Trade Reforms, Foreign Competition, and Labor Market Adjustments in the U.S.

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Abstract

Administrative data on the U.S. Trade Adjustment Assistance (TAA) for workers reveals an uneven reallocation across locations: locations with more trade-induced displacements not only shed more of their existing jobs but also create fewer new jobs to absorb these losses while population outflows are muted. In fact, one extra TAA trade-displaced worker is associated with the local employment falling by two workers relative to other locations. Both endogenous variable markups from head-to-head competition and segmented labor markets are crucial for the theory to endogenize this elasticity of local employment to trade-induced displacements. In the transition following an unexpected trade liberalization, employment and earnings collapse in the least productive locations while welfare and employment increase in the aggregate. Inequality rises during the transition partly because of reduced worker mobility.

Keywords: foreign competition, endogenous variable markups, unemployment, job flows, spatial equilibrium, import penetration, inequality.
JEL classification: F16, F66, G64

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1 Introduction

With each round of free trade negotiations, policymakers and economists grapple with the labor market effects of trade liberalization. Often, economists argue that freer trade is overall beneficial though the necessary reallocation it induces may make winners and losers. Following the seminal contributions of Bernard et al. (2003) and Melitz (2003), trade economists have extensively explored reallocation using models with heterogeneous firms. Despite rich heterogeneity in gains and losses across firms, these models only consider economy-wide labor markets (see for example Helpman et al. 2010). Yet, such uneven effects of trade are particularly relevant across locations due to the intrinsically geographic nature of labor markets.

In fact, recent evidence suggests that labor markets are unequally affected by foreign competition. In particular, Autor et al. (2013) find that, across locations in the U.S., higher import penetration is associated with lower employment. In contrast, across countries, more trade openness is associated with higher employment in the aggregate (see Dutt et al. 2009; Felbermayr et al. 2011). This paper investigates how trade liberalization affects labor market outcomes across locations within a country and in the aggregate, especially during the transition when mobility is limited.

This paper contributes to the theory and to the measurement of the labor market effects of international trade across locations. The paper first presents novel evidence on trade, unemployment, and job flows using data from the U.S. Trade Adjustment Assistance (TAA) programs for workers. In particular the data yields, across locations, a novel estimate: the elasticity of local unemployment to trade-induced displacements. This estimate controls for various attributes including local industry composition and non-tradables. The paper then builds a heterogeneous firms trade model with segmented labor markets and head-to-head competition rationalizing these findings. Head-to-head competition and segmented locations are crucial to generate uneven changes in the extensive margin and in variable markups which in turn percolate into local labor market outcomes.

First, measuring the uneven labor market effects of trade across locations is not very trivial. The standard approach is to regress local labor market outcomes such as the unemployment rate in a given location on its "import penetration", a Bartik-style measure of how much the whole country imports more of the goods produced by that location. However, such standard import penetration proxy could underestimate the relationship between net job gains and trade-induced job losses across locations. This is because the standard import penetration proxy is the same for all locations with the same industrial base. For example, a "GM town" and a "Ford town" that are equally concentrated in the auto industry would be assigned the same import penetration proxy even if one town collapsed while the other one boomed. In effect, the import penetration proxy fails to capture the very within-industry reallocation effects emphasized by the "new new" trade literature following Bernard et al. (2003) and Melitz (2003).

In contrast, this paper uses data from the U.S. Department of Labor on the certified petitions for Trade Adjustment Assistance (TAA) programs for workers. Instated as part of the Trade Act of 1974, the TAA for workers is a federal program that aims to support the professional transition of workers displaced due to foreign trade. Workers from an establishment petitioning for TAA assistance go through a rigorous certification process that was drastically revamped under the Reagan administration.[1] This paper shows that the TAA petitions data can yield an insightful direct measure of trade-induced job displacements that varies across locations and within industries.[2]

Using a panel of 50 states spanning 27 years from 1983 and 2009, this new empirical approach reveals that job gains from trade are precisely lower in the places that shed more jobs due to trade-induced foreign competition. Overall, one extra TAA trade-displaced worker is associated with the local employment falling by two to three workers relative to other locations. Clearly, existing models are not equipped to capture this elasticity of local unemployment to TAA trade-induced displacements. These findings are robust to the standard import penetration proxy, unionization rates, non-tradable activity, state indicators, time indicators and time-region interaction terms.

Motivated by this puzzling and novel elasticity, the paper then builds a Ricardian trade model to endogenize the relationship between trade-induced job displacements and local unemployment. 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; Bernard et al. 2003). The model also encapsulates a simple trade variant of Dixit and Stiglitz (1977) in order to sharply contrast the crucial role of endogenous variable markups for labor market outcomes. Head-to-head competition also provides a clear model counterpart for the data on TAA job losses attributed to the foreign competition. Such a TAA "statistic" counterpart 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). In the model, transitional dynamics after a trade reform are captured by restricting worker mobility across locations but not within. This mobility assumption, following Helpman and Itskhoki (2010), is consistent with the data.[3]

In this Ricardian model, productivity differences across locations drive the heterogeneous com-

[1]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.

[2]Margalit (2011) concurrently constructed a similar measure in the political science literature. Yotov (2013) and Uysal, Yotov and Zylkin (2015) previously, and Monarch et al. (2014) recently, used the underlying TAA petition data for industry-level and firm-level predictions of Melitz (2003). A location-specific measure is needed here precisely because labor markets are geographic in nature.

[3]Kennan and Walker (2011), Artuç et al. (2010), Dix-Carneiro (2014) estimate substantial interim switching and mobility costs. These findings are also consistent with sluggish population adjustments in this paper, Autor et al. (2013), Menezes-Filho and Muendler (2011), and Topalova (2007). See also Matsuyama (1992) and Dixit and Rob (1994) for theories of sectoral allocation under labor mobility frictions.

petitive effects of trade reforms on unemployment. Specifically, locations are assumed to differ in the productivity of their local firms.[4] Within each location, each firm produces a 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 may face competitors that are more or less productive. Thus, a firm in a more productive location is more likely to outcompete its foreign rival. This 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.[5] Workers direct their search across locations. So, workers are allocated such that they are indifferent among these locations *ex ante*.[6] Following an unexpected trade reform, consistent with the data, workers can switch firms within their home labor markets but they cannot migrate.

In the model, 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 spatial equilibrium features are corroborated using state-level productivity data from Turner et al. (2008). The *ex ante* spatial equilibrium also ensures that firms can tap into their endogenous local unemployment despite the lack of mobility in the transition following a trade reform.

In the medium run, head-to-head competition changes the distribution of markups and the extensive margin 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.

Therefore, the most vulnerable locations have both a higher job destruction rate and a lower

[4] Exogenous 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 (2013) on trade, agglomeration, and internal geography.

[5] Here, 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 from a variant of the model with matching frictions are available upon request.

[6] This 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).

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 little. The lack of worker mobility tends to exacerbate the dispersion across locations in outcomes. 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 elasticity of two.[7]

In the long run after a trade liberalization, the least productive locations become ghost towns as their residents migrate away. During the transition, trade liberalization yields aggregate welfare gains. Though workers do not migrate, local reallocation ensures gains occur. The transitional aggregate welfare gains are actually higher in the transition when workers do not migrate compared to the long run equilibrium when workers are fully mobile across locations. This is partly due to the convenient but implausible representative agent used here and the literature. 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' indifference condition across locations. However, an unbalanced foreign productivity growth reduces domestic welfare because all locations, including the most productive ones, are adversely affected and experience increased job destruction without any associated job creation.

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.[8] Autor et al. (2013) and Ebenstein et al. (2014) conduct a thorough analysis of U.S. labor markets and trade.[9] 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 (2012) document that the elimination of trade policy uncertainty with China precipitated the decline of American manufacturing.[10] This paper extends these empirical findings using novel data and also highlights the key role of within-industry heterogeneity.

[7] See 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.

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

[9] 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.

[10] A related literature investigates the decline of American manufacturing. Alder et al. (2012) and Yoon (2012) 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.

Davidson et al. (1999) made a seminal contribution by considering labor search and matching 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) which brought intra-industry heterogeneity and reallocation in focus. In particular, Verhoogen (2008), Egger and Kreickemeier (2009), Dutt et al. (2009), Mitra and Ranjan (2010), Felbermayr et al. (2010), Helpman and Itskhoki (2010), Helpman et al. (2010), Davis and Harrigan (2011), and Amiti and Davis (2012) 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 labor markets.

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 closely related to the pro-competitive effects of trade liberalization studied by Arkolakis et al. (2012), de Blas and Russ (2015), Edmond et al. (forthcoming) and Holmes et al. (2014). In particular, De Loecker et al. (forthcoming) estimate 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, endogenous variable markups are anchored to labor markets through wage bargaining and the spatial equilibrium: changes in markups and at the extensive margins are key for understanding the stylized facts on trade and unemployment across locations.[11] 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 transitional mobility frictions and endogenous variable markups also distinguishes this paper from the recent elegant 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.

[11] Felbermayr et al. (2014) also find that the effects of international trade on residual inequality across firms depend crucially on product market competition. The hybrid model proposed here clearly highlights the role of product market structure for labor market outcomes.

2 Evidence

This section presents the main empirical findings. The dataset is based on 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 data is aggregated yearly at the state level from 1983 to 2009 into a state-level panel dataset.

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.[12] 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.

To establish the eligibility of the petitioning workers, federal investigators at the Department of Labor 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.

For each petition, federal 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 Trade Adjustment Assistance (TAA) investigators also have legal power to issue subpoenas if the company does not comply to the data request.[13]

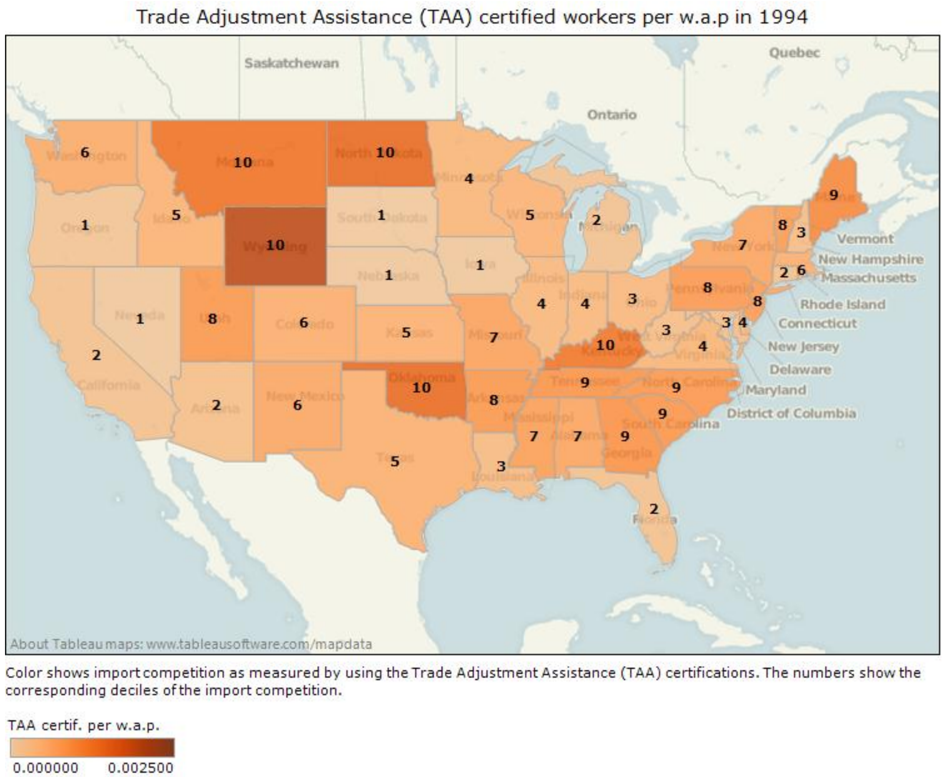
The number of workers TAA-certified workers in a given geography and period is therefore a direct measure of job losses from trade-induced foreign competition. Naturally, one would be concerned about how political pressures affect the odds of being certified. In fact, before 1980, unionized auto workers 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 of politically-influenced certifications.[14]

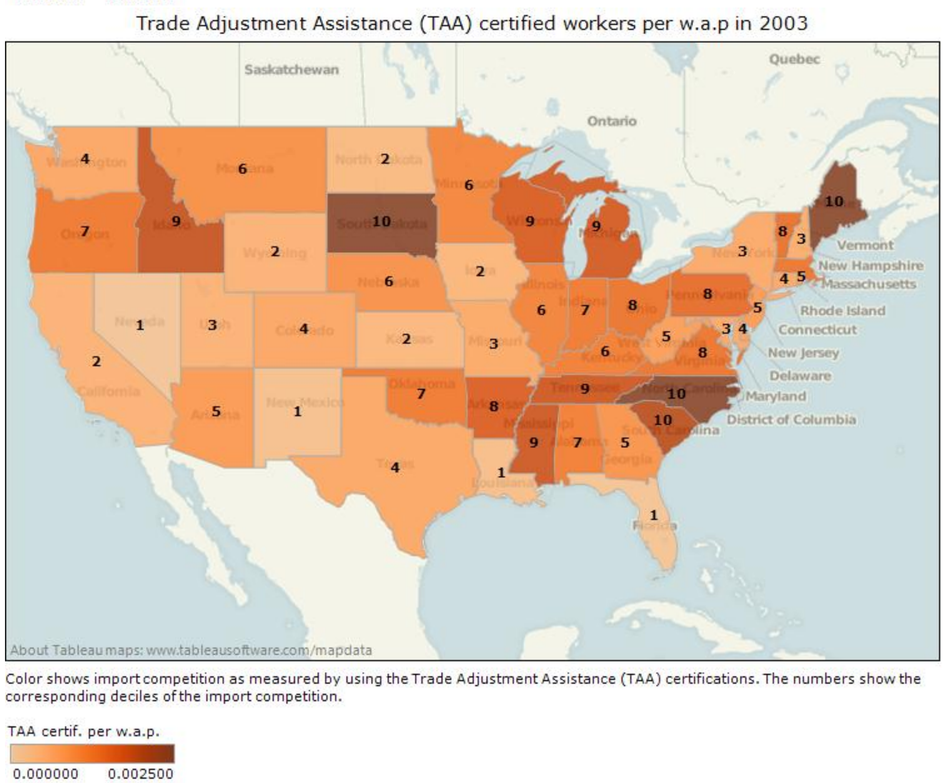
[12] A critical piece of U.S. trade policy, the TAA an import part of the "Trade Preferences Extension Act of 2015".

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

[14] Petitions are publicly available at www.doleta.gov. Meetings with the TAA staff also helped confirm the quality

Figure 1: Maps of TAA foreign competition measure in 1994 and in 2003





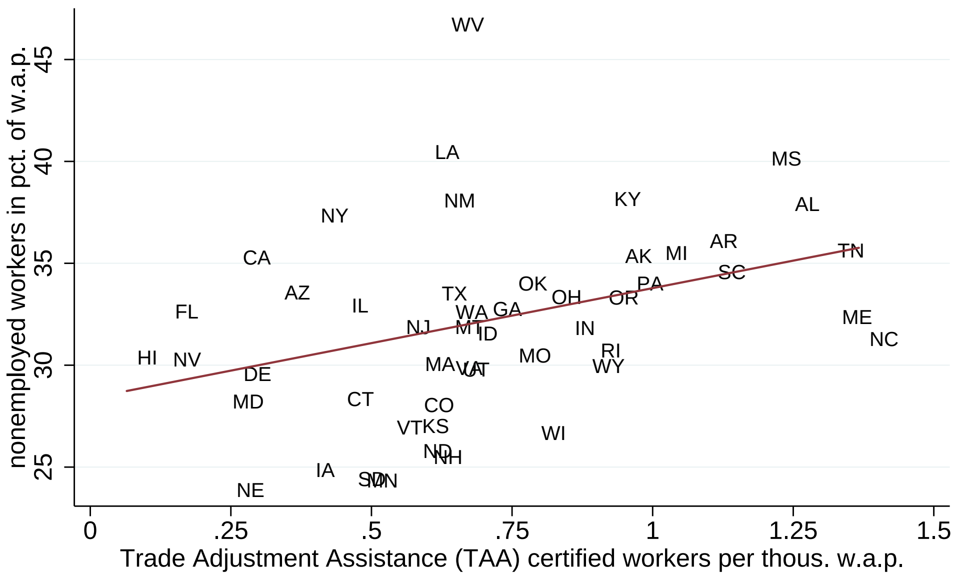
2.2 Measuring Foreign Competition

For every year $t = 1983 \ldots 2009$ and every U.S. 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.):

$$\text{TAA foreign competition}_t^i \equiv \frac{\sum_{\text{plants } j \in i} \text{TAA certified workers}_{j,t}^i}{\text{working age population}_t^i}$$

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 at the state-level but not at finer levels. The maps in Figure 1 show that TAA-based measure varies across space and over time while being broadly consistent with the conventional wisdom about which places are the most affected.[15]

Figure 2: Nonemployment and TAA certifications in the U.S. (1983-2009)



Sources: March CPS and US DoL TAA programs. w.a.p. = working age population.

Figure 2 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 1983-2009. The nonemployment rate is computed as the unemployment rate plus the 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.

of the data and how the program works. The dataset used was obtained from a FOIA request in order to ensure the universe of petitions was gathered.

[15] See additional maps in the appendix.

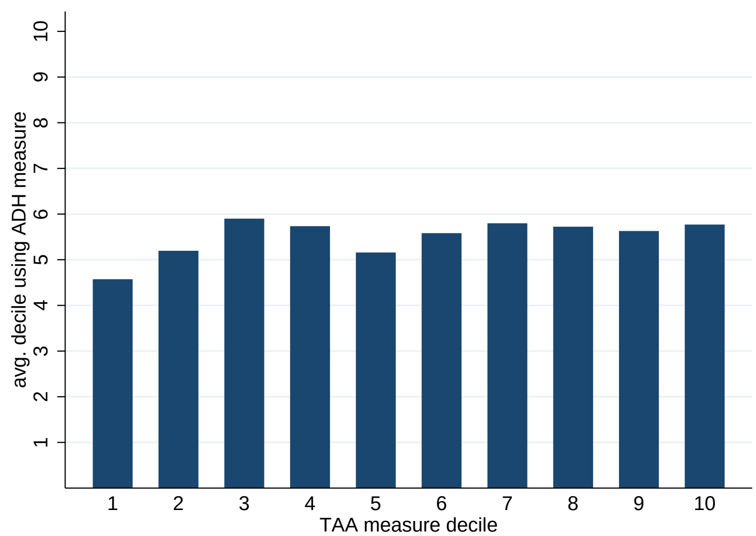
It is also useful to contrast the TAA-based measure with the standard import penetration measure. Autor et al. (2013) recently used this measure in their influential work to estimate the effects of increased Chinese imports on labor markets in the U.S. Formally, they compute the import penetration, henceforth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

$$\text{ADH import penetration}_t^i \equiv \sum_{\text{industries } k} \underbrace{\frac{\text{employment}_{i,t}^k}{\text{employment}_{i,t}}}_{\text{local industry share}} * \underbrace{\frac{\Delta\text{imports}_{US,t}^k}{\text{employment}_{US,t}^k}}_{\text{US imports per worker}}$$

This Bartik-style measure is the average of industry-specific imports weighted by the 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 direct TAA-based measure can capture the fact that two auto locations experienced different trade-induced foreign competition and job losses. In fact, there is a very weak positive correlation (0.06) between the two measures at the state level.

Figure 3 further illustrates this weak positive correlation between the standard import penetration proxy and the TAA-based measure, using within-year deciles across states of each variable.[16]

Figure 3: State-level import penetration and TAA-based measure



The next section shows that the TAA reveals important differences across locations that the import penetration cannot capture.[17]

[16]The weak correlation suggests that a decomposition of TAA-based job losses in industry, location, and firm effects using the ADH import penetration proxy at the commuting zone level would be very useful question.

[17]One salient feature is that the number of TAA-certified workers yearly is small compared to the overall population, leading scholars to overlook it.

2.3 Foreign Competition and Labor Market Outcomes

The baseline sample is a balanced panel of 50 states spanning 27 years from 1983 and 2009. To assess the relation between import competition and labor market outcomes across the U.S., the regression below is estimated:

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

The variable "TAA foreign competition$_t^i$" is the share of working age workers certified by the Trade Adjustment Assistance (TAA) in state i *during* year t. The variables used as "labor market outcome$_t^i$" are : (a) the share "not employed$_t^i$" 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$_t^i$" at which existing jobs were destroyed in state i during year t; (c) the rate "job creation rate$_t^i$" at which new jobs were created in state i during year t; (d) the share "pop. share$_t^i$" of national working age population residing in state i *as of* the March CPS in t+1.

The set of controls Z_t^i includes the lagged "labor market outcome$_{t\text{-}1}^i$", the lagged "TAA foreign competition$_{t\text{-}1}^i$", state indicators, year indicators, year and U.S. Census region indicators, the state log income per working age population, the state share of U.S. working age population. Additional controls include the state import penetration, the state unionization rate, the state Trade Adjustment Assistance (TAA) approval rate, the state new housing units started per working age population.

The estimation results are reported in Table 1 and yields a novel estimate: the elasticity of local TAA trade-induced displacements to employment. One extra trade-displaced worker is associated with the local employment falling by two to three extra workers relative to other locations. The more trade-induced displacements, the less reallocation there is. Not only do locations with more trade-induced displacements arithmetically shed more of their existing jobs but they also create fewer new jobs to absorb these losses, in the absence of any significant population outflow.[18]

Naturally, one would be concerned about the ability of the Trade Adjustment Assistance (TAA) federal investigators to identify trade-induced displacements. First, if the TAA investigators were just using industry-level data, the import penetration proxy should be strongly correlated with the TAA measure. This does not appear to be the case as reported in Table 1 and in Figure 3. Also, denied applications or approval rates have no association with labor market conditions in the data.[19]

The findings reported do not hold when the import penetration proxy is used instead of the

[18] See appendix for results on wages and other labor market outcomes. As in the literature, wages do not necessarily fall with foreign competition though hours worked do fall. See also Amiti and Davis (2012) and Autor et al. (2014) for worker-level, but not labor market level, effects of trade. Klein et al. (2003) and Moser et al. (2010) document the job flows effects of exchange rate shocks.

[19] This was not the case pre-1983 before the Reagan administration revamped the TAA certification process.

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

Labor market outcomes →	**Not Employed**			**Job Destruction Rate**		**Job Creation Rate**		**Population**	
	a1	a2	a3	b1	b3	c1	c3	d1	d4
Foreign Competition Variables									
TAA Certified Workers	2.729***	-	2.792***	1.523**	2.443***	-1.517***	-1.985**	0.686	0.217
	(.544)	-	(.873)	(.697)	(.529)	(.546)	(.845)	(1.607)	(1.719)
ADH Import Penetration	-	0.00135	0.0007	-	0.0006	-	0.0008*	-	-
	-	(.00082)	(.0008)	-	(.0005)	-	(.0005)	-	-
Additional Controls									
TAA Denied Workers	0.644	-	-0.130	1.240	0.574	1.200	0.106	-0.268	-2.338
	(.718)	-	(1.052)	(.797)	(1.016)	(.490)	(.831)	(1.847)	(2.030)
New Housing Starts	-	-	-1.178***	-	-0.936	-	0.950	-	2.423**
	-	-	(.555)	-	(.597)	-	(.769)	-	(1.204)
Unionization Rate	-	-	-0.393***	-	0.015	-	-0.027	-	0.004
	-	-	(.051)	-	(.036)	-	(.046)	-	(.096)
Standard Controls									
All controls included	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes†	Yes†
R-sq.	0.4466	0.5052	0.5161	0.3689	0.2261	0.3600	0.1629	0.1746	0.1700
N	1350	750	750	1350	750	1350	750	1350	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 27 years from 1983 and 2009. Union data is only available after 1989 in the March CPS. Import penetration can only be constructed between 1988 and 2005 with a gap in 1998 to a change from SIC to NAICS. .†: The population dynamics regression use the change in population share as the outcome variable because the population time series are not stationary.

direct TAA measure, as shown in the specification (a2) of Table 1. The findings for the direct measure based on the TAA still hold after controlling for the import penetration proxy as shown in the specifications (a3), (b3), and (c3) of Table 1.[20] The results are robust to controlling for unionization rates as well as local spillovers in the non-tradable sector measured using housing starts data. The findings reported also hold if the sample excludes the period after China's accession to the W.T.O. or the Great Recession as well as other estimation strategies (heteroskedasticity, serial correlation, difference-in-difference).

Existing models with centralized labor markets or direct TAA-like job losses are not equipped to replicate these results, especially the puzzling elasticity of unemployment to TAA trade-induced displacements. The robustness of this estimate to the inclusion of the import penetration also motivates a key role for within-industry heterogeneity. A heterogeneous firms Ricardian trade model with endogenous variable markups and segmented labor markets is used to endogenize these findings and assess the implications of the uneven worker reallocation it endogenously delivers.

3 Trade Model with Segmented Labor Markets

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.[21] Each family is composed of 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).

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 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.

[20] The import penetration ignores within-industry heterogeneity. It also suffers from an inherent degrees-of-freedom problem which is solved with finer geographic granularity as discussed in Autor et al. (2013). Here, the estimation is at the state level with time fixed effects, state fixed effects and region-time fixed effects.

[21] This symmetry assumption is relaxed later.

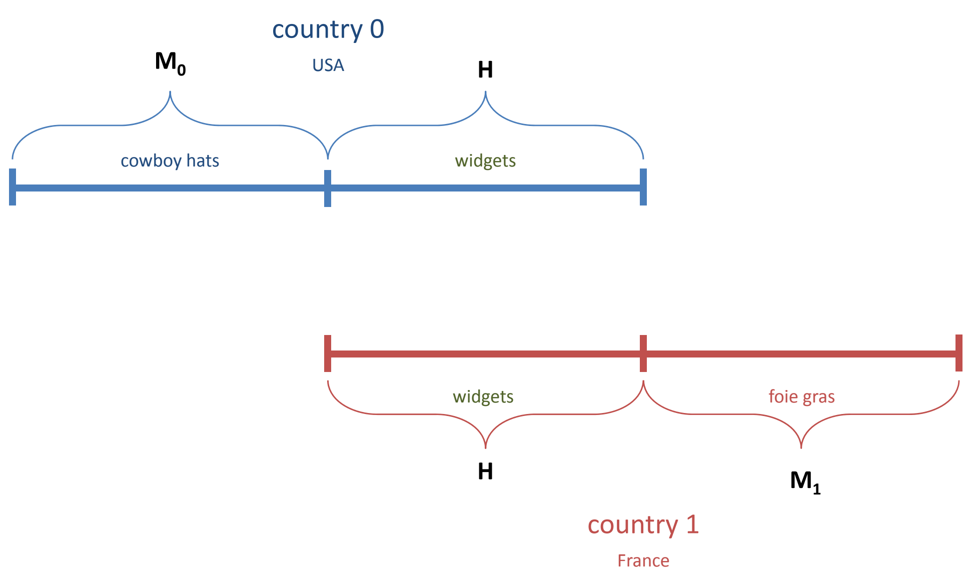
Preferences

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

$$Q \equiv \left(\int_{M_0 \cup H \cup M_1} q(\nu)^{\frac{\sigma-1}{\sigma}} \, \mathrm{d}\nu \right)^{\frac{\sigma}{\sigma-1}}$$

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

Figure 4: A simple overview of the model



The differentiated goods have two possible types, monopolistic or head-to-head, as illustrated in Figure 4. The monopolistic goods ("$M-$goods") have no foreign counterpart and the producers of these goods are monopolistic competitors (e.g. American cowboy hat varieties and French foie gras varieties in the illustration). The head-to-head ("$H-$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: $P_j \equiv \left(\int_{M_0 \cup H \cup M_1} p_j(\nu)^{1-\sigma} \mathrm{d}\nu \right)^{\frac{1}{1-\sigma}}$. A household with total income R_j from earnings and profits optimally chooses:

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

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).[22]

A model that only included monopolistic competitors without direct foreign competition would fail to match the data simply because it cannot generate TAA-like job losses due to foreign competition. A model without monopolistic competitors, on the other hand, may overstate the effects of foreign competition on job losses.[23]

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 ($H = 1$).[24]

Each firm ϕ is exogenously assigned its variety $\nu(\phi) \in M_0 \cup H \cup M_1$ 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 $\nu(\phi)$ 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: $y_0 = \ell$.

[22] This 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 also 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 (2012). Comparative statistics with respect to the number of rivals à la de Blas and Russ (2015) are an appealing extension but beyond the scope this paper.

[23] 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.

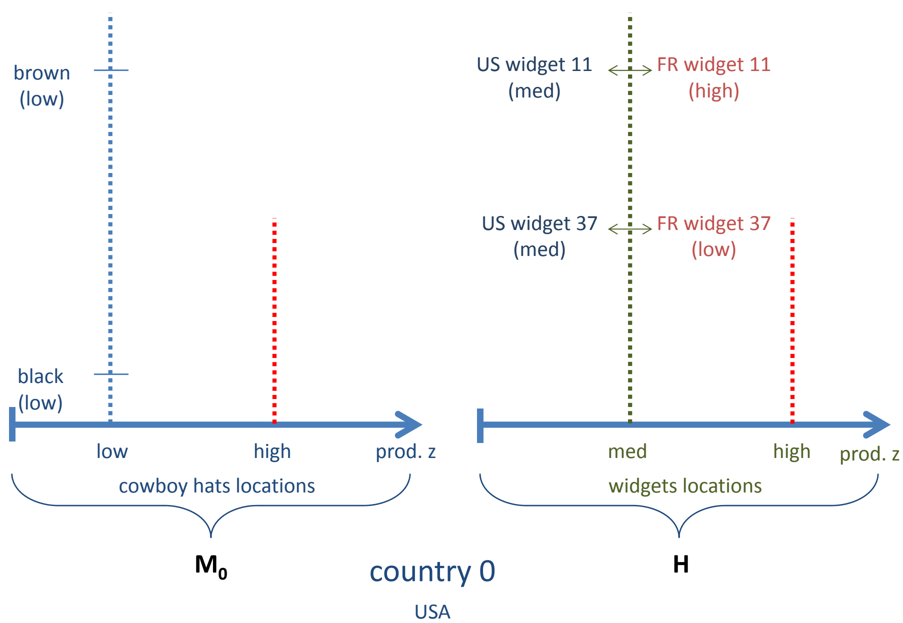
[24] The combination of both monopolistic competition and head-to-head competition resembles the model of *mass production plants* and *boutique shops* used by Holmes and Stevens (2014) in their study of plant size distribution with an application to the trade in wood furniture. Here, monopolistic firms 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.

Heterogeneous Locations and Segmented Labor Markets

The main goal in defining locations is to have heterogeneity in foreign competition. 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.[25] Therefore, in each country, there are many $H-$type (head-to-head) towns and many $M-$type (monopolist) towns, in addition to homogeneous good towns.[26]

There is further heterogeneity across firms within each $H-$type (head-to-head) town even though they share the same productivity. Figure 5 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. Within an $M-$type (monopolist) town, firms share the same productivity and they each produce different varieties.[27]

Figure 5: A simple illustration of locations



The economy has a continuum of locations across which families assign workers. Within each location, workers are randomly matched with vacancies through a Leontief matching function.[28]

[25] The 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 nonemployment effects of trade across locations.

[26] Since the homogenous numeraire good is not traded, it is simply assigned a separate town.

[27] For 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.

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

At each plant, the workers bargain collectively with the firm over wages and production decisions.[29] The workers collectively have bargaining power λ.[30] Firms have to pay a hiring cost γ per hire. The union's threat point is 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 Monopolist ($M-$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:

$$S^j_{j'}\left(z, \ell^j_{j'}\right) = \underbrace{Q_{j'}^{-(\rho-\eta)} \left(\frac{1}{\tau^j_{j'}} z \ell^j_{j'}\right)^{\frac{1}{\mu}}}_{\text{revenues } R^j_{j'}\left(z, \ell^j_{j'}\right)} - (b+\gamma)\, \ell^j_{j'}$$

The firm's profit from this plant is: $\pi^j_{j'}\left(z, \ell^j_{j'}\right) = R^j_{j'}\left(z, \ell^j_{j'}\right) - \gamma \ell^j_{j'} - w^j_{j'}(z)\, \ell^j_{j'}$ 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:[31]

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

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:

$$\begin{aligned}
p^j_{j'}(c) &= \mu\, \tau^j_{j'}\, c & & \\
w^j_{j'}(c) - b &= \lambda\, (\mu - 1)\, (\gamma + b) & &\equiv w_M - b \\
\ell^j_{j'}(c) &= Q_{j'}^{-\frac{\rho-\eta}{1-\rho}} \left[\mu\, (\gamma+b)\right]^{-\sigma} \left[\frac{(\gamma+b)}{\tau^j_{j'}\, c}\right]^{\sigma-1} & &\equiv \mu^{-\sigma}\, \bar{\ell}^j_{j'}(c)
\end{aligned}$$

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

[30]The linear production function and the simple Leontief matching function are used to provide a simpler and more tractable benchmark. An alternative multilateral bargaining à la Stole and Zwiebel (1996) has been 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 underpin the cross-section of employment and wages across export status, firms and locations. Results from a variant of the model with matching frictions are available upon request.

[31]For the monopolist, casting the problem in terms of size (ℓ) or prices yield the same outcome.

where $\tau_{j'}^{j}\,c$ is the firm-union unit cost and $\overline{\ell}_{j'}^{j}(c)$ 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.[32] 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

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 $\mathrm{W}_M(z)$ in this town therefore satisfy: $\mathrm{W}_M(z)\equiv w_M\cdot e_M(z)$.

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:

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

$$\text{s.t.}\quad p_{j'}^{j}(z,\ell)\leq\overline{p}_{j'}^{1-j}(\tilde{z}),\qquad \pi_{j'}^{j}(z,\ell)\geq0$$

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

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

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 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. Less productive firms are also more likely to pay lower wages due to lower markups. The important 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.

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

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

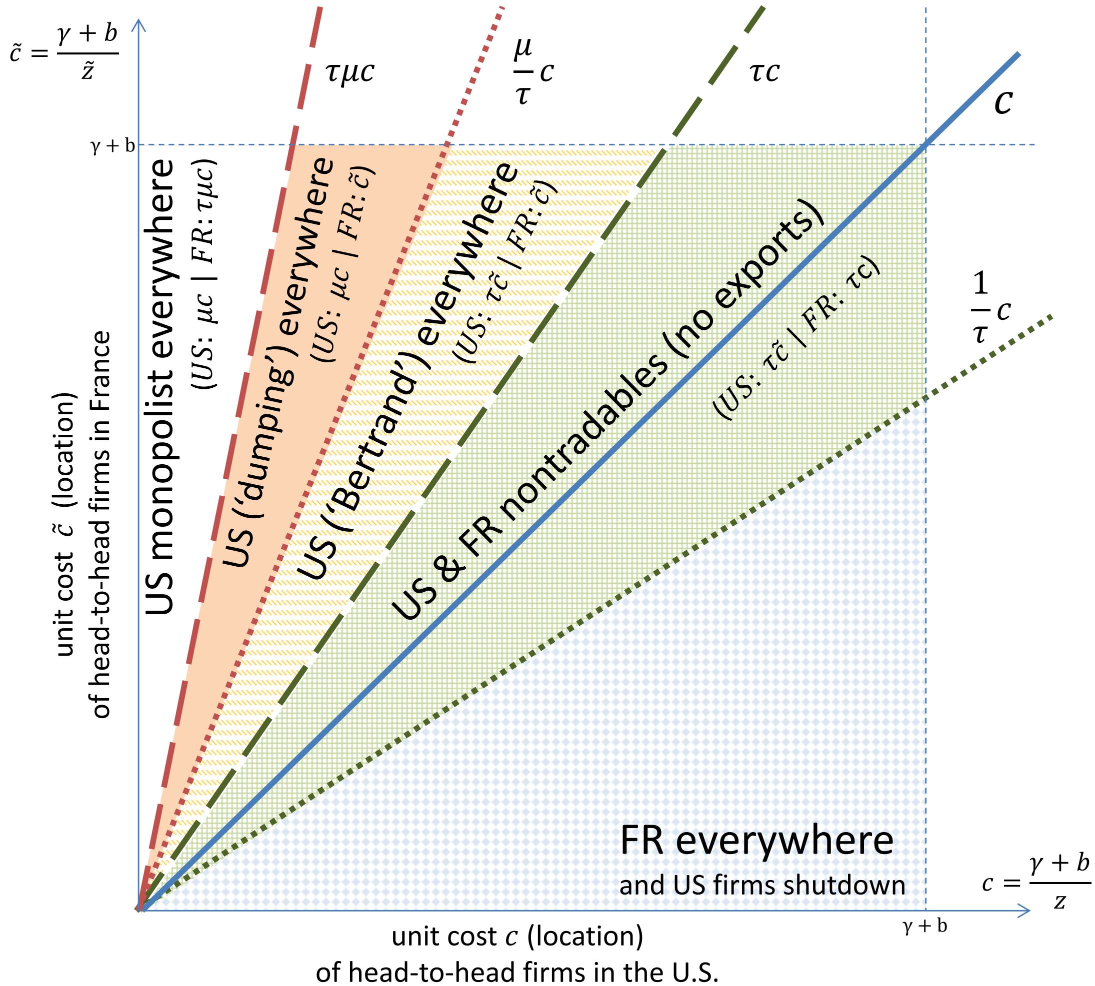
Through variable markups, the effect of the head-to-head competition on the firm behavior also depends on the level of frictions to international trade. In fact, as the tariff τ goes to infinity (autarky), the $H-$type producers are all in operation and they all charge the unconstrained monopolistic price: $\lim_{\tau\to\infty}\mu_{j}^{j}(c\,,\tilde{c}) = \mu$. On the other hand, when trade is frictionless, only some firms charge the monopolistic price.[33]

The model therefore generates rich pricing-to-market markups as shown in Figure 6.[34] 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 $\tilde{z}$.

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

[34] Figure 6 illustrates the case when trade barriers are low enough ($\tau^2 < \mu$).

Figure 6: Variable markups across firms and locations



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 6). Also, firms from less productive locations are more likely to produce 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 6).

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 6). This outcome could suggest "dumping" since the ratio of prices at home and abroad is larger than the iceberg transportation costs. This "dumping" region only disappears in the limit case of frictionless trade ($\tau = 1$).

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. Changes in trade barriers also unevenly change both the local extensive margin of exporting and the local extensive margin of firm shutdown.[35]

Overall, the distribution of markups varies within and across locations as evidenced in Figure 6. These differences competitive outcomes across locations then percolate into employment and wages through the previous equations.

Local Employment Rates

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

$$e_H(z) = \frac{\displaystyle\int \sum_{j'=0,1} \ell^j_{j'}(z,\tilde{z})\, \mathrm{d}F(\tilde{z})}{L_H(z)}$$

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 $\mathrm{W}_H(z)$ in that town satisfy:

$$\mathrm{W}_H(z) \equiv \frac{\displaystyle\int \sum_{j'=0,1} w^j_{j'}(z,\tilde{z}) \cdot \ell^j_{j'}(z,\tilde{z})\, \mathrm{d}F(\tilde{z})}{L_H(z)}$$

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:

$$L \quad = L_0 + M \int L_M(z)\, \mathrm{d}F(z) + H \int L_H(z)\, \mathrm{d}F(z)$$

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

[35] These insightful "anti-competitive" composition effects from "dumping" are seemingly overlooked when only the limit cases of free trade and autarky outcomes are compared (see Bernard et al. 2003; de Blas and Russ 2015).

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:

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

3.3 Equilibrium

A symmetric 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 Wages and Nonemployment across Locations

The following properties hold in equilibrium.[36]

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:

$$w_0 = \begin{cases} \mathrm{W}_M(z) & \forall\, z \text{ s.t. } L_M(z) > 0 \\ \mathrm{W}_H(z) & \forall\, z \text{ s.t. } L_H(z) > 0 \end{cases}$$

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*.

[36]This 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, the general equilibrium has to be numerically computed because the non trivial double integration involved.

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.

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. □

This proposition is important because it 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. However, the abstraction from multilateral bargaining is not problematic as long as the constant wage and proportional net surplus sharing results hold (e.g. Helpman and Itskhoki 2010 and Felbermayr et al. 2010)

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.[37] □

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 $\lim_{\tau\to\infty}\mu_j^j(c,\tilde{c}) = \mu$. In general, trade barriers (τ) interact with the ideal markup (μ) to alter the entire distribution of markups as illustrated in Figure 6. Hence, the expected markups across head-to-head locations do not always fall with productivity.

[37] See Table 4 and section 4.5 for evidence on this relation between TFP and the nonemployment rate.

3.5 Equilibrium Labor Allocations

The employment rate across monopolistic locations is degenerate and corresponds to the employment rate of the most productive head-to-head locations. On the other hand, the endogenous distribution of variable markups across locations also underpins a distribution of employment rates.

Figure 7: Trade Barriers and Employment Rate

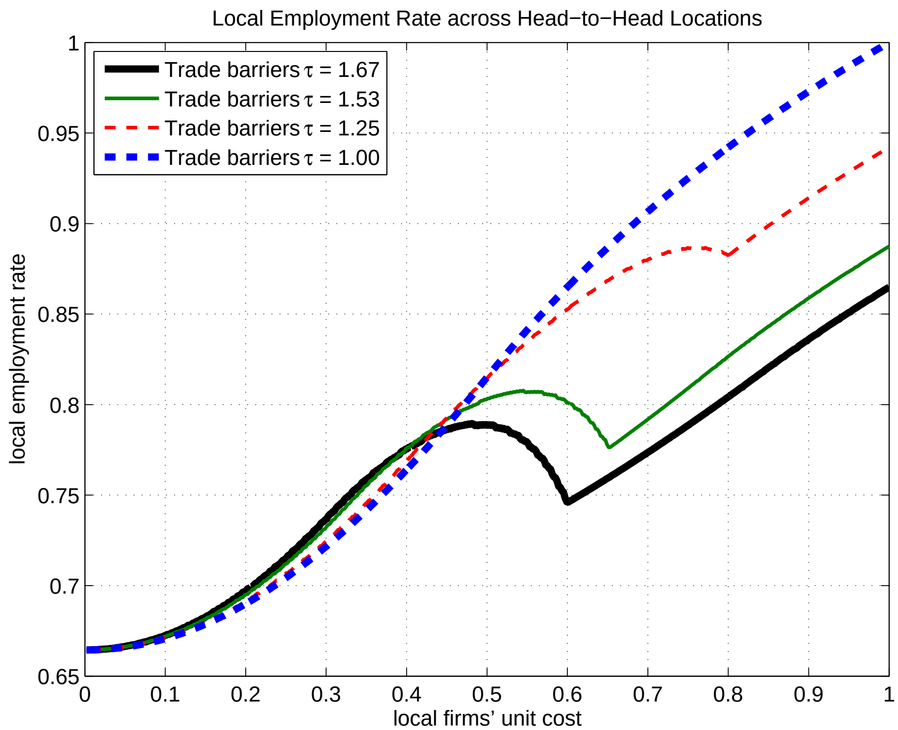


Figure 7 shows the equilibrium employment-to-population across head-to-head labor markets for various levels of trade barriers.[38] By Proposition 3, in the absence of trade barriers, the nonemployment rate across head-to-head locations decreases with productivity. However, the monotonicity does not 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 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.

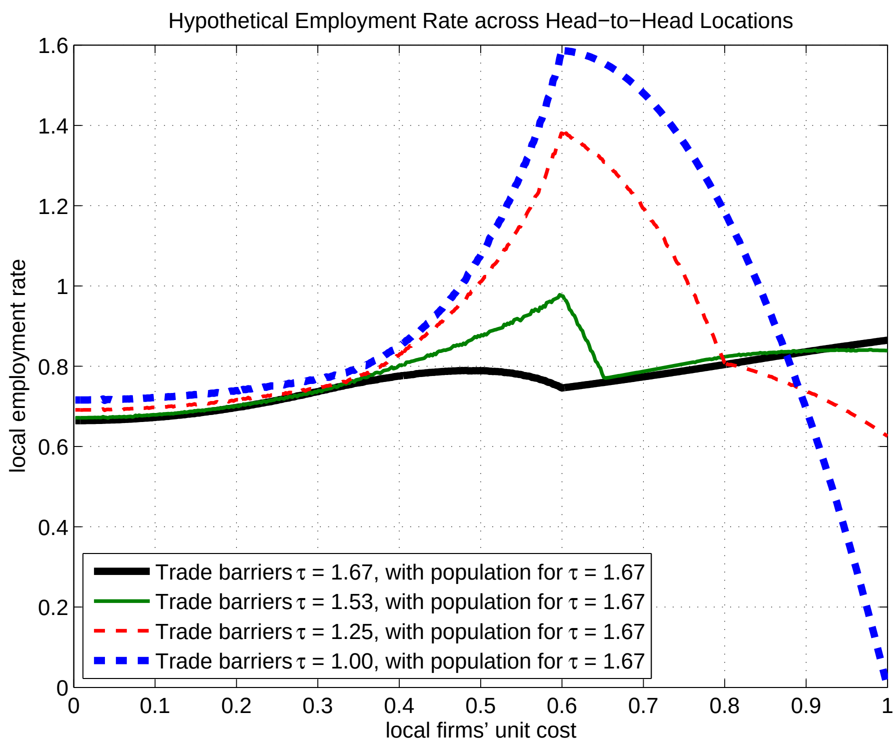
Eventually, more productive locations have more firms charging higher markups. So the hump is an artifact of the changing composition of the endogenous markups. The kink and the hump naturally vanish in the absence of trade costs. The model also predicts that more productive locations have higher employment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

[38] See Table 2 for the other parameters used in the illustration.

3.6 Long-Run Reallocation across Labor Markets

When workers are mobile within and across labor markets, the most affected locations become ghost towns in the free trade equilibrium: their population vanish. As shown in Figure 8, some locations greatly expand and employ more workers than their original population.[39] However, the full mobility assumption is at odds with the empirical evidence on muted population adjustments Therefore, worker mobility is restricted during the transition following a trade reform shock.

Figure 8: Reallocation of Labor with Full Mobility



4 Medium Run Equilibrium Outcomes

Consistent with the muted population adjustments in the data, workers are now assumed to be *ex ante* mobile across labor markets but not *ex post* as in Helpman and Itskhoki (2010). The *ex post* immobility assumption 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. An equilibrium with limited worker mobility is defined below. The model is calibrated to study trade-induced labor market adjustments across locations.

[39]The largest (proportional) firm expansions typically occur in the medium-sized locations that start exporting. This is reflected in the kink in Figure 8.

4.1 Medium Run Equilibrium 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 $\widehat{\tau}$ is: (a) a price index $\widehat{P}$; (b) quantities $\widehat{q}_0$ and $\widehat{Q}$; (c) earnings $\widehat{\mathrm{W}}$; and (e) aggregate profits $\widehat{\pi}$ 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 limited mobility 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 Pareto distribution shape parameter is set to $s = 2.05$ to guarantee finite mean and finite variance following Helpman and Itskhoki (2010). The elasticity of substitution with the outside good η is set to $0.25 < (\sigma - 1)/\sigma$ to ensure that varieties are better substitutes for each other than for the homogeneous good (see Helpman and Itskhoki, 2010). The bargaining power λ is set to 0.5 so the union and the firm have equal bargaining power. The fraction of $H-$type firms is chosen so that the average number of trade-induced displacements matches the data (0.7 workers percent of w.a.p.). The outside option parameter is chosen so that all local labor markets attract workers under full worker mobility. The other parameters are set to have a national nonemployment rate of 30 percent in free trade. The calibration parameters are summarized in Table 2.

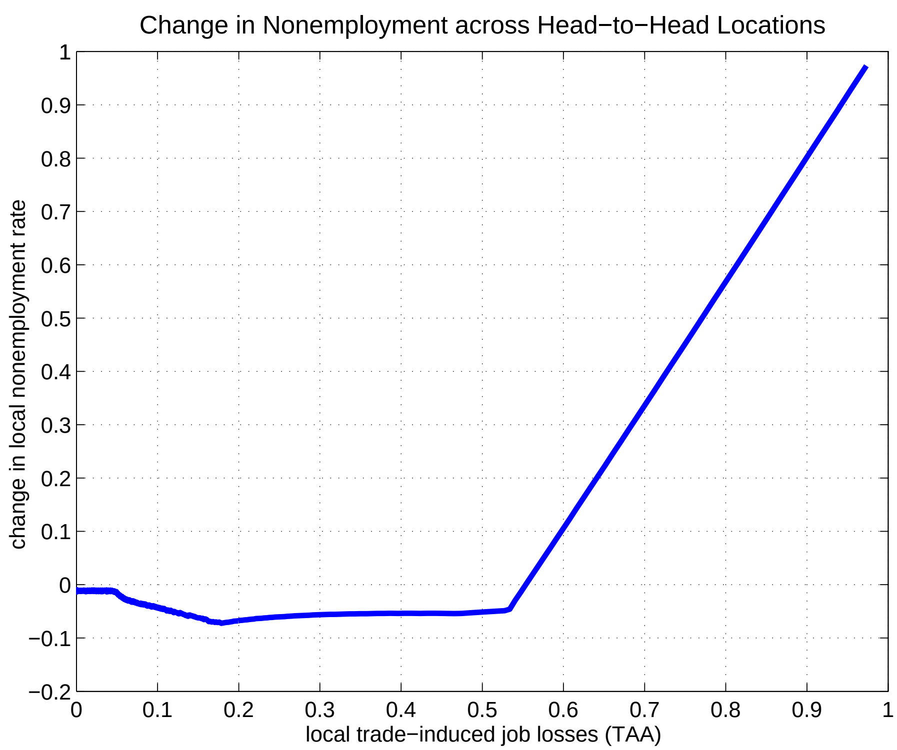
Table 2: Calibration

Parameter	Description	Value
H	Fraction of head-to-head firms	0.01
M	Fraction of monopolist firms	0.99
σ	Armington elasticity	2.01
η	Elasticity of substitution of differentiated good	0.25
s	Pareto distribution shape	2.05
λ	Union bargaining power	0.50
b	Outside option	1.00
γ	Hiring cost	0.02
L	Population	1.00
τ	Iceberg transportation costs pre-liberalization	1.11
$\widehat{\tau}$	Iceberg transportation costs post-liberalization	1.00

4.3 The Elasticity of Local Nonemployment to "TAA" Displacements

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 in the data: the number of local workers displaced because of trade-induced foreign competition. In the model, 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 6). This measure is equal to zero in non head-to-head labor markets.[40] Figure 9 illustrates the relationship between local nonemployment changes and these "TAA" trade-induced displacements.

Figure 9: Foreign Competition and Nonemployment



First, net changes in nonemployment maybe positive or negative depending on the productivity of the head-to-head labor markets. As indicated earlier, the non head-to-head labor markets correspond to a degenerate distribution at the point where trade-induced job losses are zero. Second, the reduced job creation explains the increased steepness of the curve in the locations experiencing the largest job destruction. Third, it is easy to observe that the elasticity of local nonemployment to "TAA" trade-induced job losses is slightly larger than two in the adversly hit locations.[41] The

[40] In the standard Melitz (2003) model and similar models with no direct competition, a TAA-measure of import competition would always be zero because the firms do not shut down because of direct foreign competition: TAA investigators would be unable to find evidence for trade-induced foreign competition as a cause of the layoffs.

[41] The model results are reported along the continuum of locations. These results can certainly be aggregated by

model therefore suggests that a selection bias in the petition process is needed to generate the measured elasticity of nonemployment to trade-induced displacements.

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 import competition.

The relationship is quantitatively and qualitatively robust to the size of the head-to-head sector (H).[42] This is because the size of the head-to-head sector mainly affects the aggregate price index while the nonlinear effects are driven by the endogenous changes in variable markups illustrated in Figure 6. On the other hand, the elasticity of substitution σ is naturally key for the magnitude of the elasticity of nonemployment to trade-induced displacements. This is because the elasticity of substitution determines the impact of falling prices on the demand for the goods produced by the least productive firms that manage to survive.

4.4 Aggregate Welfare Gains in the Medium Run and the Long Run

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 3.

Table 3: Effects of Limited Mobility in the Medium Run

	"TAA" job losses (per 1,000)	Not employed (percent)	$\%\Delta Q$ (diff. goods)	$\%\Delta q_0$ (hom. good)	$\%\Delta U$ (utility)
Pre-reform	0.00	30.32	-	-	-
Medium run	0.70	29.28	+7.02	-0.25	+1.69
Long run	0.00	30.84	+7.03	-19.51	+1.37

These medium run (limited mobility) welfare gains are actually not smaller than the long run (full mobility) gains. While the differentiated good demand is lower, limited mobility reduces

statistical units called "states" where each state is a selection of locations with correlated productivity. The current exposition is simpler and easier to connect to the mechanism in the model.

[42]The calibration target is rather conservative since H is chosen to match the nationwide average fraction of trade-displaced workers certified by the TAA.

inefficiencies from search frictions by increasing the overall employment level. In this model, the main source of nonemployment is the inefficiency from the directed search. Limited mobility partially undoes that inefficiency as in Helpman and Itskhoki (2010) or Farhi and Werning (2014).

While full labor mobility ensured that earnings were equalized across labor markets, limited mobility induces a non-degenerate distribution of expected earnings. This medium run earnings inequality is a source of income redistribution across labor markets.[43] In contrast, under full worker mobility, no redistribution across labor markets is needed because of the indifference condition.[44]

4.5 Further Evidence using Productivity across Locations

A fundamental ingredient in this model is the heterogeneity in productivity: differences in trade-induced displacements are due to productivity differences across locations. 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). Also, the model predicts a nonlinear quadratic relation between productivity and nonemployment when population adjustments are muted (see Figure 9). These implications are corroborated using empirical estimations similar to the one used in Section 2. The TFP estimates are from Turner et al. (2007) and Turner et al. (2008).[45] The results are shown in Table 4. All the specifications include state indicators, year indicators, and lagged variables.[46]

Productivity has a correlated effects on job creation and job destruction. In specifications (b6) and (c6), the less productive locations create fewer new jobs and lose more existing jobs. In response to productivity innovations, population gains occur in the long run as shown in specification (g1) even though population adjustments are initially muted as shown in specification (g2). Furthermore, specifications (e1) and (f1) confirm that indeed more productive locations have both higher wages and higher unemployment rates as predicted by Proposition 3.

Also, in specifications (a5) and (a6) of Table 4, the nonlinear effects of productivity on nonemployment rate are corroborated. Consistent with the theory, trade-induced displacements are no longer significant when productivity is accounted for in specification (a6). However, the quadratic effect is not significant when the trade-induced displacements alone are used in specification (a4).

[43] For earnings inequality, see Figure 13 in the appendix.

[44] Welfare gains would be different in the absence of full insurance across locations. The implications of limited insurance during trade reforms and go beyond the scope of this paper. A richer model with incomplete markets would be needed for this important question.

[45] These estimates are based on state-level sectoral inputs data including physical capital, human capital and land.

[46] Investigating micro-evidence on markups and foreign competition is unfortunately not possible using the data available for this paper. See De Loecker et al. (forthcoming) for an insightful contribution to the measurement of trade-induced changes in the distribution of markups using data from India.

Table 4: Labor Market Outcomes using TFP estimates across the United States

Labor market outcomes →	**Not Employed Workers**	**Not Employed Workers**	**Not Employed Workers**	**Job Destruction Rate**	**Job Creation Rate**	**Not Employed in 5 years**	**Log Wages in 5 years**	**Population in 5 years**	**Population Share**
	a4	a5	a6	b6	c6	e1	f1	g1	g2
Foreign Competition									
TAA Certified Workers	2.819**	-	2.625	-0.245	-1.233	-	-	-	-
	(1.255)	-	(1.800)	(1.017)	(.783)	-	-	-	-
TAA Certified Workers^2	-65.04	-	-218.50	-	-	-	-	-	-
	(217.01)	-	(316.17)	-	-	-	-	-	-
Total Factor Productivity									
Log TFP	-	-2.928**	-2.933**	-0.167***	0.222***	0.909***	0.624***	0.423**	-0.013
	-	(1.320)	(1.324)	(.061)	(.042)	(.233)	(0.112)	(.186)	(.096)
Log TFP^2	-	0.468**	0.469**	-	-	-	-	-	-
	-	(.216)	(.217)	-	-	-	-	-	-
Controls									
Standard controls	Yes	Yes	Yes	Yes	Yes	-	-	-	Yes†
Long run controls						Yes	Yes	Yes†	
R-sq.	0.7388	0.6352	0.6236	0.6296	0.4377	0.2002	0.5408	.0029	0.0028
N	1350	900	900	900	900	900	900	900	900

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 27 years from 1983 and 2009. State-level TFP estimates are available only up to 2000. The standard controls include: the lagged outcome, the lagged independent variables, year indicators, state indicators, year-region indicators. Long run controls include: the lagged outcome five years before, year indicators, state indicators. Wages are usual hourly wages adjusted for top-coding and deflated using the national PCE deflator. Hours worked are total hours worked last year.†: The population dynamics regression use the change in population as the outcome variable because the population time series are not stationary.

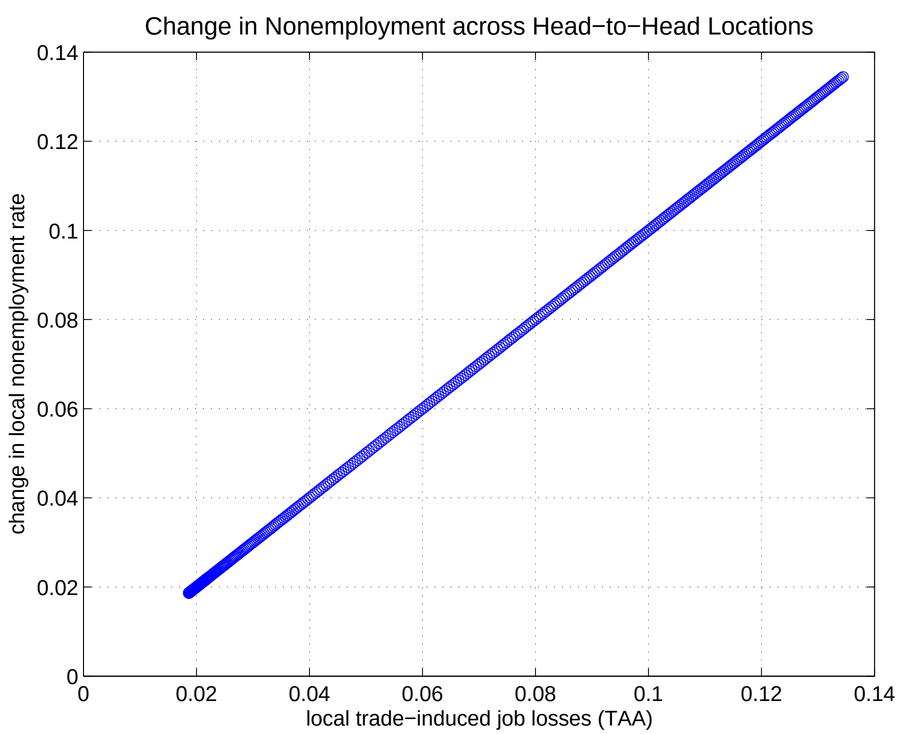
This finding also reinforces the possibility of a selection bias in the petitions. In fact, the large elasticity of nonemployment rate to trade-displacements can only be rationalized by this model when petitions mainly come from the hardest hit locations as shown in Figure 9. This would make sense if workers expected the overall labor market to expand in the more productive locations and therefore do not apply for TAA.

Altogether, these findings further confirm that trade reforms unevenly affect locations through preexisting cross-sectional productivity differences.

4.6 Trade Reforms and Exogenous Productivity Growth : Similar Effects?

In international trade, a fall in trade barriers and a growth in foreign productivity may have similar effects. For instance, Autor et al. (2013) argue that the adverse labor market effects of import competition from China are due to exogenous growth in China. In this model, the labor market effects of trade reforms and unbalanced productivity growth are not identical across locations.

Figure 10: Nonemployment under Exogenous Foreign Growth



To contrast an unbalanced productivity growth and a trade reform, an asymmetric free trade equilibrium extension of the original symmetric setup is considered. The two countries trade freely and are are different in their Pareto shape parameter. An unexpected foreign productivity increase is then induced and the corresponding *medium run* equilibrium is computed.

Specifically, the tail parameter in the foreign country is reduced from 2.29 to the home economy's tail parameter: 2.05. This represents a 10 percent growth in average productivity in the differentiated-goods sectors. Foreign competitors are randomly reassigned a new productivity according to the new distribution. Trade barriers are set to $\tau = 1$ before and after the change. See Table 2 for the other parameters.

Figure 10 illustrates the net changes in nonemployment and trade-induced job losses across head-to-head labor markets when the foreign and less productive country experiences an exogenous growth in productivity in the absence of trade barriers. There is a systematic contraction across labor markets in the *medium run*. All domestic labor markets lose jobs due to the surge in foreign competition. Aggregate employment falls across the board as no new jobs are created. Unlike the trade reform case, the relationship is no longer nonlinear and the elasticity of local nonemployment to local job losses due to foreign competition is equal to one everywhere. In other words, worker reallocation - or lack thereof - is even across locations. Overall, these effects yield negative aggregate welfare effects in the advanced economy due to the induced fall in aggregate income.[47]

5 Conclusion

This paper studies the labor market effects of trade-induced foreign competition across locations. The impact of foreign competition on labor markets is documented using a novel dataset on the universe of establishment-level petitions for Trade Adjustment Assistance (TAA) in the U.S. over the last three decades. In the data, increased foreign competition is correlated with reduced employment through higher job destruction and lower job creation. In fact across locations, an extra worker separated due to foreign competition is associated with the overall employment falling by two to three extra workers. This elasticity across locations of the local unemployment to trade-induced foreign competition is novel and it is robust to location fixed effects, time fixed effects, region and time interactions, import penetration, construction activity, and unionization.

This paper introduces a Ricardian model with nonemployment, variable markups, and heterogeneous segmented labor markets. 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. This highlights the need to further study the labor market implications of the competitive effects of international trade.

[47]Exploring the interaction between technology shocks and trade shocks is an important and a complex problem. Here, trade openness amplifies cross-sectional technology differences. In an unpublished extension of the model, trade can induce more innovation as more firms facing more cutthroat foreign competition opt for increased differentiation. See for example Freeman and Kleiner (2005) on the last American shoe manufacturer.

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 the reduction in trade barriers. However, aggregate welfare gains from trade reforms are not lower despite the lack of interim migration and the adverse effects in some locations. In contrast, aggregate welfare effects can be negative in the case of an exogenous productivity growth in the foreign country since all labor markets lose workers without creating new jobs in the domestic economy.

Trade reforms also induce increased inequality in the *medium run.* Therefore, it is important to study optimal transitional policies in the presence of heterogeneous workers and incomplete markets. For instance, the inequalities 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). Moreover, Krebs et al. (2010) and Krishna and Senses (2014) document a significant increase in labor income risk for workers exposed to foreign competition. These findings certainly motivate interesting questions at the nexus of public finance, labor markets and international trade during transition periods.

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6 Appendix (For Online Publication)

6.1 Data Sources

This section presents the main empirical findings on foreign competition and labor market outcomes across locations in the U.S. 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 from 1983 to 2009 to form a state-level panel dataset.

The March CPS

For every year $t = 1983 \ldots 2009$ 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 $t = 1983 \ldots 2009$ 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 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 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.

The Trade Adjustment Assistance (TAA) Petitions Data

This paper uses the petitions data from the Trade Adjustment Assistance (TAA) programs for workers to construct a direct measure of foreign competition at the state-level. Instated in its current form as part of the pivotal Trade Act of 1974, 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. The measure of foreign trade competition is constructed using data on the number of workers certified by the federal investigators from the U.S. Department of Labor (DoL) to have been displaced because of foreign trade from 1983 to 2009.

Firms, unions, state unemployment agencies, or groups of workers can file a petition on behalf of a group of workers at a given establishment to be eligible for Trade Adjustment Assistance (TAA) benefits. These benefits include: Trade Readjustment Assistance (TRA) for up to two years as long as the workers are enrolled in training, income support for the workers who are find full employment following the trade-induced separations, job search allowances, relocation allowances, and healthcare assistance.

To establish the eligibility of the petitioning workers, federal investigators at the Department of Labor 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) due to loss of business as an upstream supplier or downstream producer for another producer that is TAA-certified.[48]

This paper constructs measures of trade-induced foreign competition using data on all establishment-level petitions filed under the program up to 2009. Data prior to 1983 are excluded due to the lack of reliability of these data as a measure of import competition.[49] Each petition includes information such as the location of the establishment, the subset and the numbers of workers affected, the certification decision, and the date of impact.

All individual petitions are publicly available at www.doleta.gov. However, the dataset used was obtained from a FOIA request in order to ensure that no petitions was missing. Face-to-face meetings with numerous TAA staff also helped confirm the quality of the data and how the program works. I am deeply grateful to TAA office for their kindness and availability.

[48] See Decker and Corson (1994) and Magee (2001) for evaluations of TAA programs.

[49] I only use data post-1983 due to the unusual spike in the the data pre-1983. Significant changes in the program pre-1983 are documented in Rosen (2006). In particular, the auto-workers misused the program and the Reagan administration ultimately revamped it. Visits and conversations with the TAA administration confirmed this view and justify this choice.

6.2 Descriptive Statistics by State

Table 5: TAA certified workers by state per thousand of w.a.p. (1983-2009)

State	Average	Minimum	Maximum	IQR
AL	1.23	0.07	2.68	1.43
AK	0.93	0.00	6.02	1.07
AZ	0.33	0.03	1.47	0.27
AR	1.08	0.06	2.37	1.21
CA	0.25	0.03	0.74	0.23
CO	0.57	0.01	2.98	0.47
CT	0.44	0.04	1.01	0.47
DE	0.25	0.00	3.38	0.30
FL	0.13	0.04	0.29	0.13
GA	0.70	0.01	1.56	0.60
HI	0.06	0.00	0.70	0.08
ID	0.67	0.00	1.86	0.63
IL	0.45	0.02	1.87	0.38
IN	0.84	0.02	3.23	0.86
IA	0.38	0.00	2.10	0.49
KS	0.57	0.00	3.01	0.60
KY	0.91	0.02	2.56	0.84
LA	0.59	0.00	4.50	0.61
ME	1.32	0.43	2.66	1.09
MD	0.23	0.01	0.60	0.24
MA	0.58	0.05	1.63	0.34
MI	1.00	0.03	6.89	0.98
MN	0.47	0.01	2.05	0.33
MS	1.19	0.02	3.00	1.20
MO	0.74	0.06	1.33	0.46
MT	0.63	0.00	4.03	0.63
NE	0.24	0.00	0.94	0.47
NV	0.13	0.00	1.13	0.13
NH	0.59	0.00	1.88	0.65
Overall	0.67	0.00	7.35	0.71

State	Average	Minimum	Maximum	IQR
NJ	0.54	0.13	1.07	0.41
NM	0.61	0.00	3.00	0.69
NY	0.39	0.07	0.74	0.20
NC	1.37	0.07	3.77	2.18
ND	0.57	0.00	5.66	0.48
OH	0.80	0.18	3.71	0.76
OK	0.74	0.01	2.14	0.47
OR	0.90	0.00	4.40	0.82
PA	0.95	0.14	2.44	0.44
RI	0.89	0.00	1.95	0.87
SC	1.10	0.02	2.78	1.65
SD	0.46	0.00	2.86	0.33
TN	1.31	0.22	2.68	1.03
TX	0.61	0.07	2.55	0.41
UT	0.64	0.07	3.43	0.53
VT	0.53	0.00	1.85	0.82
VA	0.63	0.10	1.97	0.36
WA	0.63	0.02	5.42	0.35
WV	0.62	0.05	2.06	0.61
WI	0.78	0.10	2.68	0.77
WY	0.87	0.00	7.35	1.12
Overall	0.67	0.00	7.35	0.71

6.3 U.S. TAA Series

See Table 11 for the overall time series of TAA certifications in the US.

6.4 Standard Import Penetration Proxy

For a given location i at a time t, the "China syndrome" measure used in Autor et al. (2013) is an local import penetration measure:

$$\text{ADH import penetration}_t^i \equiv \sum_{\text{industries } k} \underbrace{\frac{\text{employment}_{i,t}^k}{\text{employment}_{i,t}}}_{\text{local industrial share}} * \underbrace{\frac{\Delta\text{imports}_{US,t}^k}{\text{employment}_{US,t}^k}}_{\text{US imports per worker}}$$

Figure 11: Total TAA-certified Workers in the U.S.

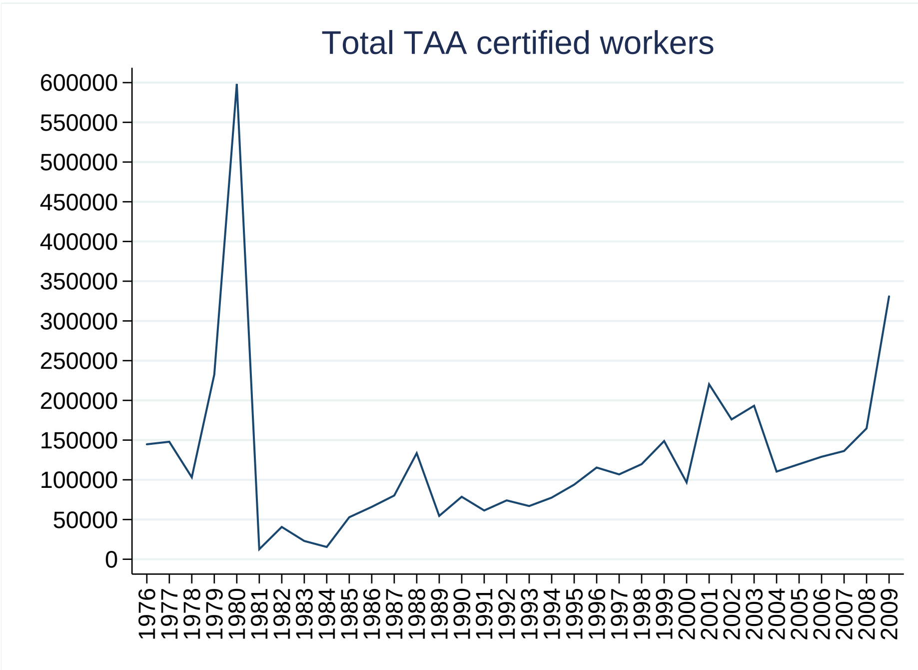


Table 7 shows the typical order of magnitude of this import penetration proxy across states. Time series of the ADH and the TAA measures are compared in Figure 12.

Table 7: Summary statistics (1988-2005)

Variable	p10	p25	p50	p75	p90
Change in China import penetration in $000s per worker	0.12	0.25	0.56	1.38	2.70

6.5 Other Labor Market Outcomes

See Table 8 for additional labor market outcomes: wages, hours worked, weeks not employed, unemployed workers, workers not in the labor force.

6.6 Medium-Run Inequality and Employment Rates

Model predictions on medium-run earnings inequality are presented in Figure 13.

6.7 Maps of TAA Foreign Competition

Figure 12: Time series of foreign competition (1988-1997;1999-2005)

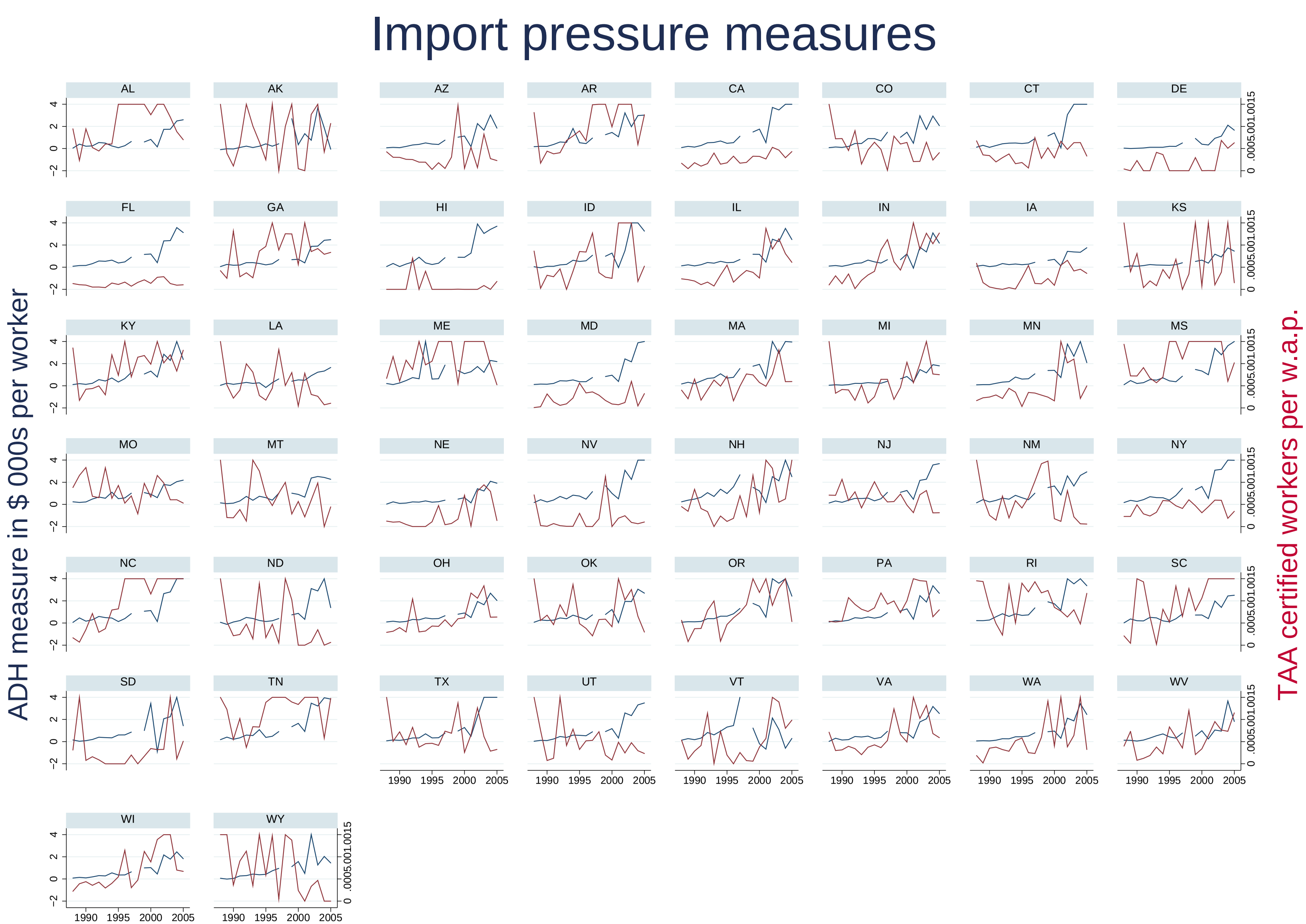
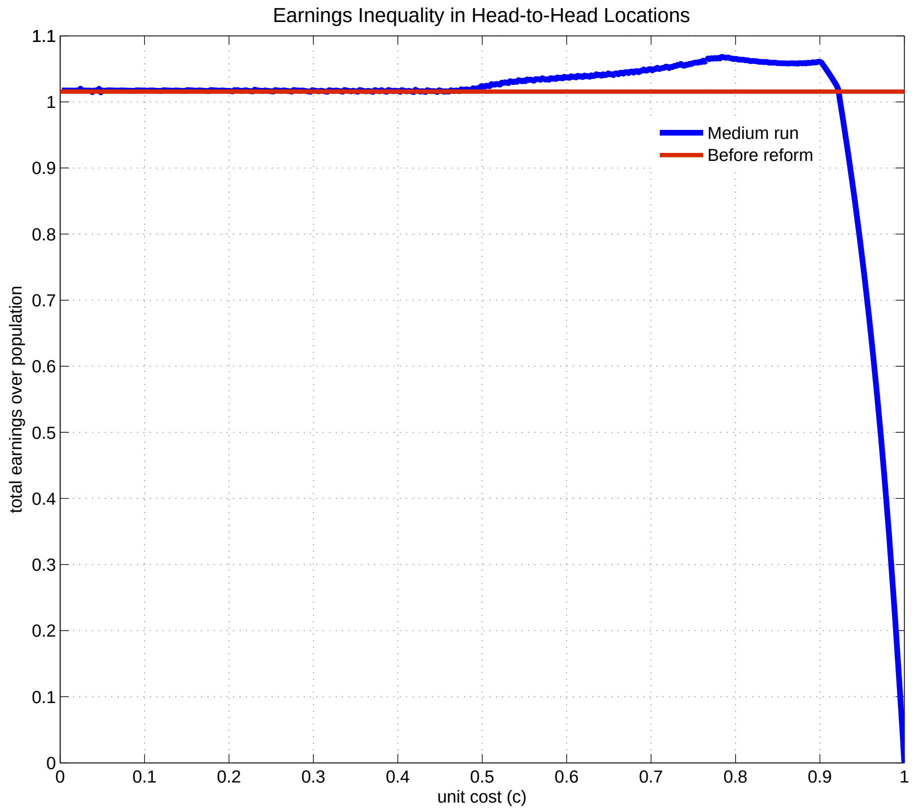


Table 8: Other Labor Market Outcomes Panel Estimation across the United States

Labor market outcomes →	**Wages**		**Hours Worked**		**Weeks Not Employed**		**Unemployed Workers**		**Not in the Labor Force**	
	e1	e3	f1	f3	g1	g3	h1	h3	i1	i3
Foreign Competition Variables										
TAA Certified Workers	0.910*	1.809**	-0.724**	-1.011**	5.021**	1.622	1.010*	1.584**	2.227***	1.581*
	(.498)	(.750)	(.317)	(.386)	(1.888)	(2.663)	(.587)	(.775)	(.517)	(.831)
ADH Import Penetration	-	-0.0004	-	-0.0006	-	-0.0013	-	-0.0007	-	-0.0013*
	-	(.0007)	-	(.0004)	-	(.0026)	-	(.0005)	-	(.0007)
Additional Controls										
TAA Denied Workers	0.520	0.505	-0.796	-1.113**	1.776	-0.047	-0.056	0.371	0.750	-0.608
	(.492)	(0.628)	(.288)	(0.531)	(1.678)	(2.506)	(.548)	(.911)	(.700)	(1.060)
New Housing Starts	-	-0.397	-	0.697**	-	-4.340***	-	-0.652	-	-0.750
	-	(.372)	-	(.314)	-	(1.460)	-	(.507)	-	(.513)
Unionization Rate	-	-0.047	-	-0.002	-	-0.202	-	-0.130***	-	-0.319***
	-	(.032)	-	(.022)	-	(.135)	-	(.037)	-	(.054)
Standard Controls										
Lagged outcome	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lagged foreign competition	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Income (log)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
U.S. population share	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year × Region indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-sq.	0.7397	0.8252	0.3474	0.1897	0.2135	0.2718	0.2293	0.3497	0.4525	0.5210
N	1350	750	1350	750	1350	750	1350	750	1350	750

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 27 years from 1983 and 2009.Union data is only available after 1989 in the March CPS. Import penetration can only be constructed between 1988 and 2005 with a gap in 1998 to a change from SIC to NAICS. All outcome variable are in log except the share of w.a.p unemployed and the share of w.a.p. not in the labor force. Wages are usual hourly wages adjusted for top-coding and deflated using the national PCE deflator. Hours worked are total hours worked last year.

Figure 13: Earnings and Employment Rates after Trade Reform



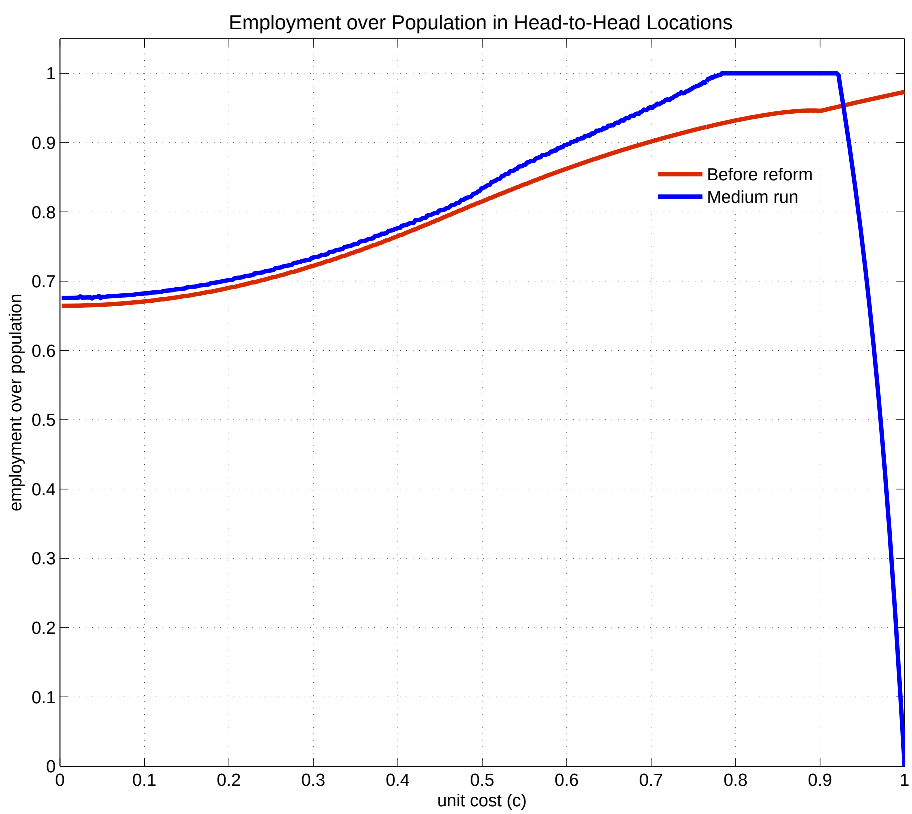
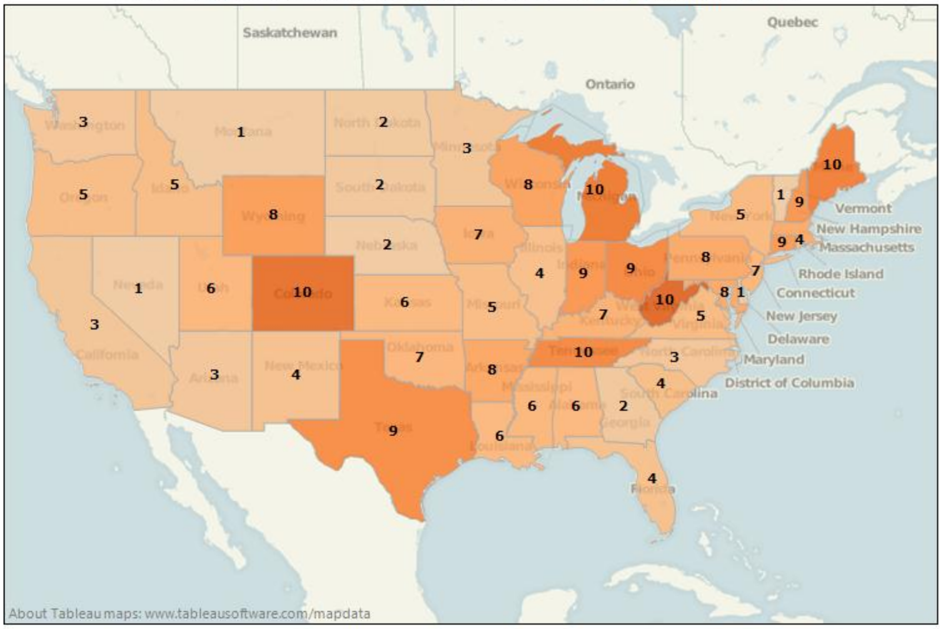


Figure 14: Maps of TAA Foreign Competition (1987 and 1994)

Trade Adjustment Assistance (TAA) certified workers per w.a.p in 1987

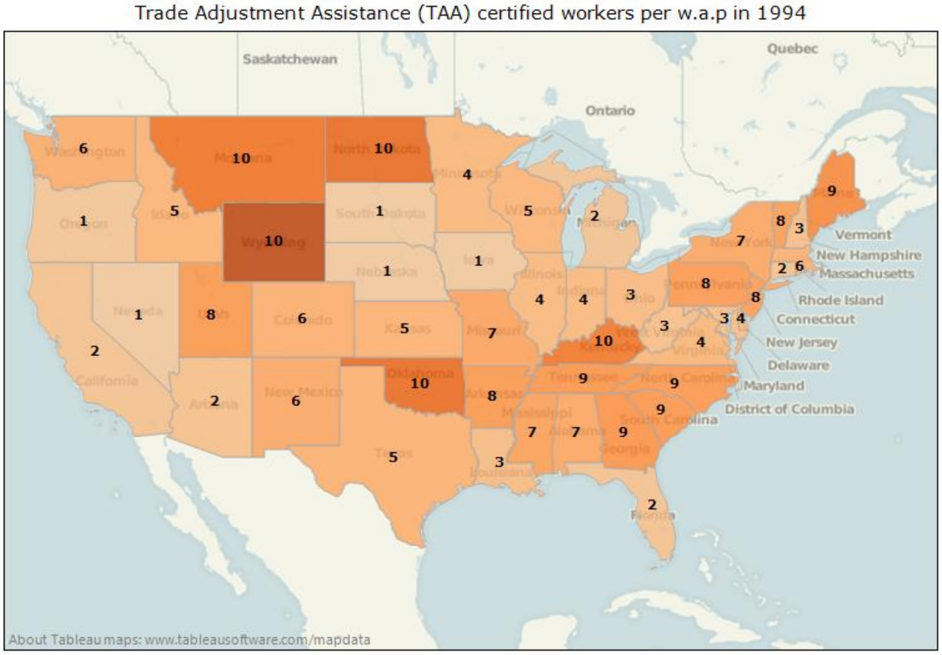


Color shows import competition as measured by using the Trade Adjustment Assistance (TAA) certifications. The numbers show the corresponding deciles of the import competition.

TAA certif. per w.a.p.

0.000000 0.002500

Trade Adjustment Assistance (TAA) certified workers per w.a.p in 1994



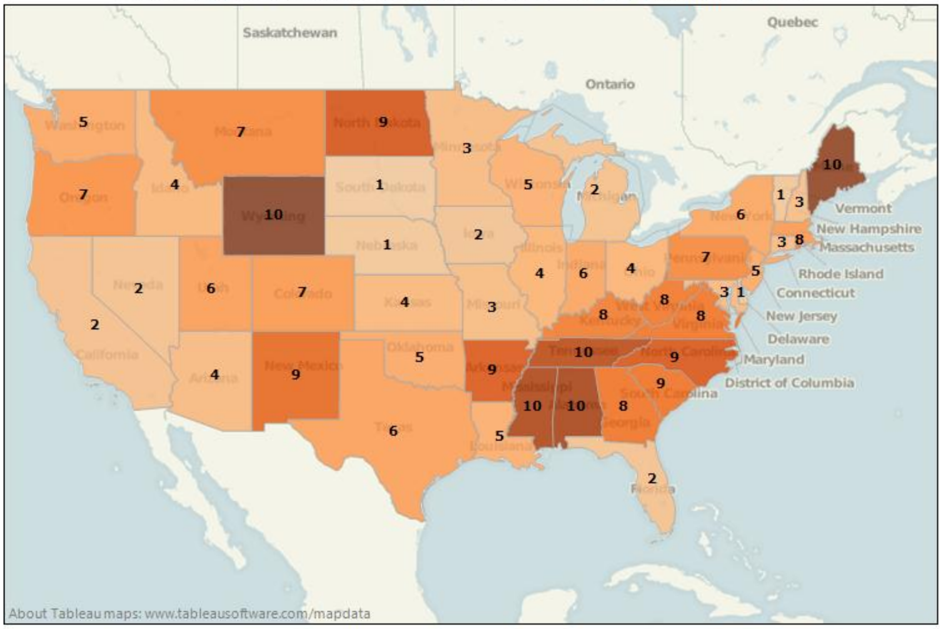
Color shows import competition as measured by using the Trade Adjustment Assistance (TAA) certifications. The numbers show the corresponding deciles of the import competition.

TAA certif. per w.a.p.

0.000000 0.002500

Figure 15: Maps of TAA Foreign Competition (1998 and 2003)

Trade Adjustment Assistance (TAA) certified workers per w.a.p in 1998

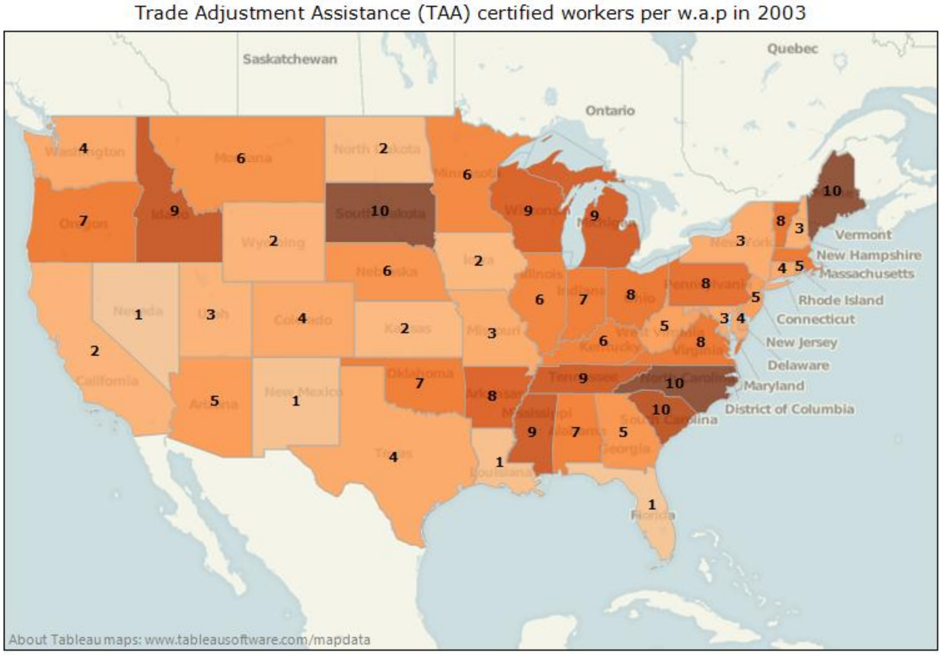


Color shows import competition as measured by using the Trade Adjustment Assistance (TAA) certifications. The numbers show the corresponding deciles of the import competition.

TAA certif. per w.a.p.

0.000000 0.002500

Trade Adjustment Assistance (TAA) certified workers per w.a.p in 2003



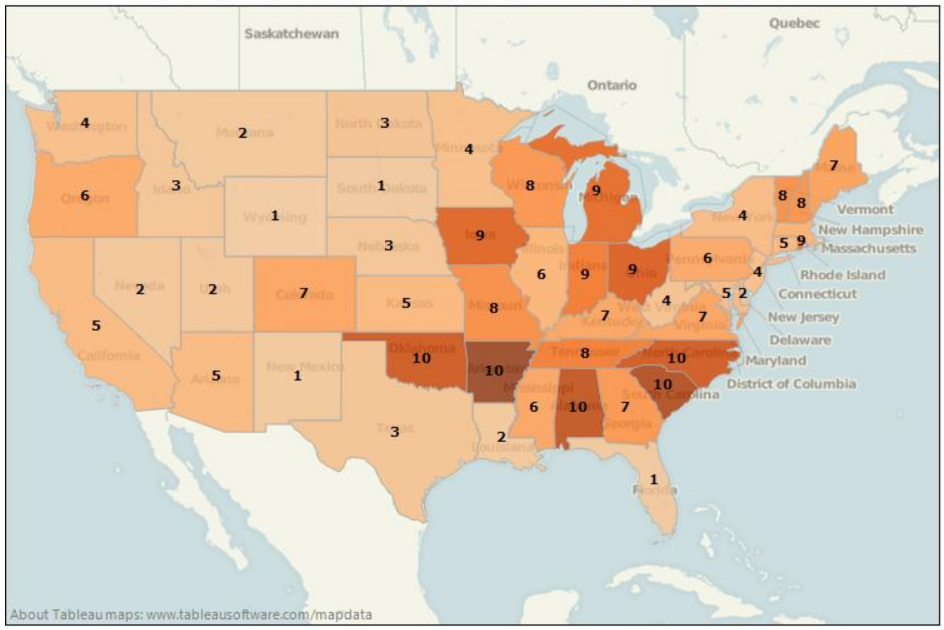
Color shows import competition as measured by using the Trade Adjustment Assistance (TAA) certifications. The numbers show the corresponding deciles of the import competition.

TAA certif. per w.a.p.

0.000000 0.002500

Figure 16: Maps of TAA Foreign Competition (2006 and 2008)

Trade Adjustment Assistance (TAA) certified workers per w.a.p in 2006

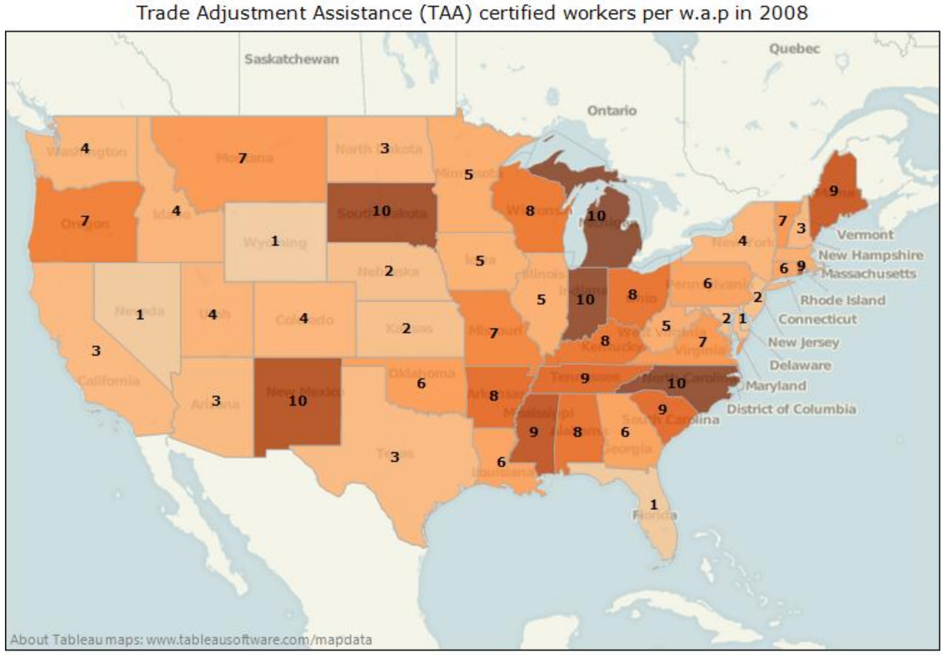


Color shows import competition as measured by using the Trade Adjustment Assistance (TAA) certifications. The numbers show the corresponding deciles of the import competition.

TAA certif. per w.a.p.

0.000000 0.002500

Trade Adjustment Assistance (TAA) certified workers per w.a.p in 2008



Color shows import competition as measured by using the Trade Adjustment Assistance (TAA) certifications. The numbers show the corresponding deciles of the import competition.

TAA certif. per w.a.p.

0.000000 0.002500