatial equilibrium features are corroborated using state-level productivity data from [Turner et al. \(2008\)](#). The presence of local unemployment also ensures that firms can tap into their endogenous local unemployment despite the lack of mobility in the medium-run transition following a trade reform.

In the medium run, tougher head-to-head competition changes the distribution of markups and

⁵[Kennan and Walker \(2011\)](#), [Artuç et al. \(2010\)](#), [Dix-Carneiro \(2014\)](#) estimate substantial switching and mobility costs. These findings are consistent with sluggish population adjustments in this paper, [Autor et al. \(2013\)](#), [Menezes-Filho and Muendler \(2011\)](#), and [Topalova \(2007\)](#). [Hakobyan and McLaren \(2016\)](#) find significant migration effects of NAFTA. See also [Matsuyama \(1992\)](#) and [Dixit and Rob \(1994\)](#) for theories of sectoral allocation and labor mobility frictions.

⁶Exogenous productivity differences here simply capture the idea that productivity is geographically correlated. See [Glaeser and Maré \(2001\)](#) and [Combes et al. \(2008\)](#) on agglomeration and worker selection across cities. See also [Allen and Arkolakis \(2014\)](#) and [Coşar and Fajgelbaum \(2016\)](#) on trade, agglomeration, and internal geography.

⁷Here, local unemployment arises from spatial search frictions and downward wage rigidity in the bargaining. The linear production function and the simple Leontief matching function are used to provide a simpler and more tractable benchmark. Results are similar in a variant of the model with matching frictions.

⁸This indifference condition is reminiscent of [Lewis \(1954\)](#), [Harris and Todaro \(1970\)](#), spatial equilibrium models à la [Roback \(1982\)](#), and directed search models such as [Lucas and Prescott \(1974\)](#) and [Alvarez and Shimer \(2011\)](#).

the extensive margins of operation and export across locations. These changes are uneven and in turn determine labor market outcomes. Firms in less productive areas face fiercer foreign competition and become more likely to shut down. These firms shut down because their markups are already compressed and they cannot further reduce them to stave off competition. Fewer jobs are also created in the least productive areas because their firms are less likely to outcompete foreign rivals or to become new exporters. General equilibrium effects of falling prices also adversely affect the firms in less productive locations through reduced demand for their goods.

Therefore, the most vulnerable locations have both a higher job destruction rate and a lower job creation rate as in the data. Unemployment rates sharply rise and earnings fall in the least productive locations. Other locations expand greatly as they simultaneously see many plants shut down while other plants start exporting. Still, other locations – the most productive locations – experience little changes in competitive pressure and expand the least. Lack of worker mobility exacerbates earnings inequality across locations. The model generates an endogenous elasticity of local unemployment to trade-induced displacements across locations. Across the losing locations, the calibrated model can deliver the measured reallocation elasticity. In the long run after a trade liberalization, the least productive locations become ghost towns as their residents migrate away.

This paper contributes to a growing literature at the nexus of international trade and labor economics. [Topel \(1986\)](#) and [Blanchard and Katz \(1992\)](#) made influential contributions on differential labor market dynamics across locations and workers. [Topalova \(2007\)](#) and [Kovak \(2013\)](#) study the impact of trade liberalization on migration and wages in India and Brazil respectively.⁹ [Autor et al. \(2013\)](#), [Ebenstein et al. \(2014\)](#) and [Hakobyan and McLaren \(2016\)](#) conduct a thorough analysis of U.S. labor markets and trade.¹⁰ They exploit variations in industrial composition to document the worsening of labor market outcomes in the localities or occupations more exposed to import competition. [Pierce and Schott \(2016\)](#) document that the elimination of trade policy uncertainty with China precipitated the decline of American manufacturing. [Monarch et al. \(2014\)](#) recently used a Census-matched subset of the same TAA petition data to document large and persistent employment declines at the firm level following offshoring events.¹¹ This paper complements these empirical findings using novel data at the geographic level and also highlights the role of within-industry heterogeneity in foreign competition.

[Davidson et al. \(1999\)](#) made a seminal contribution by considering labor search and matching

⁹[Hasan et al. \(2012\)](#) also investigate trade protection and unemployment across states in India.

¹⁰[Ebenstein et al. \(2014\)](#) also consider a more direct measure of trade-induced job losses than the import penetration: the foreign employment of U.S. multinationals reported by the BEA. Naturally, such a measure would not capture the extinction of a small shoe manufacturer for example. Unreported tabulations confirm that the TAA data and the BEA data differ substantially in industrial composition.

¹¹A related literature investigates the decline of American manufacturing. [Alder et al. \(2014\)](#) and [Yoon \(forthcoming\)](#) consider the role of unionization and biased technical change in the decline of the Rust Belt. See also [Holmes and Schmitz \(2009\)](#) for a review of the literature on competition and productivity.

frictions in international trade theory. Since then, studies of the labor market outcomes have been revived thanks to the influential work of [Bernard et al. \(2003\)](#) and [Melitz \(2003\)](#) who brought intra-industry heterogeneity and reallocation in focus. In particular, [Verhoogen \(2008\)](#), [Egger and Kreickemeier \(2009\)](#), [Dutt et al. \(2009\)](#), [Mittra and Ranjan \(2010\)](#), [Felbermayr et al. \(2010\)](#), [Helpman and Itskhoki \(2010\)](#), [Helpman et al. \(2010\)](#), [Davis and Harrigan \(2011\)](#), [Amiti and Davis \(2012\)](#), and [Cacciatore \(2014\)](#) greatly expanded the literature on trade-induced intra-industry reallocation, wages, inequality, and unemployment. [Harrison et al. \(2011\)](#) provide a review of the literature on trade and inequality. [Kambourov \(2009\)](#), [Artuç et al. \(2010\)](#), [Ritter \(2013\)](#), [Coşar \(2013\)](#), and [Dix-Carneiro \(2014\)](#) also recently studied transition paths in dynamic models of trade and unemployment with sectoral and human capital heterogeneity. This paper contributes to this literature by showing the importance of endogenous variable markups in understanding the unequal labor market effects of trade liberalization across local labor markets.¹²

In fact, this paper argues that labor market outcomes crucially depend on how the distribution of markups changes following a trade liberalization. This paper is therefore related to the pro-competitive effects of trade liberalization studied by [Arkolakis et al. \(2015\)](#), [de Blas and Russ \(2015\)](#), [Edmond et al. \(2015\)](#) and [Holmes et al. \(2014\)](#). Recently, [De Loecker et al. \(2016\)](#) estimated substantial heterogeneity in the distribution of markups following trade liberalization. This paper focuses on the labor market outcomes across segmented labor markets in the presence of competitive effects of international trade. Here, correlated changes in markups and at the extensive margin are key for understanding the stylized facts on trade and unemployment across locations.¹³ Incidentally, the model shows that variable markups from head-to-head competition also generate an exporter-premium without requiring the screening approach of [Helpman et al. \(2010\)](#). The focus on the role of transitional mobility frictions and endogenous variable markups in local labor reallocation also distinguishes this paper from the elegant tractable multi-industry multi-location Eaton-Kortum model of [Caliendo et al. \(2015\)](#).

This paper is structured as follows. Section 2 empirically analyzes foreign competition and labor market outcomes across the United States using the Trade Adjustment Assistance (TAA) petitions data. Section 3 develops a trade and unemployment model with endogenous variable markups and heterogeneous segmented labor markets. Section 4 conducts two experiments: an unexpected trade reform as well as an unexpected increase in foreign productivity when mobility is limited in the transition. Section 5 concludes.

¹²See also [Notowidigdo \(2011\)](#) and [Moretti \(2011\)](#) for studies on the effects of local shocks on wages and land prices using the spatial equilibrium framework of [Roback \(1982\)](#). See also [Beaudry et al. \(2012\)](#) for a spatial equilibrium model with unemployment in which locations vary in industrial composition.

¹³[Felbermayr et al. \(2014\)](#) also find that the effects of international trade on residual inequality across firms depend crucially on product market competition.

2 Evidence across States and across Commuting Zones

This section presents the main empirical findings. The dataset is constructed using establishment-level petitions from the U.S. Trade Adjustment Assistance (TAA), individual-level data from Current Population Survey (CPS), job flows data in U.S. Census Business Dynamics Statistics (BDS), housing starts from U.S. Census New Residential Construction (NRC) database, and U.S. imports data combined with U.S. Census County Business Patterns (CBP).

The TAA data contains more than 46,000 establishment-level petitions from 1989 to 2009 that are aggregated into a yearly state-level panel dataset. The data is also aggregated into a decadal commuting zone panel dataset which is then merged with the decadal panel dataset of [Autor et al. \(2013\)](#). The paper therefore provides evidence on the reallocation of trade-induced job losses at both the state level and the commuting zone level.

2.1 The Trade Adjustment Assistance (TAA) Petitions Data

The Trade Adjustment Assistance (TAA) for workers is a federal program that aims to support the professional transition of workers displaced due to foreign trade. Firms, unions, state unemployment agencies, or groups of three or more workers can file a petition on behalf of affected workers at a given establishment. Each petition includes information on the establishment location, the number of workers affected, the certification decision, and the date of impact. Each received petition and each determination decision are published in the Federal Register.¹⁴

To establish the eligibility of the petitioning workers, federal investigators at the Department of Labor Office of Trade Adjustment Assistance (OTAA) seek evidence that these workers were separated because of (a) import competition that led to decline in sales or production, (b) a shift in production to another country with which the United States has a trade agreement, or (c) the loss of business as an upstream supplier or downstream producer for another producer that is TAA-certified. Certified workers are eligible to receive benefits such as training, income support, job search allowances, relocation allowances, and healthcare assistance for up to two years.

In response to the filing, the OTAA institutes an investigation to determine whether foreign trade was an important cause of the workers' job loss or threat of job loss. Federal OTAA investigators issue a "confidential data request" (CDR) for data such as sales history, sales of import-competing products, major declining customers and unsuccessful bids. The OTAA investigators also have legal power to issue subpoenas if the company does not comply to the data request.¹⁵

¹⁴Petitions are also publicly available at www.doleta.gov. The dataset used was obtained from a FOIA request to ensure that all petitions were covered. In-person meetings with the TAA staff also helped confirm the quality of the data and how the program works.

¹⁵A sample CDR form is available online at www.illenin.com/research/taa_cdr_article.pdf.

For each petition, the TAA data contains a petition identifier, the petition instantiation date, the job separation date, the certification determination date, the company name, the plant location attributes, the number of workers included in the petition, a description of the plant’s products or services, the certification decision, the certification determination code (e.g. shift in production, increased customer imports, increased company imports, etc.). A petition is typically processed within a month or two. About half of petitions are submitted by the company, a quarter by the workers, a fifth by the state and the rest by unions.

The data contains more than 46,000 establishment-level petitions from 1989 to 2009. Around 60 percent of petitions are certified.¹⁶ Of the submitted petitions: 77 percent were in Manufacturing, 11 percent in Mining, 9 percent in Services or Utilities, and the small remainder in Agriculture, Finance or Construction.¹⁷ The certifications are therefore predominantly in Manufacturing: 82 percent of the certified petitions were in Manufacturing and 13 percent in Mining. The number of workers certified at an establishment has a median value of 44 workers and an inter-quartile range of 94 workers. The total number of workers certified nationally in a given year has a median value of nearly 130,000 workers and an inter-quartile range of about 70,000 workers.¹⁸

2.2 Measuring Foreign Competition for States and Commuting Zones

For every year $t = 1989 \dots 2009$ and every state i , trade-induced foreign competition is measured as the ratio of all workers newly certified for TAA during that calendar year relative to the working age population (w.a.p.):

$$\text{TAA foreign competition}_{i,t} \equiv \frac{\text{newly TAA certified workers}_{i,t}}{\text{working age population}_{i,t}}.$$

The state is used as a geographic unit in order to have longer annual time series and to exploit a vast array of economic co-variates available yearly at the state-level but not at finer levels. The maps in Figure 2 show that the TAA-based measure varies across states and over time while being broadly consistent with the conventional wisdom about which regions are the most affected.

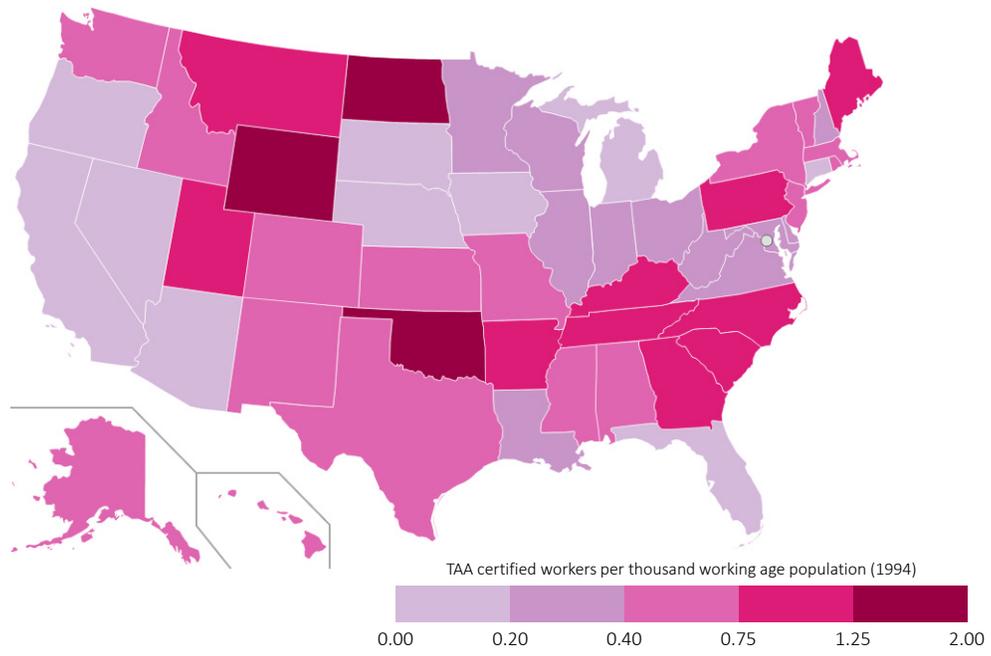
Figure 3 shows the typical order of magnitude of this TAA-based measure and illustrates a positive relationship between trade-induced job losses and the nonemployment rate across U.S. states during 1989-2009. The nonemployment rate is computed as the unemployment rate plus the

¹⁶One could also be concerned about how political pressures affect the odds of being certified. In fact, amidst the 1980s recession, unionized auto workers would get certified during seasonal slowdowns. The situation ultimately led the Reagan administration to revamp the program, especially the certification process (see [Rosen 2006](#) for a detailed history of the TAA program). The sample does not include the pre-Reagan era and starts in 1989.

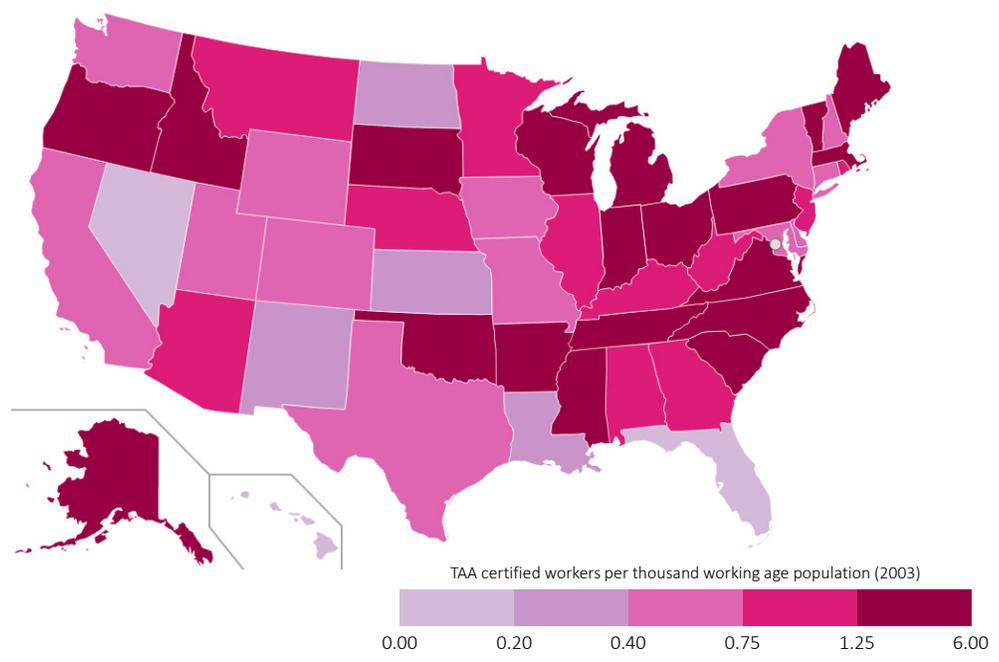
¹⁷[Monarch et al. \(2014\)](#) cover about a thousand “offshoring” events between 1996 and 2006.

¹⁸Once covered by a certification, individual workers apply for benefits and services through the state workforce agency. This paper does not use that data on workers who elect to receive TAA benefits once certified.

Figure 2: TAA certified workers across states

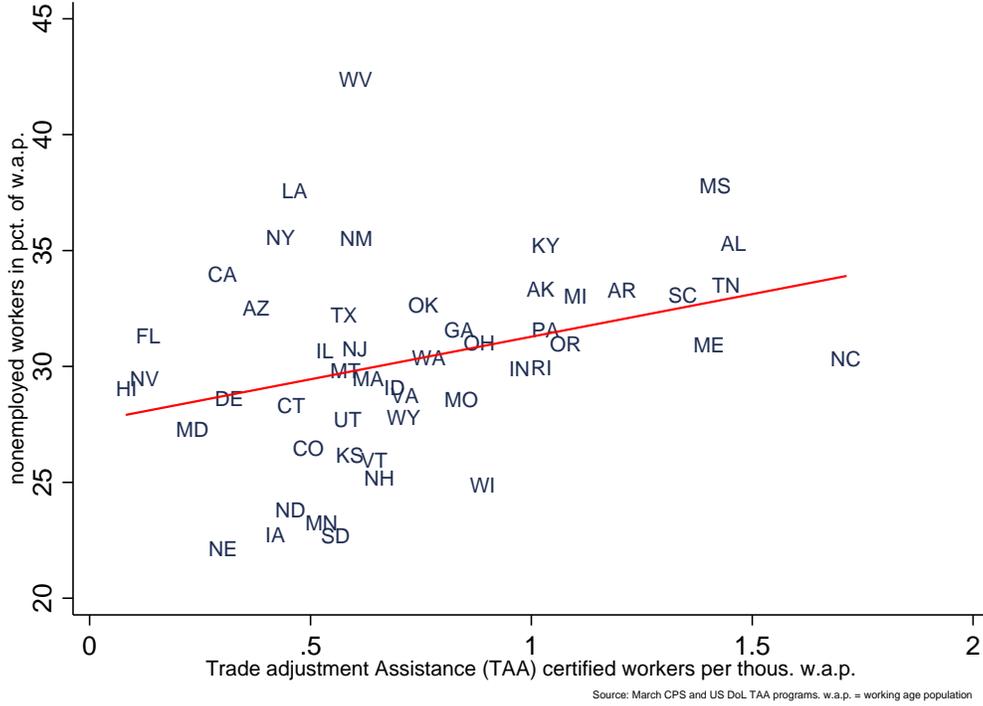


(a) TAA certified workers across states in 1994



(b) TAA certified workers across states in 2003

Figure 3: Nonemployment and TAA certifications in the U.S. (1989-2009)



non labor force participation rate. This positive correlation however may simply reflect a host of other factors. A careful estimation controlling for many co-variates is conducted next. Obviously, the TAA data does not capture trade-displaced workers that did not apply or the petitioners that were wrongly denied eligibility. These concerns are also addressed in the empirical estimation.

It is useful to contrast the TAA-based measure with the standard import penetration measure. Autor et al. (2013) recently used this measure in their influential work to estimate the effects of increased Chinese imports on labor markets in the U.S. An example of such import penetration, henceforth ADH import penetration, for a state i in year t is

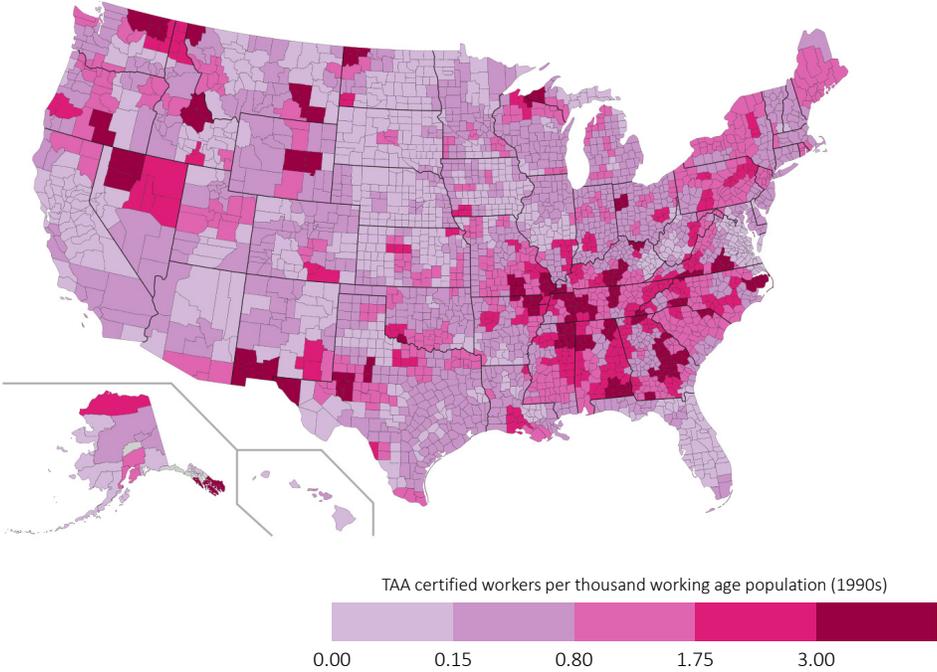
$$\Delta \text{ADH import penetration}_{i,t} \equiv \sum_{\text{industries } j} \underbrace{\frac{\text{employment}_{i,t-1}^j}{\text{employment}_{i,t-1}}}_{\text{local share of } j \text{ in } i} \times \underbrace{\frac{\text{imports}_{US,t}^j - \text{imports}_{US,t-1}^j}{\text{employment}_{US,t-1}^j}}_{\text{US imports of per worker in } j}.$$

This Bartik-style measure is the average of industry-specific imports weighted by lagged location-specific industry shares. Clearly, the standard import penetration proxy would assign the same value to two towns with same industry shares. In contrast, the more “ground-truth” TAA-based measure can capture the fact that the firms in these locations, though in the same industry, experienced different foreign competition and trade-induced job losses.

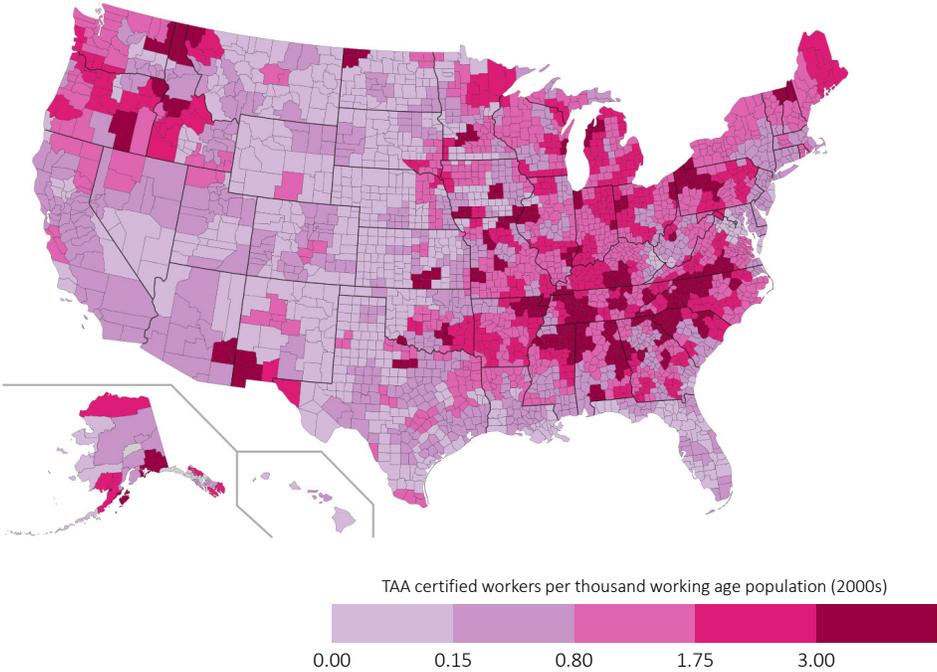
There is in fact a weak positive correlation (0.09) between the two measures at the state level.

Figure 4: TAA certified workers across commuting zones

(a) TAA certified workers across commuting zones (1990s)



(b) TAA certified workers across commuting zones (2000s)



This weak correlation at the state-level does not invalidate either measure. For instance, the important penetration is an indirect measure is prone to spatial aggregation bias if states are more similar in industry structure than counties. In the words of [Autor et al. \(2013, footnote 25\)](#): “... it bears to note that our exposure variable is *by nature* a proxy ...”

The analysis is therefore conducted at the commuting zone level also, with the same data and specification as in [Autor et al. \(2013\)](#). Commuting zones are clusters of counties that partition the U.S. counties based on cross-county commuting patterns. Following [Topel \(1986\)](#), [Autor et al. \(2013\)](#) constructed 722 clusters using the U.S. Census County-to-County Commuting Flows. The commuting-zone level TAA measure is constructed by geocoding each petition to its corresponding county and then mapping the county to the commuting zone using the crosswalk constructed by [Autor et al. \(2013\)](#).¹⁹ Commuting-zone level TAA measures are constructed for the periods 1990–1999 and 2000–2009. Figure 4 is the counterpart of Figure 2 and shows the average TAA measure at the commuting-zone level in the 1990s and in the 2000s. As expected, at the commuting zone level, decadal changes in the TAA-based measure are more positively and significantly correlated (0.18) with decadal changes in ADH import penetration.²⁰

2.3 Yearly Labor Market Outcomes across States

To assess the relation between trade displacements and labor market outcomes across states, the regression below is estimated on a panel of 50 states from 1989 to 2009:

$$\Delta \text{labor market outcome}_{i,t} = \alpha + \beta \times \Delta \underbrace{\text{TAA foreign competition}_{i,t}}_{\text{newly TAA certified workers per w.a.p.}} + \gamma \cdot Z_{i,t} + \varepsilon_{i,t}.$$

The variable “TAA foreign competition_{*i,t*}” is the share of working-age workers certified by the Trade Adjustment Assistance (TAA) in state *i* during year *t*. The variable $\Delta X_{i,t}$ denotes the change from year $t - 1$ to year t in variable $X_{i,t}$. The variables used as “labor market outcome_{*i,t*}” are : (a) the share “not employed_{*i,t*}” of working age population workers who are not employed in state *i* as of the March CPS of the following year $t+1$; (b) the rate “job destruction rate_{*i,t*}” at which existing jobs were destroyed in state *i* during year *t*; (c) the rate “job creation rate_{*i,t*}” at which new jobs were created in state *i* during year *t*; (d) the share “pop. share_{*i,t*}” of national working age population residing in state *i* as of the March CPS in $t+1$. The set of controls $Z_{i,t}$ includes state indicators, year indicators, and changes in other variables such as the state log income per working

¹⁹The underlying TAA petitions data contains the name of the company as well as the street address and the zipcode. ArcGIS is first used to geocode the data. The geocoded data is then reviewed for consistency, including manual checks. In some cases, other TAA data on the company was used to refine the geocoding based on digital archival data available online such as local newspapers, industry publications, union publications, etc.

²⁰[Hakobyan and McLaren \(2016\)](#) find that local TAA petitions are strongly correlated with NAFTA tariff changes.

Table 1: Labor Market Outcomes Panel Estimation across the United States

Labor market outcomes →	Δ Not	Δ Not	Δ Not	Δ Job	Δ Job	Δ Pop.
	Employed	Employed	Employed	Destruction	Creation	Share
	a1	a2	a3	b3	c3	d3
Δ TAA Certified Workers	2.061*** (.551)	- (.001)	2.408*** (.647)	1.533*** (.536)	-1.312*** (.531)	0.006 (.013)
Δ ADH Import Penetration	- (.001)	(.001)	(.001)	- (.001)	- (.001)	- (.001)
Δ TAA Denied Workers	0.357 (.597)	- (.001)	0.164 (.776)	0.062 (.543)	-0.327 (.881)	-0.031* (.016)
Δ New Housing Starts	-2.252*** (.503)	-2.250*** (.754)	-2.323*** (.841)	-1.676*** (.398)	2.978*** (.495)	-0.032 (.021)
Δ log Total Income	-0.251*** (.029)	-0.281*** (.033)	-0.248*** (.034)	-0.023 (.019)	-0.020 (.027)	-0.001* (.000)
Δ Unionization Rate	- (.046)	- (.046)	-0.309*** (.046)	- (.046)	- (.046)	- (.046)
State FE, Year FE	Yes, Yes	Yes, Yes				
R-sq.	0.324	0.244	0.298	0.687	0.439	0.093
N	1050	800	750	1050	1050	1050

Note: *, **, and *** denote significance at the 10, 5, and 1 percent level. Robust standard errors in parentheses are clustered on states. The estimation sample is a balanced panel of the 50 states that spans 21 years from 1989 and 2009. Union data is only available after 1989 in the March CPS. Import penetration was constructed between 1988 and 2005 with a gap in 1998 to a change from SIC to NAICS.

age population, the state import penetration, the state unionization rate, the state new housing units started per working age population, the state TAA denied workers per w.a.p.

The estimation results are reported in Table 1 and yield a novel fact: the elasticity of local employment to TAA trade-induced displacements. One extra trade-displaced worker is associated with the local employment falling by about two extra workers. The more trade displaces, the less reallocation takes place. The data shows that locations with more trade-induced displacements not only (arithmetically) shed more of their existing jobs but they also create fewer new jobs to absorb these losses. Population flows appear to have a muted response to trade-induced job displacements in the medium run.²¹ The estimated TAA reallocation elasticity is robust to the inclusion of the import penetration proxy as shown in the specifications (a3), (b3), and (c3).

One would also be concerned about the ability of the OTAA federal investigators to identify trade-induced displacements. First, if the TAA investigators were just using industry-level data, the import penetration proxy should be more strongly correlated with the TAA measure. This does not

²¹ Klein et al. (2003) and Moser et al. (2010) document the job flows effects of exchange rate shocks. See also Amiti and Davis (2012) and Autor et al. (2014) for worker-level, but not labor market level, effects of trade.

appear to be the case. Also, denied applications or approval rates have no association with labor market conditions in the data.²² The results are also robust to unionization rates and to spillovers in the non-tradable sector captured by housing starts data.

2.4 Decadal Labor Market Outcomes across Commuting Zones

As [Autor et al. \(2013\)](#) show, commuting zones are a particularly appropriate and useful level for estimating the labor market effects of trade. This is especially relevant given the possibility of aggregation bias in the standard import penetration proxy: states are less likely to be industrially dissimilar than counties or commuting zones. Therefore, the baseline estimation and data in [Autor et al. \(2013\)](#) is augmented with the commuting-zone level TAA measure. This exercise shows that the TAA reallocation elasticity is robust to finer industrial composition and more local geography as captured by the “China shock”. Specifically, the 2SLS structure below is estimated using the sample of 722 commuting zones across the two decade-periods of the 1990s and the 2000s:

$$\Delta \text{labor market outcome}_{c,t} = \alpha + \beta \times \Delta \text{TAA}_{c,t} + \gamma_1 \times \widehat{\Delta \text{IPW}}_{c,t} + \gamma_2 \cdot Z_{c,t} + \varepsilon_{c,t}.$$

where $\Delta \text{labor market outcome}_{c,t}$ is the decadal change in labor market outcome considered: (a) the share of working age population workers who are not employed, (b) average weekly wages, and (c) working age population. $\Delta \text{TAA}_{c,t}$ is the decadal change – an annualized change from the beginning of the period to the end of the period – in the commuting-zone level TAA measure of foreign competition. $\widehat{\Delta \text{IPW}}_{c,t}$ is obtained by instrumenting the decadal change in the ADH import penetration $\Delta \text{IPW}_{c,t}$ using the import penetration to other advanced economies.

The set of controls $Z_{c,t}$ follows [Autor et al. \(2013\)](#) and includes start-of-decade demographic and labor market variables, decade indicators, U.S. Census region indicators. Standard errors are clustered at the state-level and each decade-location observation is weighted by the local start-of-period population.²³

The estimation results are reported in [Table 2](#) and confirm the findings on the reallocation elasticity of local employment to TAA trade-induced displacements. Across locations, one extra trade-displaced worker is associated with the local employment falling by about two workers. As expected, the “China shock” variable has more predictive power at the commuting-zone level. Moreover, the TAA reallocation elasticity is surprisingly robust: the estimated elasticity is virtually unchanged from the annual-state data to the decadal commuting-zone analysis!

Existing models with centralized labor markets or direct TAA-like job losses are not equipped

²²This was not the case before the Reagan administration revamped the TAA certification process.

²³See [Autor et al. \(2013\)](#) for a careful justification of the merits of this estimation approach. All the non-TAA variables are constructed by [Autor et al. \(2013\)](#).

Table 2: Labor Market Outcomes Panel Estimation across Commuting Zones

Labor market outcomes →	Δ Not Employed a1	Δ Not Employed a2	Δ Not Employed a3	Δ log Wages weekly wages b3	Δ log Pop. c3
Δ TAA Certified Workers	2.235*** (.717)	2.058*** (0.770)	1.956*** (0.641)	-2.017** (0.880)	-0.142 (0.749)
Δ ADH Import Penetration	- -	0.759*** (0.172)	0.765*** (0.167)	-0.722*** (0.252)	-0.059 (0.752)
Δ TAA Denied Workers	- -	- -	0.001 (0.002)	-0.001 (0.002)	0.001 (0.002)
TAA Subsidy per capita ₋₁	0.166 (0.321)	0.004 (0.303)	0.027 (0.305)	-0.562 (0.458)	0.251 (0.680)
Manufacturing Share ₋₁	0.024 (0.016)	-0.061** (0.028)	-0.061** (0.029)	0.038 (0.038)	-0.147* (0.081)
College-Educated Share ₋₁	-0.033 (0.026)	-0.045 (0.031)	-0.046 (0.032)	0.060 (0.068)	-0.147 (0.109)
Foreign-Born Share ₋₁	-0.029 (0.022)	-0.050** (0.023)	-0.048** (0.023)	-0.061* (0.032)	0.033 (0.086)
Female Employment Share ₋₁	0.281*** (0.071)	0.266*** (0.075)	0.271*** (0.076)	0.088 (0.070)	0.349** (0.153)
Routine Occupation Share ₋₁	0.125 (0.080)	0.201** (0.086)	0.196** (0.092)	-0.434*** (0.121)	-0.288 (0.347)
Occupation Offshorability ₋₁	0.356 (0.502)	0.065 (0.544)	0.083 (0.541)	2.486*** (0.917)	4.429* (2.449)
Census Division FE, Year FE	Yes, Yes	Yes, Yes	Yes, Yes	Yes, Yes	Yes, Yes
R-sq.	0.352	0.280	0.281	0.574	0.424
N	1444	1444	1444	1444	1444

Note: *, **, and *** denote significance at the 10, 5, and 1 percent level. Robust standard errors in parentheses are clustered on states. The estimation sample is a balanced panel of the 722 commuting zones that spans two decadal periods (1990–1999 and 2000 – 2009). Models are weighted by the start of period commuting zone share of national population.

to replicate the puzzling elasticity of nonemployment to trade-induced displacements. The robustness of the TAA reallocation elasticity to the inclusion of the import penetration motivates a key role for within-industry heterogeneity. A heterogeneous-firms trade model with endogenous variable markups and segmented labor markets is used to endogenize these findings and assess the implications of a model endogenously consistent with such reallocation elasticity.

3 A Stylized Multi-Location Trade Model with Variable Markups

3.1 Environment

The model nests labor markets segmented across locations in the spirit of [Lucas and Prescott \(1974\)](#) with a Ricardian trade model of heterogeneous firms producing differentiated goods, some of which face head-to-head foreign competition (see [Dornbusch et al. 1977](#)).

The baseline environment consists of two symmetric countries $j = 0, 1$ populated by a unit measure of families and firms.²⁴ Each family has a mass L individuals allocated across a continuum of domestic locations. These locations exogenously vary in the productivity of their local firms. Within each location, firms have the same productivity, produce differentiated varieties and may compete head-to-head with a foreign competitor of randomly assigned productivity. There are international iceberg transportation costs τ . Thus, the model shares similarities with [de Blas and Russ \(2015\)](#) and [Holmes and Stevens \(2014\)](#) in their extensions of [Bernard et al. \(2003\)](#). Like [Caliendo et al. \(2015\)](#) the model features segmented labor markets, but with variable markups. As noted above, both in the theory and in the data, variable markups appear important for understanding the effects of international trade (see [de Blas and Russ 2015](#); [De Loecker et al. 2016](#)).

Nonemployment is obtained using random Leontief matching of workers to firms and collective Nash bargaining in each location. The population distribution is determined by the uncoordinated job search across locations. This structure is similar to [Alvarez and Shimer \(2011\)](#) who consider a model with directed search across many islands and random matching within each island.

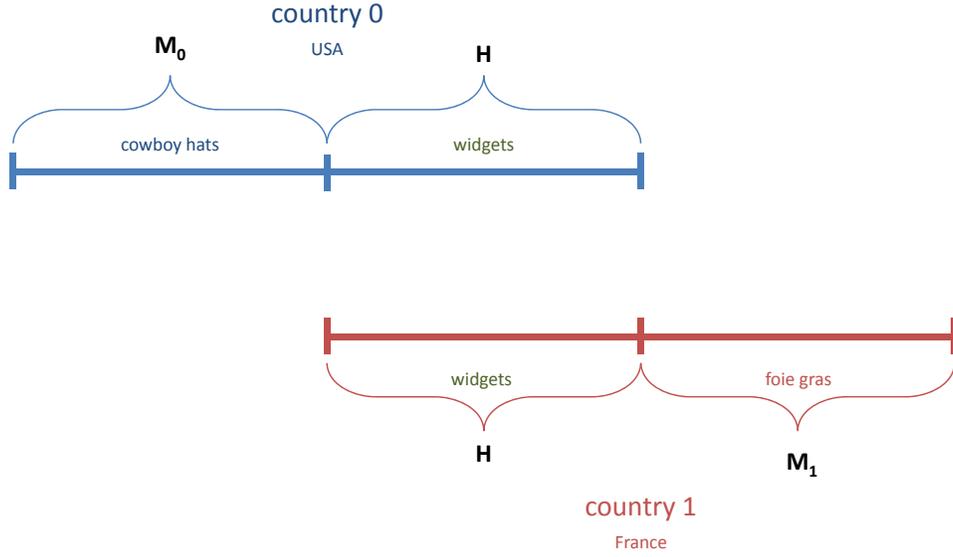
Preferences

Following [Helpman and Itskhoki \(2010\)](#), each family has quasi-linear preferences over its homogeneous good consumption q_0 and its composite good consumption Q such that $U = q_0 + \frac{1}{\eta} Q^\eta$ where Q is a Spence-Dixit-Stiglitz aggregator over differentiated goods:

$$Q \equiv \left(\int_{M_0 \cup H \cup M_1} q(v)^{\frac{\sigma-1}{\sigma}} dv \right)^{\frac{\sigma}{\sigma-1}}$$

²⁴The symmetry is relaxed in [Kondo \(2013\)](#) to discuss the effects of foreign productivity growth.

Figure 5: A simple overview of the model



and $0 < \eta < \frac{\sigma-1}{\sigma} < 1$.

The differentiated goods have two possible types, monopolistic or head-to-head, as illustrated in Figure 5. The monopolistic goods (“ M -goods”) have no foreign counterpart and the producers of these goods are monopolistic competitors (e.g. US cowboy hat varieties and French foie gras varieties in the illustration). The head-to-head goods (“ H -goods”) each have a domestic counterpart and a foreign counterpart that are perfect substitutes (e.g. widget varieties in the illustration).

Taking the homogeneous good as numeraire, a household in country j faces a composite good price index P_j defined as: $P_j \equiv \left(\int_{M_0 \cup H \cup M_1} p_j(v)^{1-\sigma} dv \right)^{\frac{1}{1-\sigma}}$.

A household with total income R_j from earnings and profits optimally chooses:

$$q_j(v) = Q_j^{-\frac{\rho-\eta}{1-\rho}} p_j(v)^{-\sigma} \forall v \quad \text{and} \quad q_{0,j} = R_j - P_j^{-\frac{\eta}{1-\eta}} = R_j - Q_j^\eta$$

where $\rho \equiv \frac{\sigma-1}{\sigma} \equiv \frac{1}{\mu}$.

Technology and Competition

Each M -type producer is a monopolistic competitor while each H -type producer competes via simultaneous price setting against a unique foreign counterpart in the spirit of [Bernard et al. \(2003\)](#).²⁵

²⁵This form of head-to-head competition is similar to [Bernard et al. \(2003\)](#) except there is no domestic head-to-head competitor here. The simpler model presented here offers tractable implications on the *internal* geography of markups and labor market outcomes. See [de Blas and Russ \(2015\)](#) for an elegant analytical study of the competitive effects of trade in an environment akin to [Bernard et al. \(2003\)](#) and similar to [Atkeson and Burstein \(2008\)](#) and [Garetto \(2016\)](#).

A model without head-to-head foreign competition would fail to match the data simply because it would not generate TAA-like job losses due to foreign competition. For instance, in the standard Melitz (2003) model, a model-based TAA-measure of foreign competition is zero since firms do not face *head-to-head* direct competition: TAA investigators would be unable to find evidence of trade-induced foreign competition as a cause of layoffs. Head-to-head competition is also shown to deliver desirable features such as variable markups (see de Blas and Russ 2015; De Loecker et al. 2016) and exporter wage premium (see Helpman et al. 2010).

There is a fixed unit measure of differentiated varieties and firms in each country. An exogenous measure $H \in [0, 1]$ of firms can produce (head-to-head) H -goods and the remaining measure $M = 1 - H$ can produce (monopolistic) M -goods. There are no fixed costs of entry or operation. The model is therefore a hybrid setup combining Chamberlinian monopolistic competition ($H = 0$) with head-to-head imperfect competition ($H = 1$).²⁶

Each firm ϕ is exogenously assigned its variety $v(\phi) \in M_0 \cup H \cup M_1$ and its productivity $z(\phi)$. Each head-to-head producer also has a randomly assigned foreign competitor. Each firm ϕ can produce its differentiated good $v(\phi)$ using a linear production technology:

$$y(\phi) = z(\phi) \cdot \ell$$

where ℓ is the labor input and y is the output.

The productivity $z(\phi)$ is assumed to be drawn randomly from a Pareto distribution with lower bound $A \equiv 1$ and shape parameter s : $\Pr(z(\phi) \leq z) = 1 - z^{-s} \equiv F(z)$.

The firms in the homogeneous good sector are homogeneous, compete perfectly and have a simple linear technology: $y_0 = \ell$.

Heterogeneous Locations and Segmented Labor Markets

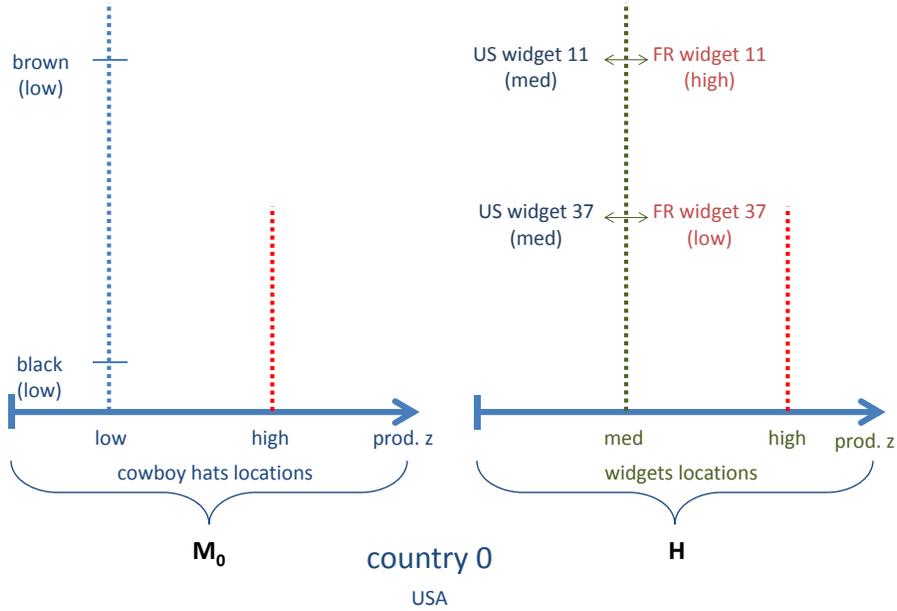
The main goal in defining locations is to have heterogeneity in foreign competition across locations as well as scope for reallocation within each location.²⁷ In the Ricardian tradition, a labor market is defined such that all the firms in that location share the same productivity level (z) and the same type of competition.²⁸ Therefore, in each country, there are many H -type (head-to-head) towns

²⁶The combination of both monopolistic competition and head-to-head competition resembles the model of *mass production plants* and *boutique shops* used by Holmes and Stevens (2014) in their study of plant size distribution with an application to the trade in wood furniture. Here, monopolistic firms are not necessarily smaller non exporting firms. Also Freeman and Kleiner (2005) show in their study of the “last American shoe manufacturers” that product differentiation and industrial relations are additional channels of adjustment. Strategic product differentiation will make M/H endogenous. A variant of the model with differentiation costs did not significantly alter the results.

²⁷Hakobyan and McLaren (2016) document a significant “location” component in the effects of NAFTA. See Yoon (forthcoming) for an estimation of location-specific comparative advantage in a dynamic stochastic spatial equilibrium.

²⁸The stark assumption on common productivity within a location is made to tractably highlight the role of variable markups. At the other extreme, if locations did not vary in productivity, this model would be unable to address the

Figure 6: A simple illustration of locations



and many M -type (monopolist) towns, in addition to homogeneous good towns that produce a non-tradable good.

Within an M -type (monopolist) town, firms also share the same productivity and they each produce different varieties. In contrast, there is further heterogeneity across firms within each H -type (head-to-head) town even though they share the same productivity: these local differences within each town allow for local reallocation.

Figure 6 provides an illustration of these differences across and within locations. Firms collocated in the same H -type (head-to-head) town share the same productivity. Yet, they differ in their varieties and most importantly in the productivity of their head-to-head foreign competitors.²⁹

Each family assigns workers across locations. Within each location, workers are randomly matched with vacancies through a Leontief matching function.³⁰ At each plant, the workers bargain collectively with the firm over wages and production decisions.³¹ The workers collectively have bargaining power λ .³² Firms have to pay a hiring cost γ per hire. The union's threat point is

nonemployment effects of trade across locations.

²⁹For simplicity, one can think of Texas towns and Pennsylvania towns making cowboy hats and widgets respectively. Certainly, a location maps more realistically to a labor market in the geography-industry-occupation-skill space.

³⁰The Leontief matching function $m(u, v) = \min(u, v)$ is highly tractable and has no congestion externalities.

³¹Due to variable markups, plant-level bargaining by destination makes the outcome more tractable.

³²The linear production function and the simple Leontief matching function are used to provide a simpler and tractable benchmark. An alternative multilateral bargaining à la [Stole and Zwiebel \(1996\)](#) was used in [Felbermayr et al. \(2010\)](#) and [Helpman et al. \(2010\)](#). While it alters the surplus sharing weight, it does change the fundamental and novel insight here: variable markups shape the cross-section of employment and wages across firms and locations.

defined by a home production technology yielding b units of the numeraire good. It is convenient to interchangeably identify a plant with productivity z by its unit cost $c \equiv (\gamma + b)/z$. Finally, the homogeneous sector is subject to no hiring or matching frictions.

3.2 Characterization

The Monoplist (M -type) Firm Problem

Consider a monopolist firm in country j with productivity z and supplying country j' . With $\ell_{j'}^j$ workers, the firm-union match generates the following surplus:

$$S_{j'}^j(z, \ell_{j'}^j) = \underbrace{Q_{j'}^{-(\rho-\eta)} \left(\frac{1}{\tau_{j'}^j} z \ell_{j'}^j \right)^{\frac{1}{\mu}}}_{\text{revenues } R_{j'}^j(z, \ell_{j'}^j)} - (b + \gamma) \ell_{j'}^j.$$

The firm's profit from this plant is:

$$\pi_{j'}^j(z, \ell_{j'}^j) = R_{j'}^j(z, \ell_{j'}^j) - \gamma \ell_{j'}^j - w_{j'}^j(z) \ell_{j'}^j$$

where $w_{j'}^j(z)$ is the wage paid to each worker.

The wages $w_{j'}^j(z)$ and the plant size $\ell_{j'}^j$ are determined through Nash-bargaining with the workers' union by solving:

$$\max_{w, \ell} \left[Q_{j'}^{-(\rho-\eta)} \left(\frac{1}{\tau_{j'}^j} z \ell \right)^{\frac{1}{\mu}} - \gamma \ell - w \ell \right]^{1-\lambda} \times \left[(w - b) \ell \right]^{\lambda}.$$

Since all costs are variable, the optimal outcome splits the maximal net surplus according to the bargaining power λ . Hence, the firm-union produces the monopolistic output and proportionally splits the net surplus generated.

That is:

$$\begin{aligned} p_{j'}^j(c) &= \mu \tau_{j'}^j c \\ w_{j'}^j(c) - b &= \lambda (\mu - 1) (\gamma + b) && \equiv w_M - b \\ \ell_{j'}^j(c) &= Q_{j'}^{-\frac{\rho-\eta}{1-\rho}} \left[\mu (\gamma + b) \right]^{-\sigma} \left[\frac{(\gamma + b)}{\tau_{j'}^j c} \right]^{\sigma-1} && \equiv \mu^{-\sigma} \bar{\ell}_{j'}^j(c) \end{aligned}$$

where $\tau_{j'}^j c$ is the firm-union unit cost and $\bar{\ell}_{j'}^j(c)$ is the size corresponding to the marginal cost pricing (zero profits).

The M -type (monopolist) producers therefore choose the standard markup pricing rule that equalizes the marginal revenue and the marginal cost. Although more productive firms are larger, it is important to note that the wages are independent of the firm productivity. This has been a standard result in environments with power revenue functions and linear technology.³³ This property that wages do not depend on firm productivity implies that the M -type (monopolist) towns all have the same wage and therefore the same equilibrium employment rate. Each worker extracts a share λ of the net markup $(\mu - 1)$. Also, since there are no fixed cost of exporting, all M -type producers export in this model.

Local Employment Rates in M -type Towns

Finally, given the random Leontief matching, an M -type labor market of firms with productivity z has an employment rate $e_M(z)$:

$$e_M(z) = \frac{\sum_{j'=0,1} \ell_{j'}^j(z)}{L_M(z)}$$

where $L_M(z)$ is the endogenous population of workers available in that town. The expected earnings per worker $W_M(z)$ in this town therefore satisfy: $W_M(z) \equiv w_M \cdot e_M(z)$.

The Head-to-Head (H -type) Firm Problem

Consider a head-to-head firm in country j that is hiring $\ell_{j'}^j$ workers to supply country j' . Let z be the firm's productivity and \tilde{z} be its foreign competitor's productivity. Unlike a monopolistic firm, the firm has to set its price above its competitor's zero profit price (see [Bernard et al. 2003](#)).

The firm therefore solves:

$$\begin{aligned} \max_{w, \ell} & \left[Q_{j'}^{-(\rho-\eta)} \left(\frac{1}{\tau_{j'}^j} z \ell \right)^{\frac{1}{\mu}} - \gamma \ell - w \ell \right]^{1-\lambda} \times \left[(w - b) \ell \right]^{\lambda} \\ \text{s.t.} & \\ & p_{j'}^j(z, \ell) \leq \bar{p}_{j'}^{1-j}(\tilde{z}) \\ & \pi_{j'}^j(z, \ell) \geq 0 \end{aligned}$$

where $\bar{p}_{j'}^{1-j}(\tilde{z}) = \tau_{j'}^{1-j}(\gamma + b) / \tilde{z}$ is the foreign competitor's marginal cost to supply country j' .

Due to head-to-head competition, this H -type producer from country j supplies a country j' if and only if it is the lowest unit cost supplier for that market: $\tau_{j'}^j/z < \tau_{j'}^{1-j}/\tilde{z}$. Conditional

³³See for example [Felbermayr et al. \(2010\)](#). This property partly motivated models with screening and sorting such as [Helpman et al. \(2010\)](#) to generate an exporter wage premium. Variable markups break this property.

on supplying the market j' , the producer may either be at the corner (constrained) or choose the unconstrained monopolistic (constant markup) price:

$$p_{j'}^j(c, \tilde{c}) = \underbrace{\min \left\{ \tau_{j'}^{1-j} \tilde{c}, \mu \tau_{j'}^j c \right\}}_{\mu_{j'}^j(c, \tilde{c}) \times \tau_{j'}^j c}.$$

The threat of being undercut induces variable markups $\mu_{j'}^j(c, \tilde{c}) \in [1, \mu]$ as the firm seeks to maximize the net surplus shared with its workers. Less productive firms are more likely to have lower markups as they are more likely to face more productive competitors (see [de Blas and Russ 2015](#) for an elegant generalization of [Bernard et al. 2003](#) in the case of frictionless trade).

Given the net surplus sharing outcome, wages are commensurate to the variable markup:

$$w_{j'}^j(c, \tilde{c}) - b = \lambda \left(\mu_{j'}^j(c, \tilde{c}) - 1 \right) (\gamma + b).$$

Therefore, wages are variable in contrast to the case of the monopolistic firms that do not face head-to-head competition. This result delivers variable wages through variable markups and stands in contrast with the existing literature (see for example [Helpman and Itskhoki 2010](#)). For instance, in this model, exporters being more productive pay higher wages and have higher markups.

Furthermore, the more productive the competitor faced, the larger the firm because the lower markup translates into a higher demand:

$$\ell_{j'}^j(c, \tilde{c}) = \left[\mu_{j'}^j(c, \tilde{c}) \right]^{-\sigma} \times \bar{\ell}_{j'}^j(c).$$

With head-to-head competition, firm behavior also depends on the level of trade frictions. For instance, as the tariff τ goes to infinity (autarky), all H -type producers operate and charge the unconstrained markup μ . On the other hand, only some do when trade is frictionless.³⁴

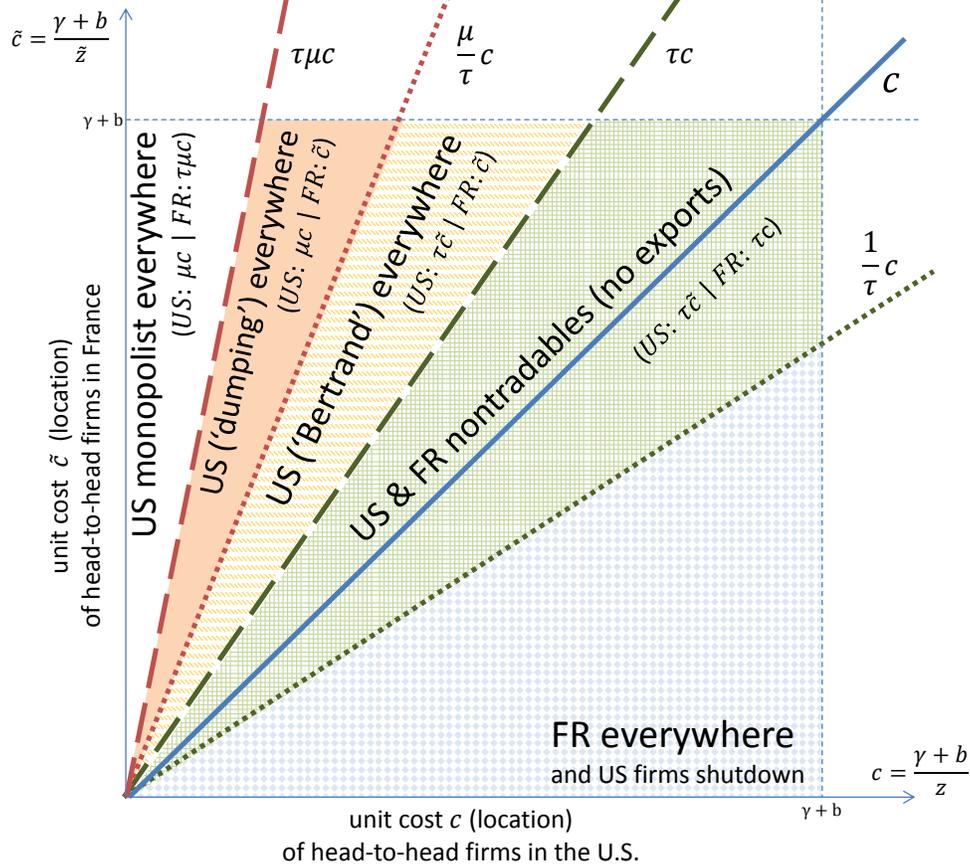
The model therefore generates rich pricing-to-market markups as shown in [Figure 7](#).³⁵ A point (c, \tilde{c}) represents a head-to-head firm located in a town of productivity $z = (\gamma + b)/c$ and facing a competitor with productivity $\tilde{z} = (\gamma + b)/\tilde{c}$. A vertical line represents firms in a head-to-head town of productivity z , each of which face a foreign competitor with productivity \tilde{z} .

These variable markups are also the reason why productivity differences yield differences in foreign competition across locations. In the more productive locations, more firms outcompete their foreign competitors relative to the less productive locations. In the less productive locations, more firms shutdown altogether: this is the local extensive margin of operating (see blue solid diamond region in [Figure 7](#)). Also, firms from less productive locations are more likely to pro-

³⁴When $\mu < \tau^2$, in particular in autarky, tariff-protected firms price as monopolists even though they do not export.

³⁵[Figure 7](#) illustrates the case when trade barriers are low enough ($\tau^2 < \mu$).

Figure 7: Variable markups across firms and locations



duce without exporting. This region is akin to the Ricardian non-tradable region and yield a local extensive margin of exporting when trade barriers fall (see green gridded region in Figure 7).

The model also generates a region of international “dumping”: firms charge the monopolistic price at home and the competitor’s marginal cost abroad (see solid colored region in Figure 7). This outcome could suggest “dumping” since the ratio of prices at home and abroad is larger than the iceberg costs. This region disappears in the limit case of frictionless trade ($\tau = 1$).³⁶

As trade barriers τ fall, the composition of markups changes both across and within locations. In particular, some of the firms in this “dumping” region become monopolistic competitors both at home and abroad: trade barriers were hurting their competitive edge abroad. Other firms in this region now have to charge the competitor’s marginal cost at home instead of the monopolistic markup. This highlights non-monotonic price changes at the firm-level even though lower trade barriers mean lower marginal costs across the board. Trade barriers also unevenly change the local extensive margin of exporting and the local extensive margin of firm shutdown.

³⁶These “anti-competitive” composition effects from “dumping” are absent when only the limit cases of free trade and autarky are compared (see Bernard et al. 2003; de Blas and Russ 2015).

Overall, the distribution of markups varies within and across locations as illustrated in Figure 7. The results are broadly in line with the empirical findings in [De Loecker et al. \(2016\)](#) and the theoretical findings in [de Blas and Russ \(2015\)](#). Furthermore, these endogenous differences in competitive outcomes across locations in turn percolate into employment and wages.

Local Employment Rates in H -type Towns

Based on these results, a town of H -type (head-to-head) producers with productivity z has an employment rate $e_H(z)$ satisfying:

$$e_H(z) = \frac{\int \sum_{j'=0,1} \ell_{j'}^j(z, \tilde{z}) dF(\tilde{z})}{L_H(z)}$$

where $L_H(z)$ is the endogenous population of the town and $\ell_{j'}^j(z, \tilde{z})$ the markup-dependent plant size. The expected earnings per worker $W_H(z)$ in that town satisfy:

$$W_H(z) \equiv \frac{\int \sum_{j'=0,1} w_{j'}^j(z, \tilde{z}) \cdot \ell_{j'}^j(z, \tilde{z}) dF(\tilde{z})}{L_H(z)}.$$

Labor Allocation across Locations

Workers are allocated knowing the tariff, the town's type (monopolistic or head-to-head competition), and the local productivity. So, each family knows the distribution of wages and nonemployment rates across towns. Each family therefore allocates $\{L_0, L_M(z), L_H(z)\}_{z \geq A}$ such that:

$$L = L_0 + M \int L_M(z) dF(z) + H \int L_H(z) dF(z) .$$

In equilibrium, families must be indifferent across locations to send workers.

Market Clearing

The market clearing condition for each differentiated good is trivially satisfied. Since hiring costs are paid in units of the homogeneous good, its market clearing condition is:

$$L_0 = q_0 + \gamma \cdot \left(M \int \sum_{j'=0,1} \ell_{j'}^j(z) dF(z) + H \iint \sum_{j'=0,1} \ell_{j'}^j(z, \tilde{z}) dF(\tilde{z}) dF(z) \right).$$

3.3 Long-Run Equilibrium

A symmetric long-run equilibrium with tariff τ is: (a) a price index P ; (b) quantities q_0 and Q ; (c) aggregate earnings W ; (d) aggregate profits π ; (e) populations $\{L_0, L_M(z), L_H(z)\}_{z \geq A}$ such that: (i) households solve their utility maximization given prices, profits and earnings; (ii) firms producing the differentiated goods solve their profit maximization problem given their productivity, their competition, and the aggregate consumption indexes; (iii) aggregate profits, aggregate earnings, and the price index are consistent with the firm decisions; (iv) all goods markets clear; and (v) the indifference condition across towns for labor allocation holds.

3.4 Long-Run Wages and Employment

The following properties hold in the long-run equilibrium.³⁷

Proposition 1. Equal expected earnings.

Expected earnings are equalized across all labor markets. Average income is also equalized across locations since all workers receive an equal share of firm profits.

Proof. The proposition trivially follows from the labor allocation indifference condition. Given the quasi-linear preferences, the equilibrium indifference condition means that expected earnings are equalized across locations:

$$w_0 = \begin{cases} W_M(z) & \forall z \text{ s.t. } L_M(z) > 0 \\ W_H(z) & \forall z \text{ s.t. } L_H(z) > 0 \end{cases}$$

where $w_0 = p_0 = 1$ is the wage in the homogeneous regions. □

In light of this proposition, greater vulnerability to foreign competition due to lower productivity does not necessarily mean that labor market outcomes are “worse” *ex ante*.

Moreover, *ex ante*, no transfers are required across locations to equate consumption allocations because the indifference condition makes it hold trivially. In others words, *ex ante*, transfers within a location are enough to implement the optimal consumption allocation for each individual.

Proposition 2. Constant nonemployment rate across monopolistic locations.

Across monopolistic locations, more productive labor markets have higher total employment and higher population but their workers earn the same wage and face the same nonemployment rate as less productive monopolistic locations.

³⁷This model is quite tractable because of its block-recursive nature. Firms and households do not need to carry any cross-sectional distributions. While the model is simple in terms of firm and household optimizations but the general equilibrium has to be numerically computed because of the non-trivial double integration involved.

Proof. The proof is based on Proposition 1 and the optimal firm decision. Wages are constant across monopolistic locations because markups are constant and the bargaining yields a simple net surplus sharing rule. \square

This proposition shows why, in this class of models, head-to-head competition can induce a non-degenerate distribution of wages and employment rates across labor markets. In the absence of head-to-head competition, the distribution of nonemployment rate is degenerate because wages would be independent of firm productivity. Consequently, the wage determination rule assumed in this class of models or the constant markups are not innocuous assumptions.³⁸

Proposition 3. Different nonemployment rates across head-to-head locations.

Across head-to-head locations, when there are no trade barriers, the more productive labor markets have higher employment, pay higher wages and thereby have higher nonemployment rate than less productive labor markets.

Proof. The proof follows from Proposition 1 and the fact that expected markups and wages in head-to-head locations increase with local productivity. See Table 3 and section 3.6 for evidence on this relation between TFP and the nonemployment rate. \square

This proposition characterizes the free trade long-run equilibrium. In the extreme case of autarky, the distribution of markups and employment rates become degenerate since $\lim_{\tau \rightarrow \infty} \mu_j^i(c, \tilde{c}) = \mu$. In general, trade barriers (τ) interact with the ideal markup (μ) to alter the entire distribution of markups as illustrated in Figure 7.

3.5 Long-Run Labor Allocations

The endogenous distribution of variable markups across locations also underpins a distribution of employment rates.

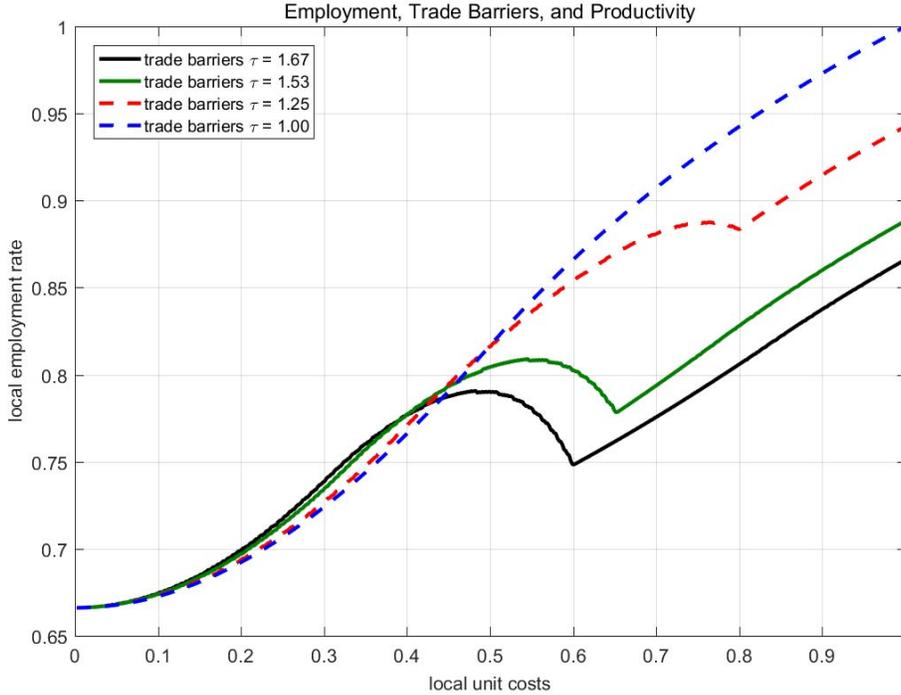
Figure 8 shows the long-run equilibrium employment-to-population across head-to-head labor markets for various levels of trade barriers.³⁹ The employment rate across monopolistic locations is degenerate and corresponds to the employment rate of the most productive head-to-head locations. By Proposition 3, in the absence of trade barriers, the nonemployment rate across head-to-head locations decreases with productivity. However, the monotonicity does not hold in the presence of trade barriers.

First, there is a kink at the marginal productivity level where all firms in a head-to-head location do not export. Above the kink, a slightly less productive location has a higher employment rate

³⁸The abstraction from multilateral bargaining is not problematic as long as the constant wage and proportional net surplus sharing results hold (see for example Helpman and Itskhoki 2010; Felbermayr et al. 2010).

³⁹See Table 4 for the other parameters used in the illustration.

Figure 8: Trade Barriers and Employment Rate



because it faces tougher competition. Below the kink, the infra-marginal location exports and has a higher employment rate because trade costs lower markups abroad.

Eventually, more productive locations have more firms charging higher markups. So the hump is an artifact of the changing composition of the endogenous markups. The kink and the hump naturally vanish in the absence of trade costs. The model also predicts that more productive locations have higher employment level since their firms are larger (see Proposition 3).

3.6 Some Evidence using TFP across States

A fundamental ingredient in this model is the heterogeneity in productivity: differences in trade-induced displacements are due to productivity differences across locations. One of the spatial implications of the model is further investigated using state-level data on Total Factor Productivity (TFP). In the model, more productive locations have higher population, higher wages, and higher unemployment rate in the long run (Proposition 3).

Some of these implications are corroborated using empirical estimations similar to the one used in Section 2. State-level TFP estimates from Turner et al. (2007) and Turner et al. (2008) are used. These estimates are based on state-level sectoral inputs data including physical capital, human capital and land. The results are shown in Table 3. All the specifications include location

indicators and time indicators.⁴⁰

In response to sustained productivity innovations, population gains occur in the long run as shown in specification (g1). Furthermore, specifications (e1) and (f1) confirm that indeed more productive locations have both higher wages and higher unemployment rates in the long run as predicted by Proposition 3.

Table 3: Labor Market Outcomes and TFP across the United States

Labor market outcomes →	Δ Not Employed (next 5 years)	Δ log Wages (next 5 years)	Δ Population (next 5 years)
	e1	f1	g1
<i>Total Factor Productivity</i>			
Δ log TFP	0.233*** (.040)	0.132*** (.045)	0.624*** (.212)
<i>Controls</i>			
Census Division FE, Year FE	Yes	Yes	Yes
R-sq.	0.520	0.591	.314
N	1000	1000	1000

Note: *, **, and *** denote significance at the 10, 5, and 1 percent level. Robust standard errors in parentheses are clustered on states. The estimation sample is a balanced panel of the 50 states from 1982 to 2001. State-level TFP estimates are available up to 2001. Wages are usual hourly wages adjusted for top-coding and deflated using the national PCE deflator. Δ log TFP is the average change in TFP in the last 5 years and the outcomes are computed as the average over the next five years.

4 Medium-Run Equilibrium

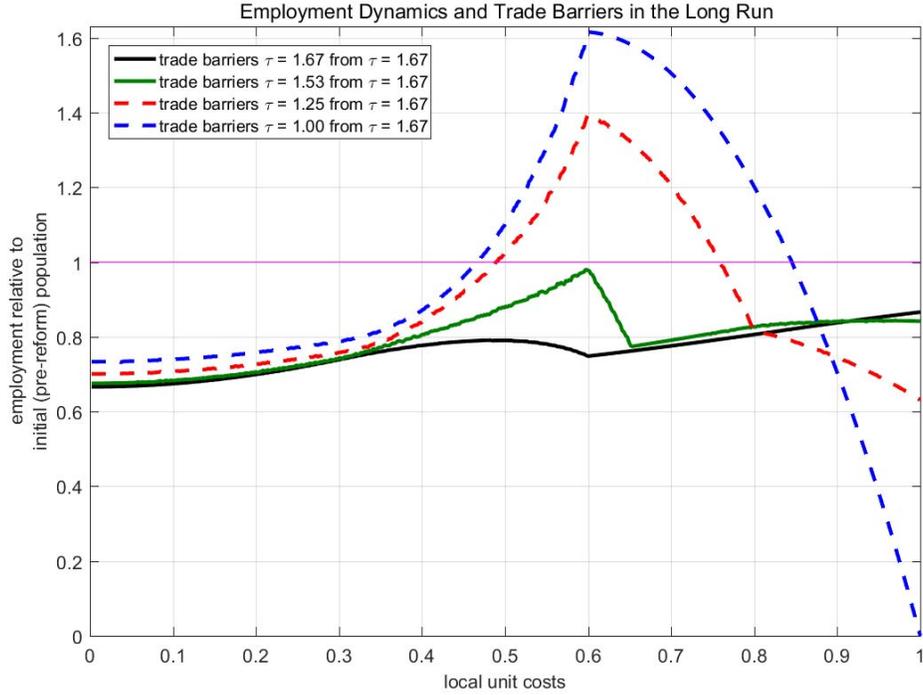
When workers are mobile within and across labor markets, the most affected locations become ghost towns in the free trade equilibrium as their population vanish. As shown in Figure 9, some locations greatly expand and employ more workers than their original population.⁴¹ However, the full mobility assumption is at odds with the evidence on muted or sluggish population adjustments.

Consistent with the muted population adjustments in the data, workers are assumed to be *ex ante* mobile across labor markets but not *ex post* as in Helpman and Itskhoki (2010). *Ex post* immobility means that workers cannot leave their original home locations even though they may switch jobs. Labor markets may still expand by tapping into their local pool of nonemployed workers. A *medium-run* equilibrium with limited worker mobility is defined below.

⁴⁰Investigating micro-evidence on markups and foreign competition is unfortunately not possible using the data available for this paper. See De Loecker et al. (2016) for an excellent contribution on trade-induced changes in the distribution of markups. See also Alder et al. (2014) for related evidence on wages and employment at the MSA level.

⁴¹The largest firm expansions typically occur in the medium-sized locations that start exporting. This is reflected in the kink in Figure 9.

Figure 9: Reallocation of Labor with Full Mobility



4.1 Definition

Given an initial equilibrium population allocation $\{L_0, L_M(z), L_H(z) : z \in Z\}$ with tariff τ , a symmetric *medium-run equilibrium* with tariff $\hat{\tau}$ is: (a) a price index \hat{P} ; (b) quantities \hat{q}_0 and \hat{Q} ; (c) earnings \hat{W} ; and (e) aggregate profits $\hat{\pi}$ such that: (i) households solve their utility maximization problem; (ii) firms solve their profit maximization problems; (iii) aggregate profits, aggregate earnings, employment rates, and the price index are consistent; (iv) all goods markets clear.

4.2 Calibration

The model is calibrated to quantify the effects of a trade liberalization across labor markets in the U.S. The Armington elasticity is set to $\sigma = 2.01$ following [Ruhl \(2009\)](#). The iceberg transportation cost before the reform $\tau = 1.11$ induces a 10 percent fall in trade costs and is in the range of trade costs documented by [Anderson and van Wincoop \(2004\)](#) for the U.S. The fraction of H -type firms is chosen so that the average number of trade-induced displacements matches the data. The average TAA across commuting zones is 1.1 workers per thousands w.a.p. The bargaining power set to $\lambda = 0.492$ in order to match the mean employment rate of 68.41 percent across commuting zones in 1990s.

The Pareto distribution shape parameter is set to $s = 2.02$ to guarantee finite mean and finite

variance following [Helpman and Itskhoki \(2010\)](#). The elasticity of substitution with the outside good η is set to $0.30 < (\sigma - 1) / \sigma$ to ensure that varieties are better substitutes for each other than for the homogeneous good (see [Helpman and Itskhoki 2010](#)).

The outside option parameter is chosen so that all local labor markets attract workers under full worker mobility. The calibration parameters are summarized in Table 4.

Table 4: Calibration

	Parameter description	Value	
			<i>Jointly targeted</i>
H	Fraction of head-to-head firms	.0145	Mean TAA: 1.1 workers per 000s w.a.p.
λ	Union bargaining power	.4917	Employment rate (1990s): 68.41 percent
τ	Iceberg transportation costs pre-liberalization	1.11	10 percent trade liberalization
$\hat{\tau}$	Iceberg transportation costs post-liberalization	1.00	to frictionless international trade
			<i>Externally determined</i>
σ	Armington elasticity across varieties	2.01	Ruhl (2009)
η	Elasticity of substitution of composite good	.301	Helpman and Itskhoki (2010)
s	Pareto distribution shape	2.02	Helpman and Itskhoki (2010)
b	Outside option	1.00	Lowest productivity draw
γ	Hiring cost	.030	3 percent of expected wages
L	Population	1.00	

4.3 “TAA” Reallocation Elasticity

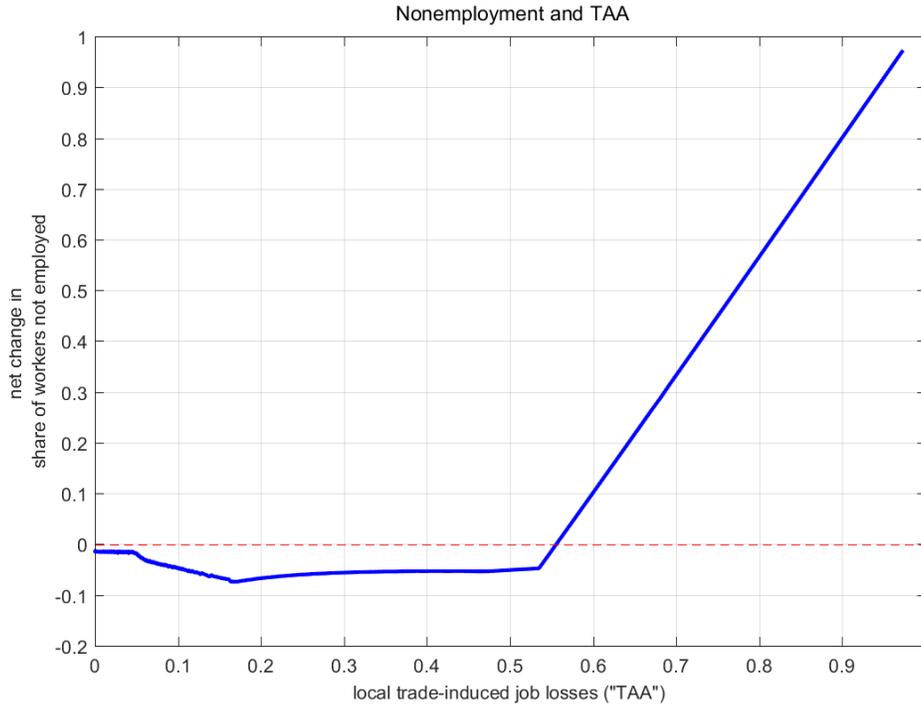
To relate the model to the empirical findings, the foreign competition faced by a labor market is measured using a model statistic akin to Trade Adjustment Assistance (TAA) certifications: the number of local workers displaced because of trade-induced foreign competition.⁴² These are local workers at tariff-protected plants who lost their jobs after their plant shut down due to heightened head-to-head competition (see Figure 7):

$$TAA_H(c) = \int_{c/\tau}^c \sum_{j'=0,1} \ell_{j'}^j(c, \tilde{c}) dF(\tilde{c}).$$

Figure 10 illustrates the relationship between local nonemployment changes and “TAA” trade-induced displacements per capita. First, net changes in local nonemployment maybe positive or negative depending on the productivity of the head-to-head labor markets. Second, reduced job

⁴²In the standard [Melitz \(2003\)](#) model and similar models with no direct competition, a TAA measure would be zero because the firms do not shut down because of direct foreign competition but lower price index and higher wages: TAA investigators would be unable to find evidence for trade-induced foreign competition as a cause of the layoffs.

Figure 10: TAA Reallocation Elasticity



creation explains the increased steepness of the curve in the locations experiencing the largest job destruction. Third, the elasticity of local nonemployment to “TAA” trade-induced job losses is about two across the adversely hit locations: the slope is 2.33 across the locations that are net job losers. The model therefore suggests that a selection bias – say if net gainers do not file TAA petitions – is needed to rationalize the measured elasticity.

As trade barriers fall, the firms in the marginal exporting labor markets are able to outcompete their foreign rivals in foreign markets, and thereby expand at the extensive margins. Less productive head-to-head locations lose most of their firms because they are out-competed. At the other extreme, the most productive head-to-head labor markets are hardly affected by the fall in trade barriers as they still behave as monopolists. These differences in local markups and local export participation drive uneven labor market outcomes across locations. The resulting employment rate is non monotonic due to the heterogeneity in markups and the correlation between lower productivity and vulnerability to foreign competition.

The robustness of the model TAA reallocation elasticity and the drivers of the calibration strategy are further documented in the sensitivity analysis shown in Table 6 of the appendix.

4.4 Aggregate Welfare Gains

Both the model and the data indicate that foreign competition has large uneven effects on labor markets across locations. The model predicts overall aggregate welfare gains and increased aggregate employment in the medium run, despite the large increase in nonemployment and the fall in earnings in the worst hit locations. The aggregate effects are summarized in Table 5.

Table 5: Effects of Limited Mobility in the Medium Run

	“TAA” job losses (per 1,000)	Not employed (percent)	$\% \Delta Q$ (diff. goods)	$\% \Delta U$ (utility)
Pre-reform	0.00	31.59	-	-
Medium run	1.10	30.18	+7.54	+2.19
Long run	0.00	32.29	+7.55	+1.71

While full labor mobility ensured that earnings were equalized across labor markets, limited mobility induces a non-degenerate distribution of expected earnings (see Figure 12 in the appendix). This *medium-run* earnings inequality induces income redistribution across labor markets, “*trade adjustment assistance*” in the model. In fact, in the long run, no redistribution across labor markets is needed because of the indifference condition arising from full worker mobility.⁴³

These medium-run (limited mobility) welfare gains are actually not smaller than the long run (full mobility) gains. This is partly due to the convenient but implausible representative agent used here and the literature. While the differentiated good demand is lower, limited mobility reduces inefficiencies from directed search frictions by increasing the overall employment level. This result also resembles the findings in Farhi and Werning (2014) and Helpman and Itskhoki (2010): limited interim mobility partially undoes the distortions arising from workers’ location indifference condition.

5 Conclusion

This paper studies foreign competition and American labor markets using a novel dataset on the universe of establishment-level petitions for Trade Adjustment Assistance (TAA) in the U.S. In the data, increased foreign competition is correlated with reduced employment through higher job destruction and lower job creation. Across locations, an extra trade-displaced worker is associated with the overall employment falling by about two extra workers: the more trade displaces,

⁴³Welfare gains would be different in the absence of full insurance. Considering limited insurance during trade reforms is very important but go beyond the scope of this paper. See also Antràs et al. (2015) on taxation and trade-induced inequality.

the less reallocation takes place. This elasticity across locations of the local unemployment to trade-induced foreign competition is robust to location fixed effects, time fixed effects, the “China shock”, construction activity, and unionization.

This paper introduces a multi-location heterogeneous-firms trade model with nonemployment and foreign head-to-head competition to rationalize and assess the implications of this finding. Both productivity heterogeneity across locations and endogenous variable markups are crucial to account for the uneven effects of foreign competition on unemployment across labor markets. In the model, the competitive effects of international trade percolate into labor markets outcomes and the spatial equilibrium. The model can rationalize the correlated effect of foreign competition on job destruction and job creation because the locations that are more vulnerable to foreign competition are precisely the less productive ones.

Some locations are severely affected while other locations gain from lower trade barriers. However, aggregate welfare improves after a trade reform despite the lack of interim migration and the adverse effects in some locations. Trade reforms increase earnings inequality in the *medium run* and prompt additional *inter-location* transfers (“trade adjustment”).

Therefore, it is important to further study transitional policies in the presence of heterogeneous workers and incomplete markets. Inequalities and risks arising from transitional labor mobility frictions can interact with political economy frictions and generate a protectionist overshooting in the transition as in [Blanchard and Willmann \(2013\)](#). [Krebs et al. \(2010\)](#) and [Krishna and Senses \(2014\)](#) also document a significant increase in labor income risk for workers exposed to foreign competition. Altogether these findings certainly motivate further studies at the nexus of public finance, labor markets and international trade during transition periods.

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6 Appendix: Additional Tables, Figures, and Data Sources

The dataset is based on establishment-level petitions from the U.S. Trade Adjustment Assistance (TAA), individual-level data from the Current Population Survey (CPS), job flows data in the U.S. Census Business Dynamics Statistics (BDS), housing starts data in the U.S. Census New Residential Construction (NRC) database, and U.S. imports data. The data is aggregated yearly at the state level to form a state-level panel dataset. The TAA dataset is described in the main text. Other data sources are described below.

The March CPS

For every year $t = 1989 \dots 2009$ and for every state, the following labor market outcomes are constructed: unemployed per working age population, not in the labor force per working age population, not employed (equivalently “nonemployed”) per working age population, and average unemployment duration. These measures are based on the public data from the Current Population Survey (CPS). In particular, this paper uses data from the Annual Social and Economic Supplement (ASEC) applied to the sample surveyed in March and assembled into the Integrated Public Use Microdata Series by [King et al. \(2010\)](#).

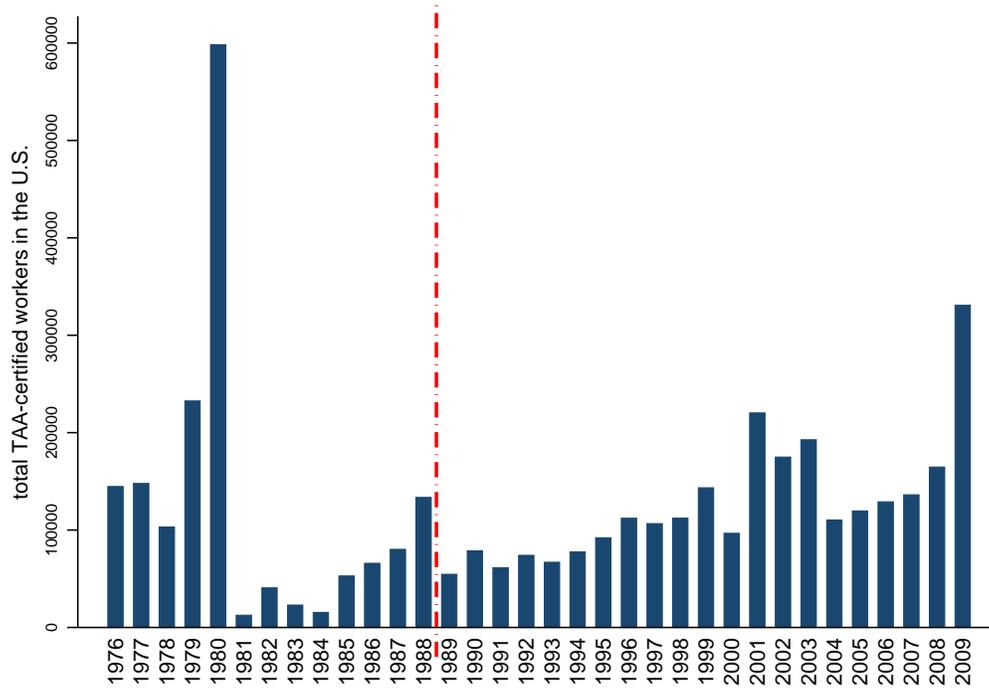
The Business Dynamics Statistics

For every year $t = 1989 \dots 2009$ and for every state, the following job flows measures are used: jobs destruction rate, job creation rate, and net job creation rate. These measures are computed following [Davis, Haltiwanger and Schuh \(1998\)](#) and publicly available from the Business Dynamics Statistics (BDS). The BDS are created from the Longitudinal Business Database (LBD) by the U.S. Census Bureau. The BDS contain annual series describing establishment-level business dynamics.

Import Penetration Data

[Autor et al. \(2013\)](#) use the years 1990, 2000, and 2007 at the commuting zone level. The commuting-zone dataset is the publicly released dataset of [Autor et al. \(2013\)](#). The state-level measure is computed here for each year between 1988-1997 and 1999-2005. The industry-country U.S. trade data used for the state-level import penetration proxies comes from [Schott \(2008\)](#). The industrial mix comes from the U.S. Census County Business Patterns (CBP) aggregated at the state level.

Figure 11: TAA program in the U.S. over time



Note: The sample used starts in 1989, after the Reagan-era reforms of the TAA program.

Table 6: Sensitivity to Key Parameters

Parameters						Outcomes		
σ	H	λ	s	τ	$\hat{\tau}$	employed (percent)	TAA workers (per thous.)	TAA elasticity of non-employment
2.01	0.015	0.492	2.02	1.11	1.00	68.41	1.10	2.33
2.01	0.150	0.492	2.02	1.11	1.00	69.91	11.52	2.33
2.01	0.500	0.492	2.02	1.11	1.00	73.95	39.78	2.33
4.00	0.015	0.492	6.00	1.11	1.00	86.77	2.59	2.67
5.00	0.015	0.492	4.40	1.11	1.00	89.25	0.53	2.74
5.00	0.015	0.492	5.00	1.11	1.00	89.29	1.17	2.76
5.00	0.015	0.492	6.00	1.11	1.00	89.49	1.96	2.78
5.00	0.015	0.492	8.00	1.11	1.00	89.78	3.07	2.85
8.00	0.015	0.492	14.00	1.11	1.00	93.93	3.77	3.50
2.01	0.015	0.333	2.02	1.11	1.00	78.60	1.10	2.35
2.01	0.015	0.667	2.02	1.11	1.00	61.55	0.99	2.29
2.01	0.015	0.492	2.02	1.25	1.00	69.14	1.91	2.78
2.01	0.015	0.492	2.02	1.25	1.13	69.14	0.90	1.43
2.01	0.015	0.492	2.02	1.12	1.05	68.44	0.60	1.83
2.01	0.015	0.492	2.02	1.05	1.00	68.06	0.59	2.16

Figure 12: Medium-Run Earnings Inequality and Reallocation

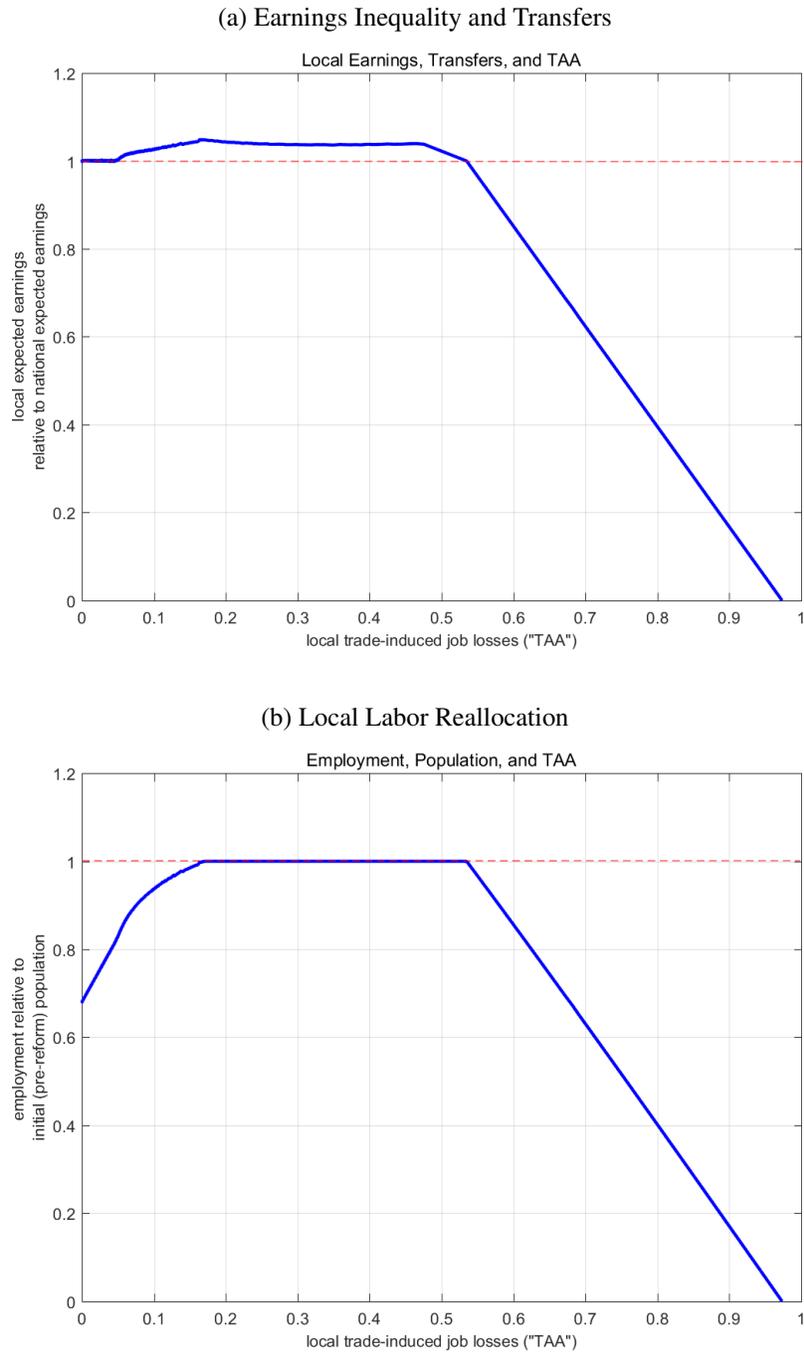


Figure 13: Decadal change in TAA Foreign Competition (1990s and 2000s)

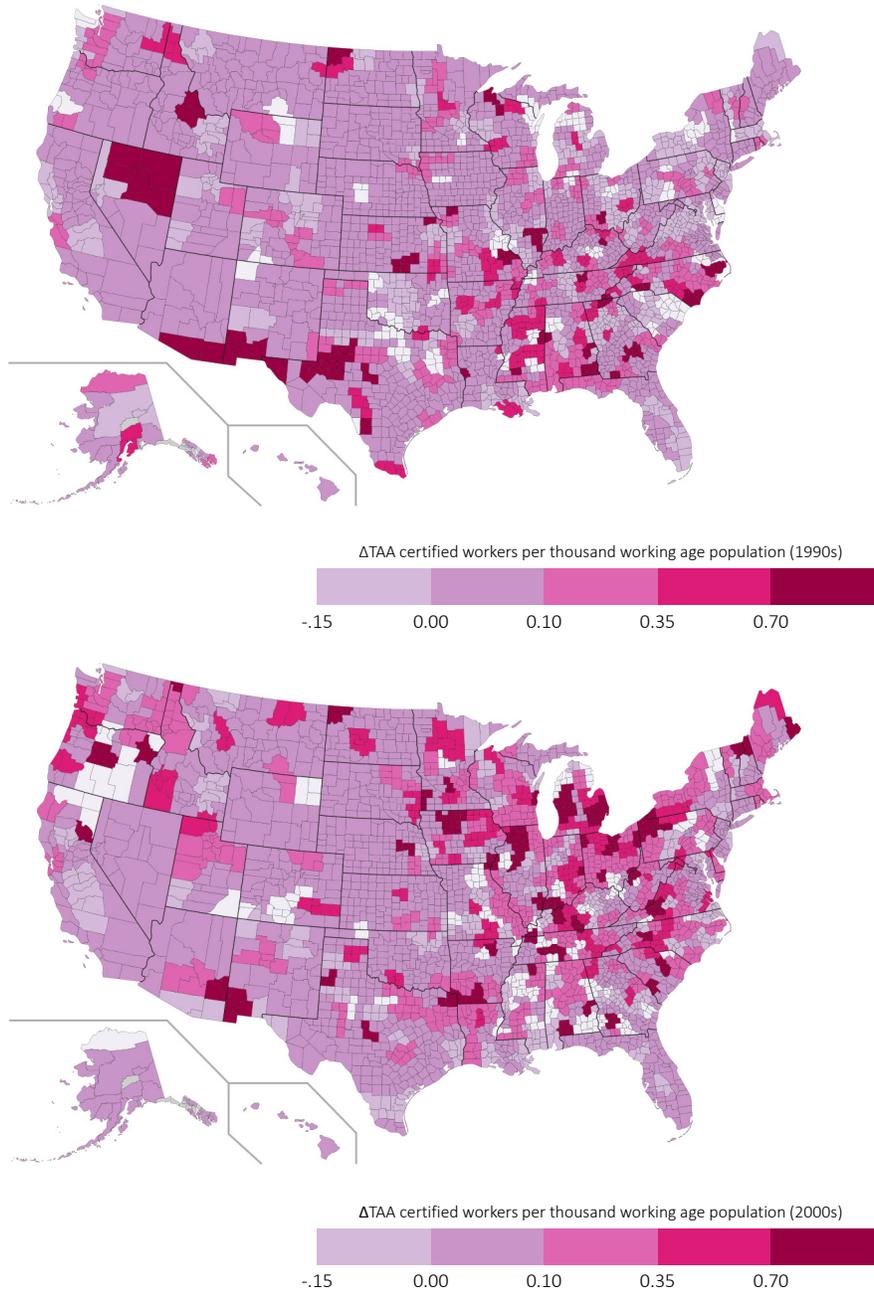


Figure 14: Maps of ADH measure (1990s and 2000s)

