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

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Abstract

How does trade liberalization affect unemployment across locations within the U.S.? Using direct administrative evidence on trade-induced job displacements, this paper first documents that locations experiencing more foreign competition not only have higher job destruction rates but also lower job creation rates and thereby lower employment rates. Aggregate import penetration proxies based on industrial composition do not explain these uneven labor market outcomes, highlighting within-industry heterogeneity. In a heterogeneous firms trade model with both head-to-head competition and segmented labor markets, foreign competition has an endogenous correlated effect on job destruction and job creation because the most vulnerable locations are also the least productive. Competitive effects of trade on the entire distribution of variable markups underpin the unequal labor market effects of trade liberalization. In the transition following an unexpected trade liberalization, employment and earnings collapse in the worst hit locations while welfare, inequality, and employment increase in the aggregate.

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

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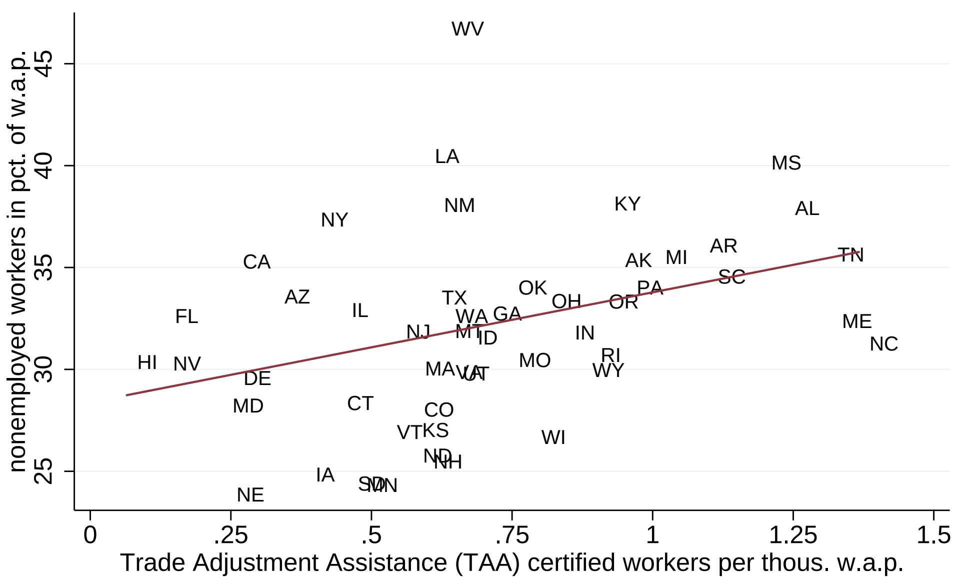
1 Introduction

How does international trade affect unemployment across locations within a country, especially when mobility is limited? Recent evidence suggests that labor markets are unequally affected by foreign competition. In particular, Autor, Dorn and Hanson (2013) find that, across U.S. localities, higher import penetration is associated with lower employment. In contrast, across countries, more trade openness is associated with higher aggregate employment (see Dutt et al. 2009; Felbermayr et al. 2011). Yet, standard trade models are silent on the uneven unemployment effects of trade across labor markets in a country. This paper investigates how trade-induced foreign competition unequally impacts labor market outcomes across locations using a Ricardian trade model with segmented labor markets and variable markups along with new evidence on trade and unemployment.

Figure 1: Nonemployment and TAA certifications in the U.S. (1983-2009)



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

First, using direct evidence on trade-induced job losses from the U.S. Trade Adjustment Assistance (TAA), this paper documents that: locations facing more foreign competition experience reduced employment (see Figure 1) through a higher job destruction rate but also a lower job creation rate, while population adjustments are muted. In fact, one extra worker displaced due to foreign competition is associated with an overall employment reduction by two to three workers. These findings are robust to various controls especially industrial composition. The paper then offers a Ricardian trade model nesting labor markets segmented across locations and heterogeneous firms facing head-to-head foreign competition à la Bernard et al. (2003). Across locations, productivity differences drive the effects of trade reforms on variable markups and unemployment.

This paper contributes to the theory and the measurement of the labor market effects of trade-induced competition across locations. Empirically, it is not trivial to measure job losses induced by foreign competition. Consider, for instance, a shipment of electronic parts imported from China arriving at the port of Los Angeles, CA. Which workers, plants, and locations are affected by these imports, and how? The import penetration is the proxy widely used to infer trade-induced pressures. For instance in Autor et al. (2013), the import penetration is the weighted-average of industry-specific imports per worker, using local industry employment shares as weights.[1] It can be derived in standard environments with constant markup, full employment, and frictionless labor reallocation (e.g., Autor et al. 2013). In other words, labor reallocation frictions, variable markups, and unemployment are ignored when deriving this proxy. For example, a "GM town" and a "Ford town" that are equally concentrated in the auto industry would be deemed equally affected by trade even if they substantially in the competition they each face. Meanwhile, the international trade literature has paid unprecedented attention to intra-industry reallocation since the influential contributions on within-industry firm heterogeneity of Bernard et al. (2003) and Melitz (2003).

To circumvent these measurement issues, this paper uses a novel panel dataset with a direct measure of job losses due to foreign competition. The dataset is constructed using administrative data on all the certified petitions from the U.S. Department of Labor Trade Adjustment Assistance (TAA) programs for workers since 1983. Federal investigators carefully investigate all establishment-level petitions submitted on behalf of workers that were deemed displaced due to import competition. These investigators have subpoena power and review detailed firm-level including such as sales history, sales of import-competing products, major declining customers and unsuccessful bids. Petitioning workers at a given plant in a given time are only certified if federal investigators conclude that the displacements are due to "trade-related circumstances" and "no fault of their own". 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.[2]

This direct TAA-based measure sheds new light on foreign competition and labor markets. First, Figure 1 illustrates a positive relationship between trade-induced job losses and the nonemployment rate across U.S. states during 1983-2009.[3] Estimations on the underlying state-level panel data show that, across locations, one extra worker displaced due to foreign competition is associated with two to three workers without employment. Both a rise in job destruction and a fall

[1] See Acemoglu et al. (forthcoming) for a insightful import penetration extension using the input-output matrix.

[2] 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. All individual petitions are also publicly available at www.doleta.gov. See appendix for additional details.

[3] The nonemployment rate is the unemployment rate plus the non labor force participation rate. The firm-level TAA data is aggregated at the state level allowing for more control variables and longer time series. This approach also shows the explanatory power of the TAA-based measure at highly aggregated levels unlike the import penetration proxy (see Section 2).

in job creation account for the reduction in employment rate, while population adjustments appear muted in the medium run. These correlations are robust to the widely used import penetration proxy as well as state indicators, time indicators, time-region interaction terms, heteroskedasticity, and other controls such as unionization rates.[4]

Despite the growing empirical evidence, trade theory has little to say about the uneven labor markets effects of trade across locations: existing models typically feature full employment or non-segmented labor markets. Moreover, the empirical evidence suggests within-industry heterogeneity is important since industrial composition as captured by the import penetration proxy does not systematically explain these uneven outcomes. Also, sluggish transitional population dynamics are often overlooked in the theory. Finally, empirical estimations require theoretical foundations to discipline various issues of measurement, selection and endogeneity: which locations are more likely to file TAA petitions? what if local labor outcomes and trade-induced job losses endogenously related? This paper introduces a model to study the labor markets effects of trade-induced foreign competition across locations, especially when geographic mobility is limited.

The model features labor markets that are segmented across locations and heterogeneous firms, some of which face head-to-head foreign competition (see Dornbusch et al. 1977; Bernard et al. 2003; Atkeson and Burstein 2008; Edmond et al. 2012; Holmes and Stevens 2014). The model encapsulates a simple trade variant of Dixit and Stiglitz (1977) with heterogeneous locations and unemployment to highlight the crucial role of endogenous variable markups arising from head-to-head competition. Head-to-head competition also provides a natural model counterpart for job losses due to the foreign competition faced by the firm.[5] After a trade reform, transitional dynamics are captured by limiting worker mobility across locations but not within.

In this Ricardian model, productivity differences across locations makes the foreign competition differ across segmented local labor markets. Specifically, locations are assumed to differ in the productivity of their local firms.[6] Within each location, firms facing head-to-head competition also vary in the productivity of their foreign competitor. Thus, a firm in a more productive location is more likely to outcompete its foreign rival. Also, local heterogeneity in the foreign rival's productivity means there can be worker reallocation within locations even in the absence population flows. Local nonemployment is obtained using random Leontief matching within each labor mar-

[4] Margalit (2011) concurrently constructed a similar measure in the political science literature. Yotov (2007) and Uysal and Yotov (2011) previously used the underlying TAA petition data for industry-level and firm-level measures. Recently, Monarch et al. (2014) applied the same approach to offshoring. A location-specific measure is used here precisely because of the salient geographic nature of labor markets.

[5] For instance, in Melitz (2003) and Melitz and Ottaviano (2008), firms are mainly driven out by low economy-wide prices and not firm-specific competition as in Bernard et al. (2003) or Atkeson and Burstein (2008).

[6] 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.

ket and collective Nash bargaining.[7] Workers direct their search across locations in the long run spatial equilibrium. So, workers are allocated such that they are indifferent among these locations *ex ante*.[8] Following an unexpected trade reform, consistent with the data, workers can switch firms within their home labor markets but they cannot change location. This limited transitional mobility assumption follows Helpman and Itskhoki (2010).[9]

Both cross-sectional productivity differences and variable markups are crucial to explain the correlation between trade and nonemployment across locations. Following a trade reform, changes in the entire distribution of markups within and across locations determine labor market outcomes. After a trade reform, firms in less productive areas face fiercer foreign competition and are 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. Furthermore, 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. Hence, in the model as in the data, the most vulnerable locations have both a higher job destruction rate and a lower job creation rate. These findings are related to recent studies on the pro-competitive effects of trade such as Arkolakis et al. (2012), Edmond et al. (2012), de Blas and Russ (2012) and De Loecker et al. (2012).

Overall, the effects of trade on labor market outcomes are not monotonic across locations since the distribution of markups changes unevenly. Some locations - the least productive locations - are wiped out of their jobs and eventually their population. Other locations expand greatly as they simultaneously also see many jobs closed and surviving lowering markups and expanding. Still, other locations - the most productive locations - experience little changes in competitive pressure and expand little. In the medium run, when workers can switch jobs but not locations, unemployment rates sharply rise and earnings fall in the least productive locations.[10]

In the model, productivity differences across locations endogenously influence both trade-induced job losses, trade-induced job gains, and overall unemployment. More productive locations have larger firms, higher population, pay higher wages, and higher unemployment rates in the long run. This spatial equilibrium channel is corroborated using data from Turner et al. (2008). In

[7] 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 simple benchmark.

[8] 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).

[9] Kennan and Walker (2011), Artuç et al. (2010), Dix-Carneiro (2013) 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.

[10] 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.

the long run, after a trade liberalization, the least productive areas simply become ghost towns as their population vanish. The *ex ante* spatial equilibrium also ensures that firms can tap into their endogenous local unemployment despite the limited geographic mobility in the transition.

Trade liberalization yields aggregate welfare gains along with large reductions in employment rate and earnings in the badly hit labor markets, when population adjustments are sluggish. The 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 result resembles the findings in Farhi and Werning (2014). Limited interim mobility partially undoes the distortions arising from workers' indifference condition across locations. However, these aggregate welfare gains do not hold after unbalanced foreign productivity growth. 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.[11] Autor et al. (2013) and Ebenstein et al. (2014) conduct a thorough analysis of U.S. labor markets and trade.[12] They document the worsening of labor market outcomes in localities and occupations that are more exposed to import competition due to their industrial composition. Pierce and Schott (2012) also document that the elimination of trade policy uncertainty with China in 2000 contributed to the subsequent swift decline of American manufacturing.[13] This paper extends these empirical findings using novel data on trade-induced displacements across locations in the U.S. and also highlights the key role of within-industry heterogeneity.

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 our understanding of the effects on trade-induced intra-industry

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

[12] 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.

[13] 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.

reallocation on 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 (2013) 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 both labor market segmentation and endogenous variable markups in understanding the unequal labor market effects of trade liberalization.

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 (2012), De Loecker et al. (2012), Edmond et al. (2012) and Holmes et al. (2014). This paper focuses on the labor market outcomes across segmented labor markets in the presence of competitive effects of international trade. Endogenous changes in the distribution of markups and the correlation between markups and firm size are critical to the aggregate competitive effects of trade. Here, endogenous variable markups are anchored to labor markets through wage bargaining and the spatial equilibrium: trade-induced changes in markups and at the extensive margins are key for understanding the stylized facts on trade and unemployment across locations.[14]

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 baseline 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.

2 Evidence

This section presents the main empirical findings on foreign competition and labor market outcomes across locations. 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.

[14] 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.

2.1 The Trade Adjustment Assistance (TAA) Petitions Data

Instated in its current form as part of the 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. Each petition includes information on the location of the establishment, the subset and the number of workers affected, the certification decision, and the date of impact.

Firms, unions, state unemployment agencies, or groups of workers can file a petition on behalf of a subset of workers at a given establishment. 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. 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.[15]

2.2 Measuring Foreign Competition

For every year $t = 1983 \ldots 2009$ and for every state i in the U.S., import competition is measured as the ratio of all workers newly certified for Trade Adjustment Assistance (TAA) relative to the working age population (w.a.p.):

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

Table 1 and Figure 1 show the typical order of magnitude of this TAA-based measure across states between 1983 and 2009. The standard import penetration instead assumes that locations with similar industrial composition are equally impacted by foreign imports as in Autor et al. (2013):

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

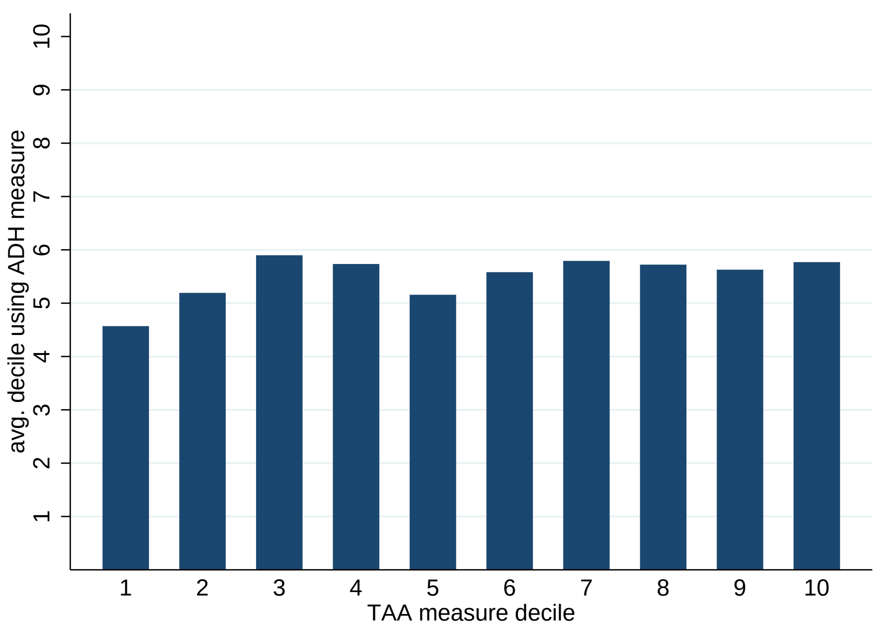
[15] See appendix for more details, statistics, and maps. A sample CDR form is available online at www.illenin.com/research/taa_cdr_article.pdf.

Table 1: Summary statistics (1983-2009)

	p10	p25	p50	p75	p90
TAA certified workers (per thousand working age population)	0.03	0.17	0.43	0.88	1.64
TAA petitioning workers (per thousand working age population)	0.11	0.39	0.80	1.43	2.38
Unemployed minus US average (percent working age population)	-2.24	-1.33	-0.35	0.79	1.99

Figure 2 clearly illustrates a weak positive correlation between the standard import penetration proxy and the TAA-based measure, using within-year deciles across states of each variable. The correlation between the two variables is 0.066 with a significance level of 0.056. Unlike import penetration proxies, the TAA-based measure is direct and it can capture within-industry cross-sectional differences between a hypothetical GM auto city and a hypothetical Ford auto city.[16] As shown in Table 1, the total number of TAA-certified workers yearly in the U.S. is often in the hundreds of thousands. The small size of this program relative to the unemployment pool has understandably led scholars to overlook it. This paper shows that the TAA reveals important differences across locations, especially within industries, that the import penetration cannot capture.

Figure 2: State-level import penetration and TAA-based measure



[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 is an important and useful question. It is beyond the scope of this paper and therefore explored separately.

2.3 Foreign Competition and Labor Market Outcomes

To assess the relation between import competition and labor market outcomes across the U.S., the regression below is estimated:

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

The variable "TAA foreign competition$^{\text{i}}_{\text{t}}$" 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$^{\text{i}}_{\text{t}}$" are : (a) the share "not employed$^{\text{i}}_{\text{t}}$" of working age population workers who are not employed in state i *as of* the March CPS of the following year t+1; (b) the rate "job destruction rate$^{\text{i}}_{\text{t}}$" at which existing jobs were destroyed in state i during year t; (c) the rate "job creation rate$^{\text{i}}_{\text{t}}$" at which new jobs were created in state i during year t; (d) the share "pop. share$^{\text{i}}_{\text{t}}$" of national working age population residing in state i *as of* the March CPS in t+1.[17]

The set of controls Z^{i}_{t} includes the lagged "labor market outcome$^{\text{i}}_{\text{t-1}}$", the lagged "foreign competition$^{\text{i}}_{\text{t-1}}$", the share of working age workers denied by the Trade Adjustment Assistance (TAA), 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 baseline sample is a balanced panel of 50 states spanning 27 years from 1983 and 2009.

The estimation results are reported in Table 2. Increased foreign competition is correlated with reduced employment through higher job destruction and lower job creation, while population dynamics are sluggish.[18] In fact, an extra worker separated (or at risk of being separated) due to foreign competition is associated with the overall employment falling by two to three extra workers relative to other locations.

Naturally, one would be concerned about the ability of the Trade Adjustment Assistance (TAA) federal investigators to identify trade-induced displaced. 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 2 and in Figure 2. Furthermore, denied applications or approval rates are not associated with worsening or improving labor market conditions.[19]

[17] As found in the existing literature, the relationship with wages is not significant. Estimation results for wages and other labor market outcomes are reported in the appendix.

[18] The sluggish population dynamics echo the findings of Autor et al. (2013) and Topalova (2007). Klein et al. (2003) and Moser et al. (2010) also document similar effects of exchange rate fluctuations on job flows in the U.S. and in Germany respectively.

[19] The Reagan administration drastically revamped the TAA certification process (see Rosen (2006)). That is the

Table 2: 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	d3
Foreign Competition Variables									
TAA Certified Workers	2.729***	-	2.792***	1.523**	2.443***	-1.517***	-1.985**	.508	0.181
	(.544)	-	(.873)	(.697)	(.529)	(.546)	(.845)	(1.451)	(1.901)
ADH Import Penetration	-	0.00135	0.0007	-	0.0006	-	0.0008*	-	0.0005
	-	(.00082)	(.0008)	-	(.0005)	-	(.0005)	-	(.0020)
Additional Controls									
TAA Denied Workers	0.644	-	-0.130	1.240	0.574	1.200	0.106	-0.691	-4.778
	(.718)	-	(1.052)	(.797)	(1.016)	(.490)	(.831)	(2.061)	(3.160)
New Housing Starts	-	-	-1.178***	-	-0.936	-	0.950	-	6.965**
	-	-	(.555)	-	(.597)	-	(.769)	-	(3.124)
Unionization Rate	-	-	-0.393***	-	0.015	-	-0.027	-	-0.131
	-	-	(.051)	-	(.036)	-	(.046)	-	(.122)
Standard Controls									
Lagged outcome	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lagged foreign competition	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Income (log)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
U.S. population share	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-	-
Year indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year × Region indicators	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	0.9994	0.9938
N	1350	750	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.

The findings reported do not hold when the import penetration proxy is used instead of the direct TAA measure, as shown in the specification (a2) of Table 2. The findings for the direct measure based on the Trade Adjustment Assistance (TAA) still hold after controlling for the import penetration proxy as shown in the specifications (a3), (b3), (c3), and (d3) of Table 2.[20] The results are robust to controlling for unionization rates as well as local spillovers in the non-tradable sector using housing starts data.

These findings reported above pose a challenge to existing models. Certainly, models with frictionless or centralized labor markets are not equipped to replicate these results and address related questions: why does foreign competition have a correlated effect of both job destruction and job creation? what are the consequences of the limited geographical mobility of workers in response to trade shocks? what are the welfare effects of the uneven effect of foreign competition across locations? The robustness of the empirical results to the inclusion of the import penetration also motivates a key role for within-industry heterogeneity since the import penetration proxy interacts local industrial composition and national imports. These questions are addressed using a heterogeneous firms Ricardian trade model with endogenous variable markups and segmented labor markets across locations.

3 Trade Model with Segmented Labor Markets

3.1 Environment

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 locations in their country. These locations vary in the exogenous productivity of their local firms. Within a given location, local firms vary in the degree of foreign competition they face. Local nonemployment is obtained using random Leontief matching of workers to firms and collective Nash bargaining. The population distribution is determined by the uncoordinated search for work across locations. There are international iceberg transportation costs τ.[22]

reason why the sample does not include the pre-Reagan reform era. Indeed, before 1983, the denied cases are associated with worsening labor markets and certified cases had an insignificant effect. In contrast, the findings reported here hold even if sample excludes the period after China's accession to the W.T.O. or the Great Recession.

[20] As discussed in the previous subsection, the import penetration proxies ignore differences across firms and locations with similar industrial composition. Moreover, import penetration proxies suffer from an inherent degrees-of-freedom problem. This problem is solved with finer geographic granularity as discussed in Autor et al. (2013). In contrast, the estimation with the TAA measure is done at the state level with region-time fixed effects.

[21] This symmetry assumption is relaxed later.

[22] This structure is similar to Alvarez and Shimer (2011) who consider a model with directed search across many islands and random matching within each island.

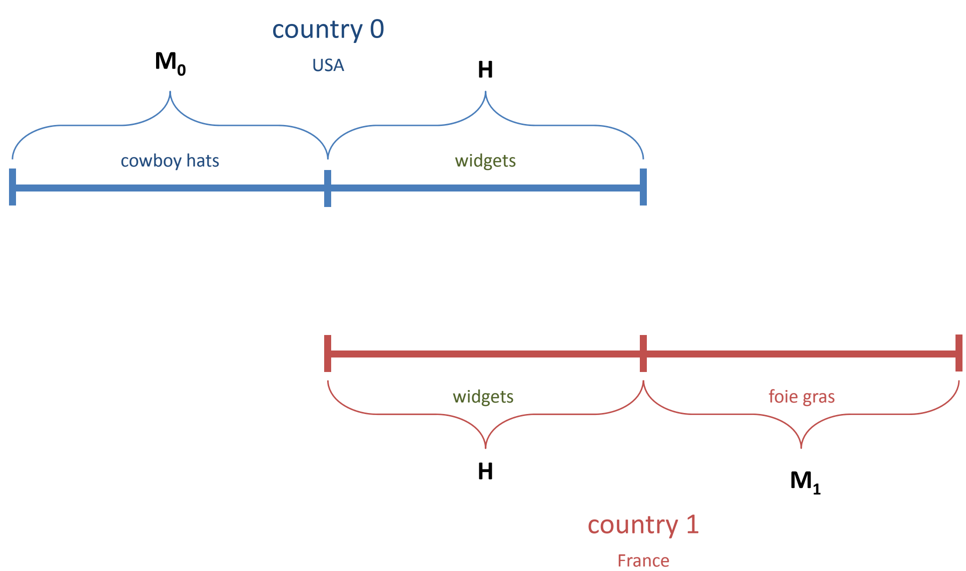
Preferences

Following Helpman and Itskhoki (2010), each family has quasi-linear preferences over its homogeneous good consumption q_0 and its composite good consumption Q: $U = q_0 + \frac{1}{\eta}Q^{\eta}$, 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 3: A simple overview of the model



The differentiated goods have two possible types, monopolistic or head-to-head, as illustrated in Figure 3. 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. Each $H-$type producer competes via simultaneous price setting against a unique foreign counterpart.[23]

A model that includes only monopolistic competitors without direct foreign competition will fail to match the data simply because it cannot generate 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 and understate the gains from increased varieties.[24]

An exogenous measure H of firms can produce (head-to-head) $H-$goods and the remaining measure M can produce (monopolistic) $M-$goods. There is a fixed unit measure of differentiated varieties (and firms) in each country. There are no fixed costs of entry or operation. The model is therefore a hybrid setup combining Chamberlinian monopolistic competition with head-to-head imperfect competition. These two modes of competition are special cases ($H = 0$ and $H = 1$ respectively).[25]

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: $y_0 = \ell$.

[23] This form of head-to-head competition is similar to Bernard et al. (2003) with the distinction that there is no domestic head-to-head competitor here. See Caliendo et al. (2013) for a closed economy model with multiple locations and domestic competition. See also de Blas and Russ (2012) for an excellent theoretical study of the competitive effects of trade in an environment akin to Bernard et al. (2003).

[24] 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.

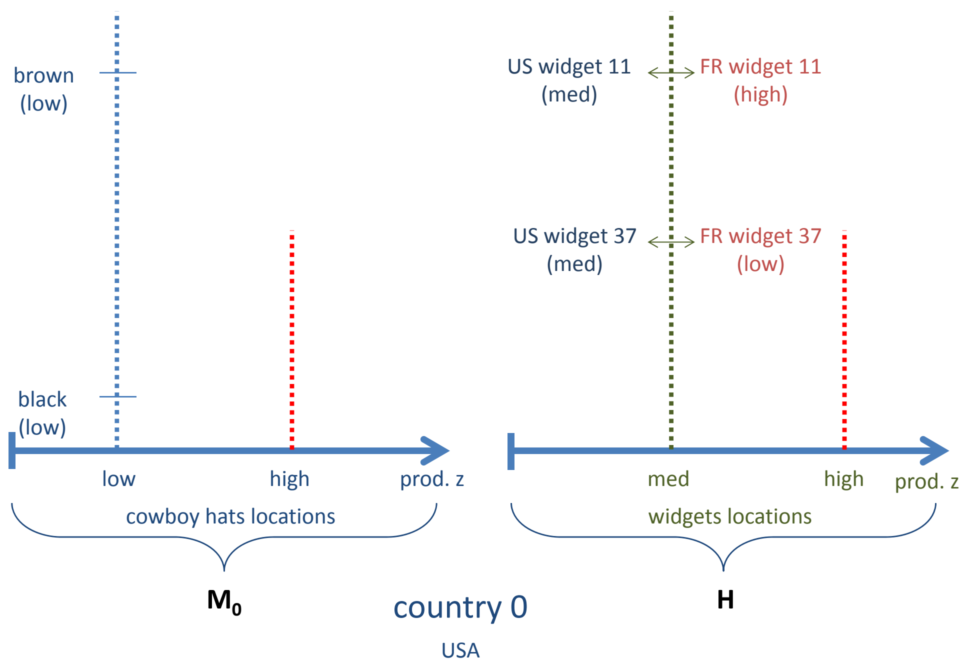
[25] The combination of both monopolistic competition and head-to-head competition resembles the model of *mass production plants* and *boutique shops* used by Holmes and Stevens (2014) in their study of plant size distribution with an application to the trade in wood furniture. Here, monopolistic firms 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. This exogenous margin did not significantly alter the results from this model when the differentiation costs are proportional to monopoly profits.

Heterogeneous Locations and Segmented Labor Markets

The main goal in defining locations is to have variations 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 (M or H).[26] 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.[27]

There is still heterogeneity across firms within each $H-$type (head-to-head) town even though they share the same productivity. Figure 4 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 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.[28]

Figure 4: A simple illustration of locations



The economy is composed of a continuum of labor markets across which families assign their workers. Within each local labor market, workers are randomly matched with vacancies based on a

[26] 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.

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

[28] 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.

Leontief matching function: firms fill all their vacancies as long as there are more workers looking for jobs than vacancies.[29]

At each plant, the workers bargain collectively with the firm over wages and production decisions.[30] The workers collectively have bargaining power λ.[31] 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: $c \equiv (\gamma + b)/z$.

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 the workers. The wages $w^j_{j'}(z)$ and the plant size $\ell^j_{j'}$ are determined through Nash-bargaining with the workers' union by solving:[32]

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

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

[29] The Leontief matching function $m(u.v) = \min(u, v)$ has no congestion externalities.

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

[31] Nash-bargaining provides a simple and tractable baseline to highlight how nonemployment is determined. In this model, variable markups are key for the cross-sectional distribution of employment and wages. The alternative multilateral bargaining à la Stole and Zwiebel (1996) has been used in Felbermayr et al. (2010) and Helpman and Itskhoki (2010).

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

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

where $\tau_{j'}^{j} c \equiv \tau_{j'}^{j}(\gamma+b)/z$ 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.[33] This property that wages do not depend on firm productivity implies that the $M-$type (monopolist) towns 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.

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 the town of an $M-$type producer with productivity z 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:

[33] See for example Felbermayr et al. (2010) and Helpman and Itskhoki (2010).

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

$$\text{s.t.}$$

$$p_{j'}^{j}(z,\ell) \leq \overline{p}_{j'}^{1-j}(\tilde{z})$$
$$\pi_{j'}^{j}(z,\ell) \geq 0$$

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'.

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: $\tau_{j'}^{j}(\gamma+b)/z < \overline{p}_{j'}^{1-j}(\tilde{z})$. 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.

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. Also, the more productive the competitor faced, the larger the firm because the lower markup translates into a higher demand and lower markups:

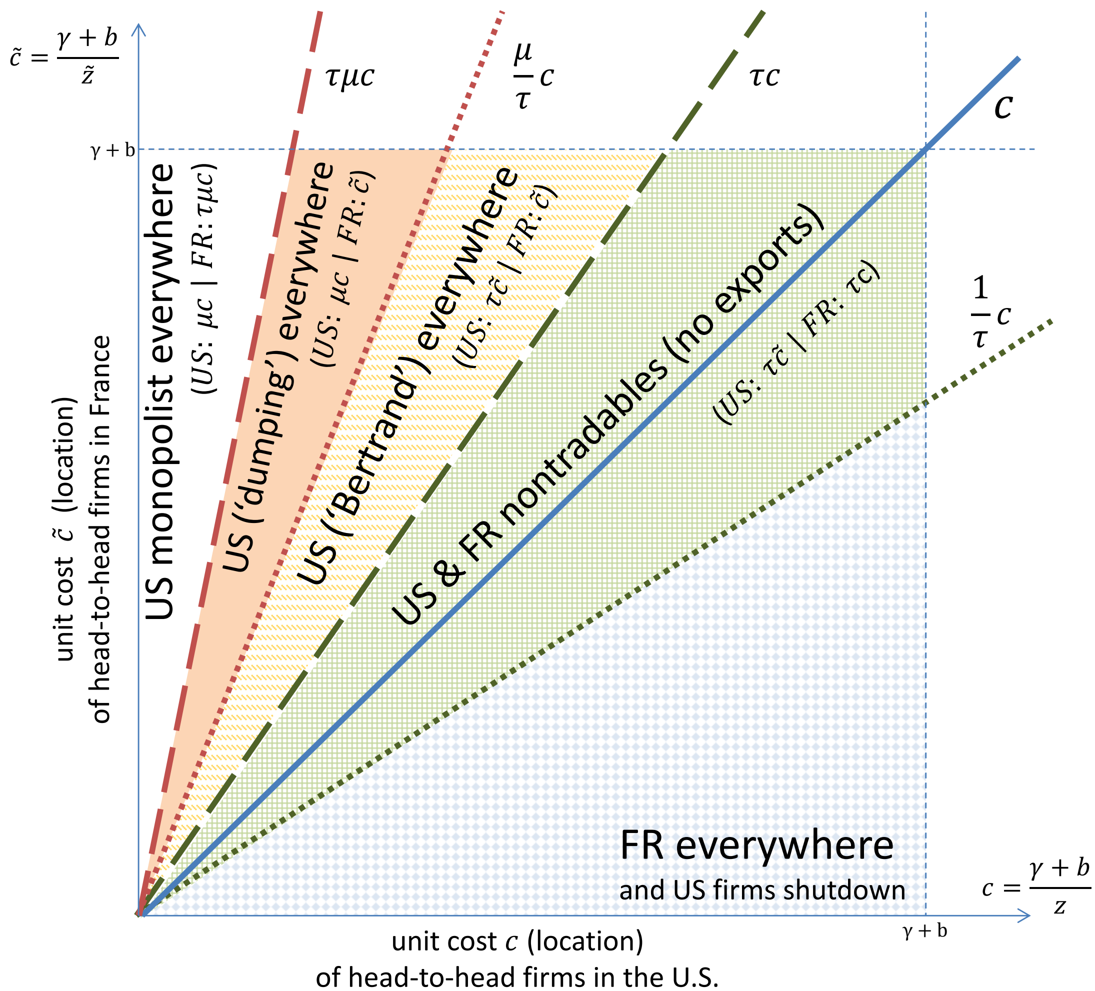
$$\ell_{j'}^{j}(c,\tilde{c}) = \left[\mu_{j'}^{j}(c,\tilde{c})\right]^{-\sigma} \times \overline{\ell}_{j'}^{j}(c)$$

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.[34]

The model therefore generates rich pricing-to-market markups as shown in Figure 5.[35] A point

[34] When $\mu < \tau^2$, in particular in autarky, tariff-protected firms price as monopolists even though they do not export.
[35] Figure 5 illustrates the case when trade barriers are low enough ($\tau^2 < \mu$).

Figure 5: Variable markups across firms and locations



$(c, \tilde{c})$ represents a head-to-head firm located in a town of productivity $z = (\gamma + b)/c$ and facing a competitor with productivity $\tilde{z} = (\gamma + b)/\tilde{c}$. Hence, a vertical line represents a head-to-head town of productivity z.

These variable markups are also the reason why productivity differences yield differences in foreign competition across locations: in the more productive locations, more firms outcompete their foreign competitors relative to the less productive locations. Hence, in less productive locations, more firms do not produce but shutdown altogether (see blue solid diamond region in Figure 5). Also, firms from less productive locations are more likely to produce without exporting. This region is akin to the Ricardian non-tradable region and yields an extensive margin of new exporters when trade barriers fall (see green gridded region in Figure 5).

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 5). 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.[36]

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:

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

where $L_H(z)$ is the endogenous population of the town and $\ell_{j'}^{j}(z,\tilde{z}) = 0$ if a producer is outcompeted. The expected earnings per worker $\mathrm{W}_H(z)$ in that town satisfy:

$$\mathrm{W}_H(z) \equiv \frac{\int \sum_{j'=0,1} w_{j'}^{j}(z,\tilde{z}) \cdot \ell_{j'}^{j}(z,\tilde{z})\,\mathrm{d}F_H(\tilde{z})}{L_H(z)}$$

Labor Allocation across Locations

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

$$L = L_0 + \int L_M(z)\,\mathrm{d}F_M(z) + \int L_H(z)\,\mathrm{d}F_H(z)$$

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

Market Clearing

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

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

[36] As trade barriers fall, 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 the monopolistic markup.

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.[37]

Proposition 1. Equal expected earnings.
Expected earnings are equalized across all labor markets. Average income is also equalized across locations since all workers receive an equal share of firm profits.

Proof. The proposition trivially follows from the labor allocation indifference condition. Given the quasi-linear preferences, the equilibrium indifference condition means that expected earnings are equalized across locations:[38]

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

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*. Moreover, *ex ante*, no transfers are required across locations to equate consumption allocations because the indifference condition makes it trivial. 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

[37] 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.

[38] As in Helpman and Itskhoki (2010), the family interpretation is essential in the case of quasi-linear preferences but not when preferences are homothetic.

population but 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 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 innocuous assumptions. However, the abstraction from multilateral bargaining is not problematic as long as the constant wage and proportional net surplus sharing results hold. This is the case in Helpman and Itskhoki (2010) and Felbermayr et al. (2010) for example.

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 ead-to-head locations increase with local productivity. □

This proposition characterizes the free trade long run equilibrium.[39] 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 5. Hence, the expected markups across head-to-head locations do not always fall with productivity.

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 corresponds to a distribution of employment rates.

[39] See the appendix for empirical evidence corroborating this relation between productivity and the nonemployment rate in the long run.

Figure 6: Trade Barriers and Employment Rate

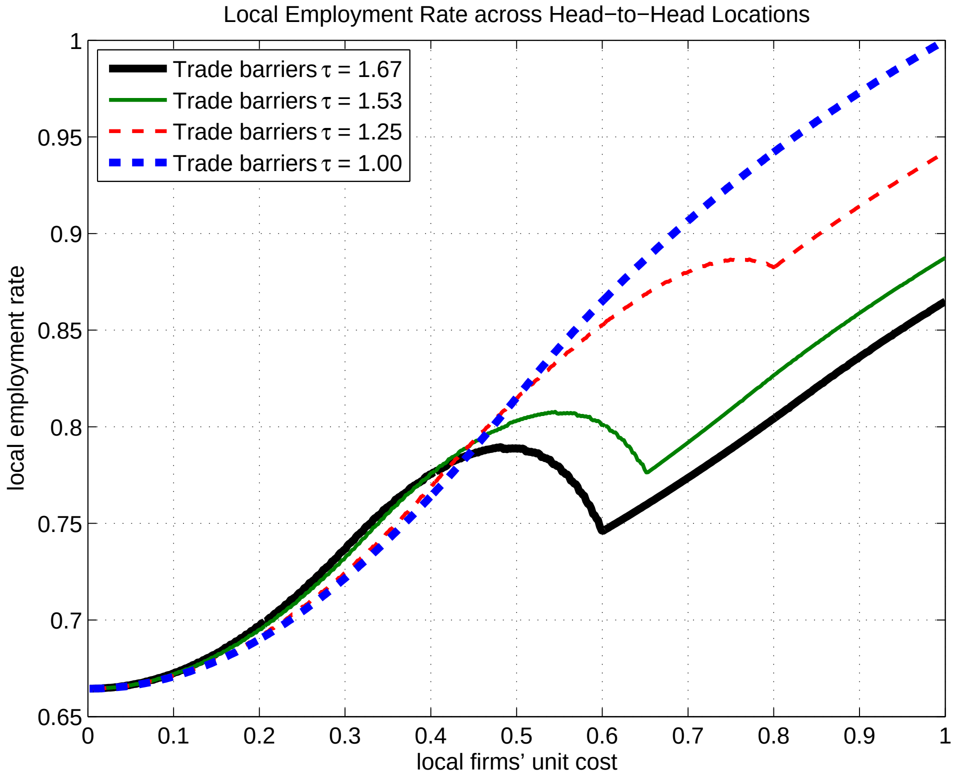


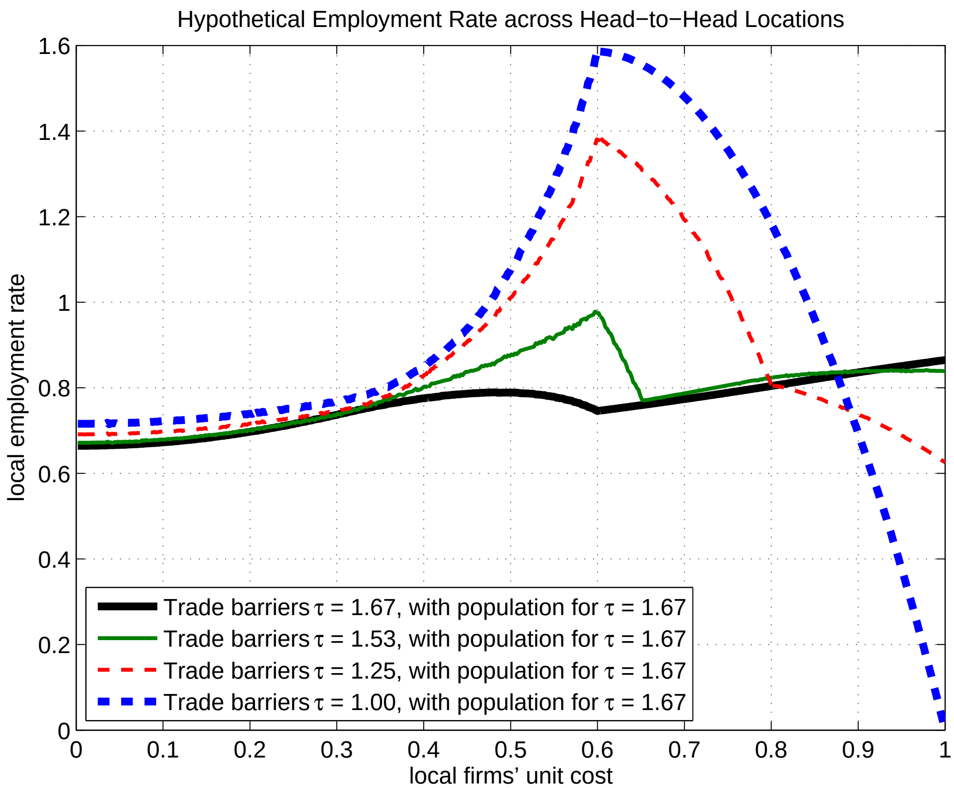
Figure 6 shows the equilibrium employment-to-population across head-to-head labor markets for various levels of trade barriers.[40] By Proposition 3, in the absence of trade barriers, the nonemployment rate across head-to-head locations decreases with productivity. However, the monotonicity does not 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. Therefore, 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. Furthermore, the model predicts that more productive locations have higher employment level since their firms are larger.

[40] In the upper limit of autarky, the employment rate is constant since in all locations, all firms have a constant markup. See Table 3 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 7, some labor markets greatly expand and employ more workers than their original population.[41] However, the full mobility assumption is at odds with the empirical evidence on muted population adjustments to trade shocks. Therefore, in the next section, worker mobility after a trade reform shock is restricted.

Figure 7: Reallocation of Labor with Full Mobility



4 Unexpected Trade Reform with Limited Mobility

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.

[41] The largest (proportional) firm expansions typically occur in the medium-sized locations that start exporting. This is reflected in the kink in Figure 7.

The *ex ante* indifference condition across locations no longer has to hold *ex post*. 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.

4.1 Medium Run Equilibrium Post-Reform

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 is chosen to be in the range of trade costs - including observed tariffs and non-tariff barriers - 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. The bargaining power λ is set to 0.5 so the union and the firm have equal bargaining power. The fraction of firms subject to head-to-head foreign competition 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 around 30 percent in free trade. The calibration parameters are summarized in Table 3.

4.3 Foreign Competition and Nonemployment

To relate the model to the empirical findings, the import competition faced by a labor market is measured using a statistic akin to Trade Adjustment Assistance (TAA) certifications observed in the data: the number of workers in a given labor market that are displaced because of foreign competition. In the model, this is the fraction of local workers who lost their jobs after their plant shut down due to heightened head-to-head competition. This measure is equal to zero in non head-

Table 3: 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

to-head labor markets.[42] Figure 8 illustrates the relationship between the measure of TAA-certified workers and nonemployment changes.

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 local job losses due to foreign competition is slightly larger than two in the worst hit locations.[43] The model therefore suggests that a selection bias in the petition process is needed to generate the measured elasticity of nonemployment to trade-induced displacements.

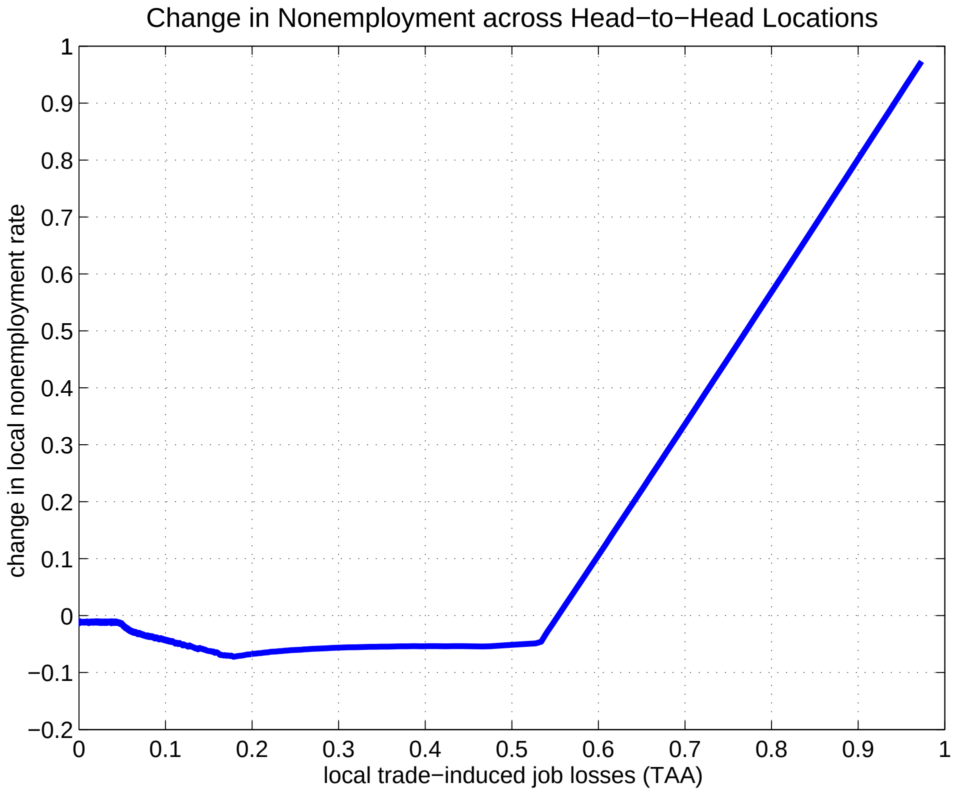
As trade barriers fall, the firms in the marginal exporting labor markets are able to outcompete their foreign rivals in foreign markets, and thereby expand at the extensive margins. Less productive head-to-head locations lose most of their firms because they are out-competed. At the other extreme, the most productive head-to-head labor markets are hardly affected by the fall in trade barriers as they behave as monopolists. These changes in markups and export participation drive changes labor market outcomes across locations.

The overall relationship for the employment rate is non monotonic due to the heterogeneity in markups and the correlation between lower productivity and vulnerability to import competition.

[42] 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.

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

Figure 8: Foreign Competition and Nonemployment



The relationship is quantitatively and qualitatively robust to the size of the head-to-head sector (H).[44] 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 5. On the other hand, the elasticity of substitution σ is 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 Welfare Gains and Limited Worker Mobility

Both the model and the data indicate that import 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 4.

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

Table 4: Effects of Limited Mobility in the Medium Run

	Trade 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 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 as opposed to matching frictions. Hence, limited mobility partially undoes that inefficiency as in Helpman and Itskhoki (2010).[45]

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. In contrast, under full worker mobility, no redistribution across labor markets is needed because of the indifference condition.[46]

4.5 Evidence using Measured Cross-Sectional Productivity

A fundamental ingredient in this model is the heterogeneity in productivity across locations: differences in trade-induced displacements are due to productivity differences across locations. In particular, as shown in Figure 8, the model predicts a nonlinear quadratic relation between productivity and nonemployment when population adjustments are muted.

These key tenants of the model are investigated using state-level data on Total Factor Productivity (TFP) estimated by Turner et al. (2007) and Turner et al. (2008). These TFP estimates are derived using carefully constructed data on state-level sectoral inputs, especially physical capital, human capital, and land. The empirical estimation is similar to the one used in Section 2. The results are shown in Table 5. All the estimated specifications include state indicators, year indicators, year-region indicators, and lagged variables.[47]

In specifications (a5) and (a6) of Table 5, the nonlinear effects of productivity on nonemployment rate are corroborated. Consistent with the theory, trade-induced displacements are no longer

[45] See also Farhi and Werning (2014) for a related point on inefficiencies and externalities induced by worker mobility across labor markets.

[46] Welfare gains would be different in the absence of full insurance across locations. A richer and more complex model with incomplete markets such as Krusell et al. (2010) would be needed. The implications of limited insurance during trade reforms that change inequality and income risk are very important and go beyond the scope of this paper.

[47] Income is not included since it is strongly correlated with productivity.

Table 5: Labor Market Outcomes using TFP estimates across states

Labor market outcomes →	Nonemployed Workers			Job Destruction Rate		Job Creation Rate		Population	
	a4	a5	a6	b4	b6	c4	c6	d4	d6
Foreign Competition									
TAA Certified Workers	2.819**	-	2.625	1.489**	-0.245	-1.496***	-1.233	0.005	0.016
	(1.255)	-	(1.800)	(.682)	(1.017)	(.531)	(.783)	(.015)	(.238)
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***	-	0.0005
	-	(1.320)	(1.324)	-	(.061)	-	(.042)	-	(.0014)
Log TFP^2	-	0.468**	0.469**	-	-	-	-	-	-
	-	(.216)	(.217)	-	-	-	-	-	-
Standard Controls									
Lagged outcome	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lagged independent variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year $\times$ Region indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-sq.	0.7388	0.6352	0.6236	0.4925	0.6296	0.5654	0.4377	0.9996	0.9995
N	1350	900	900	1350	900	1350	900	1350	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.

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). This finding reinforces the possibility of a selection bias in the petitions as noted above. 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 8. This would make sense if workers expect the overall labor market to expand in the more productive locations and therefore do not apply for TAA.

Finally, 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.[48] Population dynamics remain muted in response to productivity innovations as shown in specifications (d4) and (d6). Altogether, these findings reinforce the view that trade reforms unevenly affect locations through preexisting cross-sectional productivity differences.

4.6 Trade Reforms and Exogenous 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 subsection, the effects of an unexpected trade reform and an unbalanced foreign productivity growth are contrasted. In this model, the labor market effects of trade reforms and foreign productivity are not identical in the cross-section or in the aggregate.

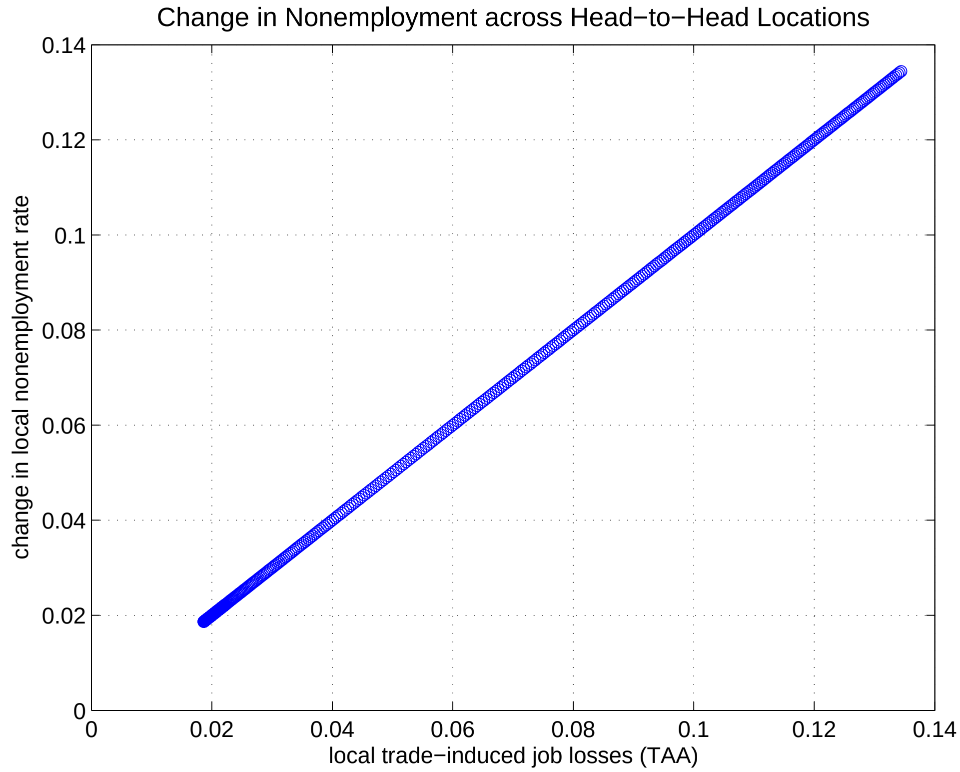
To do so, an asymmetric free trade equilibrium is first computed by extending the symmetric setup in Section 3. The two countries are assumed to be different in their Pareto shape parameter. An unexpected productivity increase is then induced in the spirit of the *medium run* equilibrium of Section 4. 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.[49]

Figure 9 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. Overall,

[48] Notice that the effects of trade-induced displacements are no longer significant once productivity is included.

[49] 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 3 for the other parameters.

Figure 9: Nonemployment under Exogenous Foreign Growth



these effects yield negative aggregate welfare effects in the advanced economy due to the induced fall in aggregate income. [50]

5 Conclusion

This paper studies the labor market effects of trade-induced foreign competition across locations in the U.S. 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, while population dynamics are sluggish. Furthermore, across locations, an extra worker separated due to foreign competition is associated with the overall employment falling by two to three extra workers. These findings are robust to location fixed effects, time fixed effects, region and time interactions, import penetration,

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

construction activity, and unionization.

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

The model is used to study the welfare effects associated with the uneven effects of trade across locations. 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 as a result of reduced relocation across labor markets. 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.

Overall, this paper makes a contribution to the growing literature on trade-induced labor market adjustments. Given the findings in this paper, future work on welfare effects of trade reforms should also focus on a richer set of labor market frictions and investigate technological change in negatively affected locations, firms, and workers.

In light of the *medium run* inequality induced by trade reforms, it is also 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 motivate interesting questions at the nexus of public finance 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.[51]

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.[52] 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.

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

[52] 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 6: 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 10 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 10: Total TAA-certified Workers in the U.S.

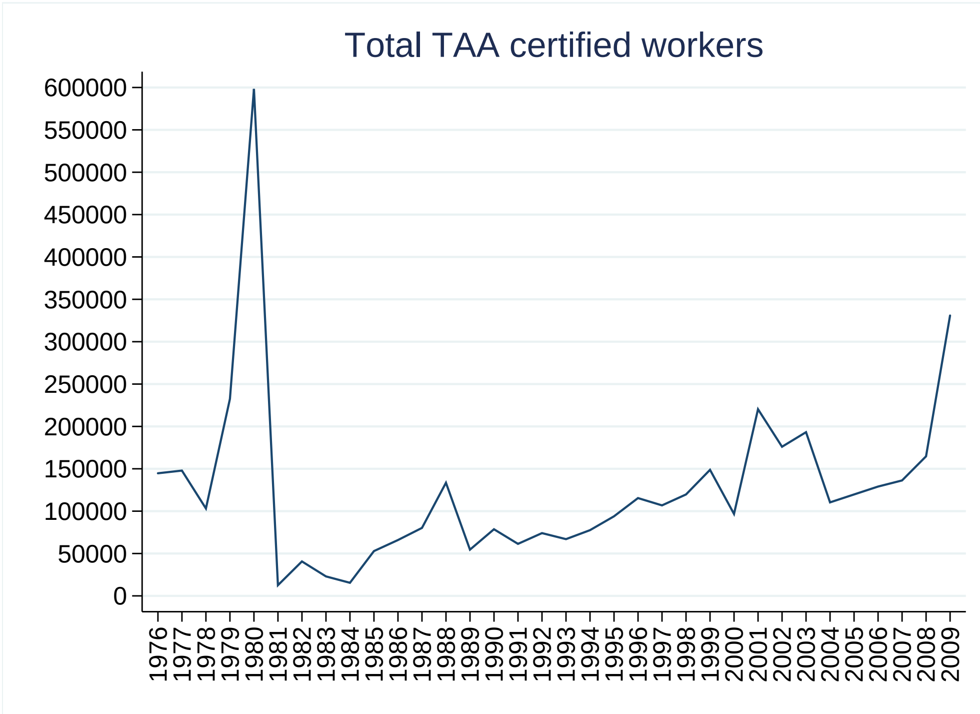


Table 8 shows the typical order of magnitude of this import penetration proxy across states between 1988 and 2005. State-level time series of the ADH and the TAA measures are compared in Figure 11.

Table 8: 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 9 for additional labor market outcomes.

6.6 Additional Model Outcomes

Model predictions on medium-run earnings inequality and differences in employment rates are presented in 12.

Figure 11: Time series of foreign competition (1988-1997;1999-2005)

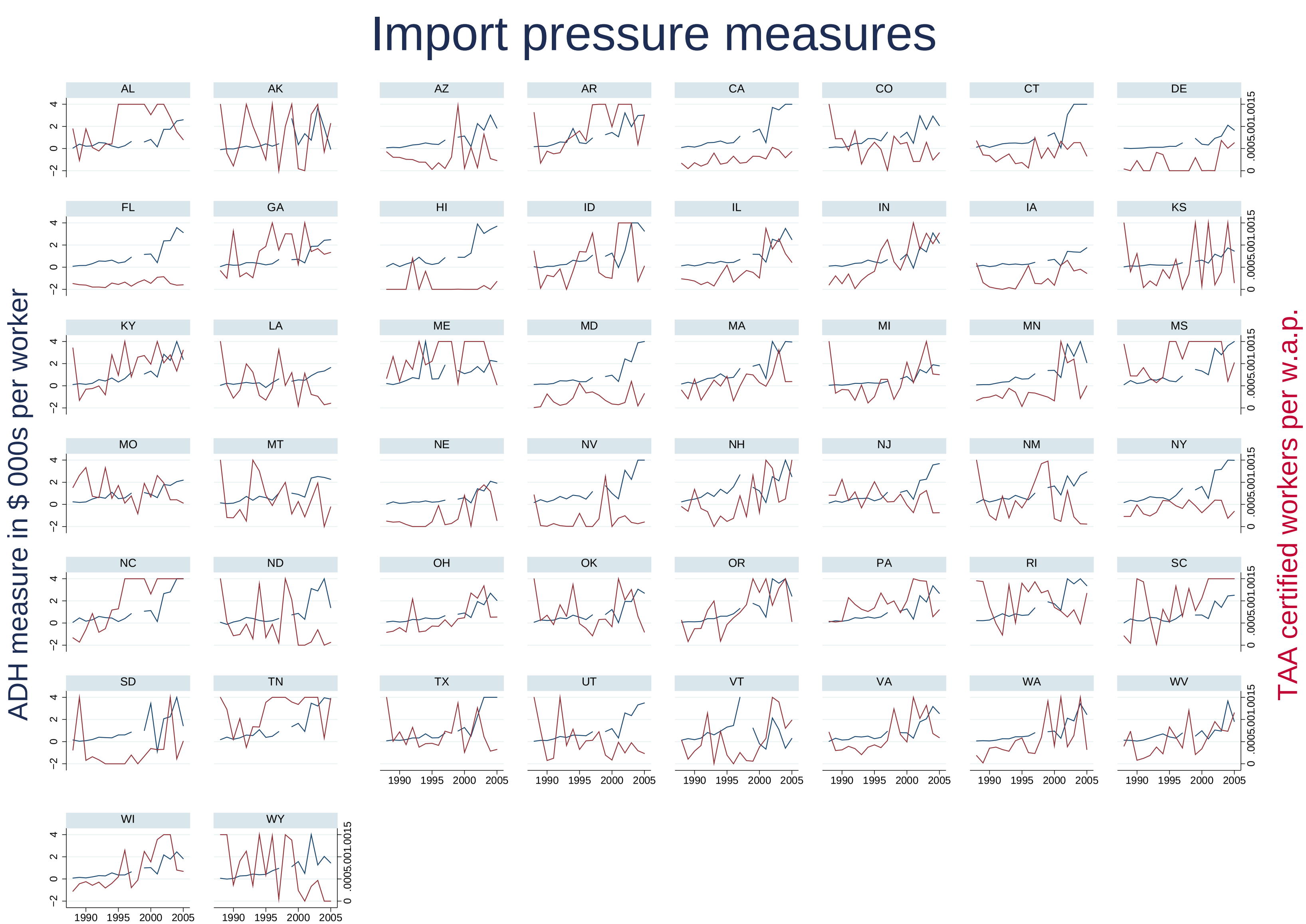
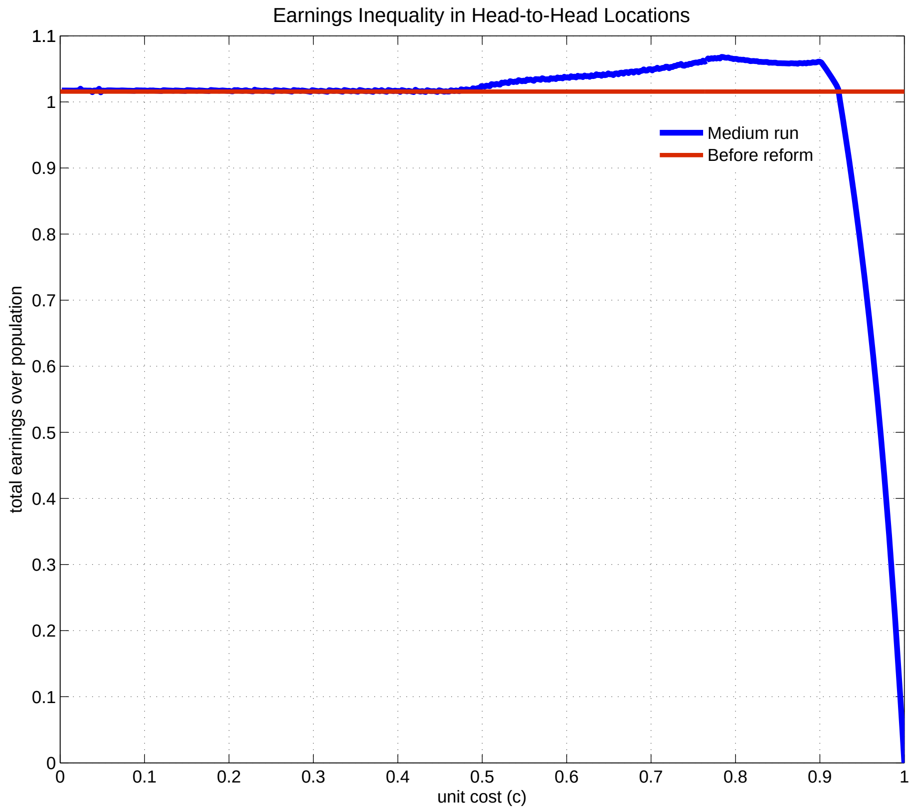


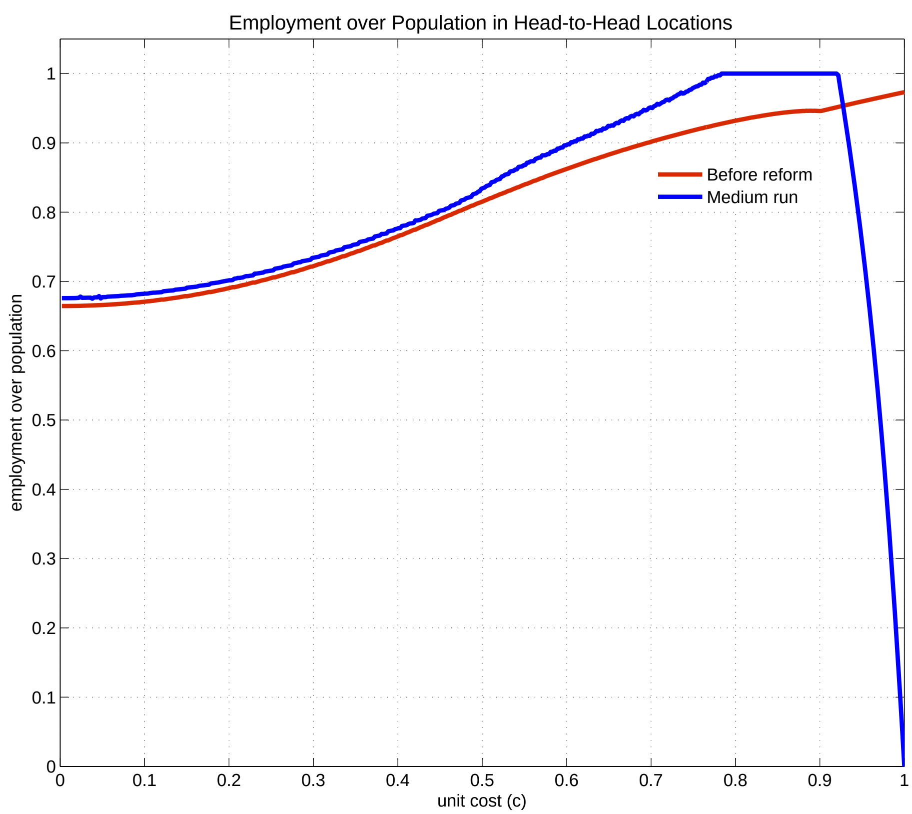
Table 9: Other Labor Market Outcomes Panel Estimation across the United States

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 12: Earnings and Employment Rates after Trade Reform





6.7 Productivity and Long-Run Outcomes

See Table 10 the long run effects of productivity.

Table 10: Long Run Labor Market Outcomes across the United States

Labor market outcomes →	**Not Employed in Five Years**	**Wages in Five Years**	**Population Share† in Five Years**
Total Factor Productivity			
Log TFP	0.909***	23.05***	.004*
	(.233)	(4.250)	(.002)
Standard Controls			
Lagged outcome	Yes	Yes	-
U.S. population share	Yes	Yes	-
Year indicators	Yes	Yes	-
State indicators	Yes	Yes	-
R-sq.	0.2002	0.5408	.0993
N	900	900	900

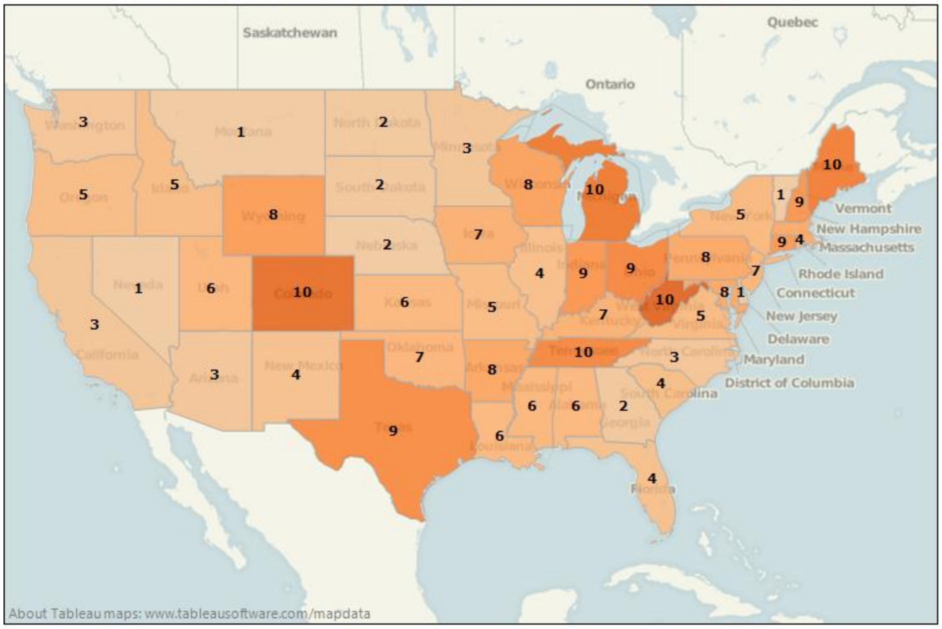
Note: *, **, and *** denote significance at the 10, 5, and 1 percent level.Robust standard errors in parentheses are clustered on states. The estimation sample is a balanced panel of the 50 states from 1983 and 2000. All outcome variable are in log except the share of w.a.p unemployed and the share of 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.†: The population dynamics regression is a difference-in-difference estimation because the population time series are not stationary.

6.8 Maps

Figures 13, 14, and 15 show maps of the TAA-based foreign competition measure.

Figure 13: Maps of foreign competition

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

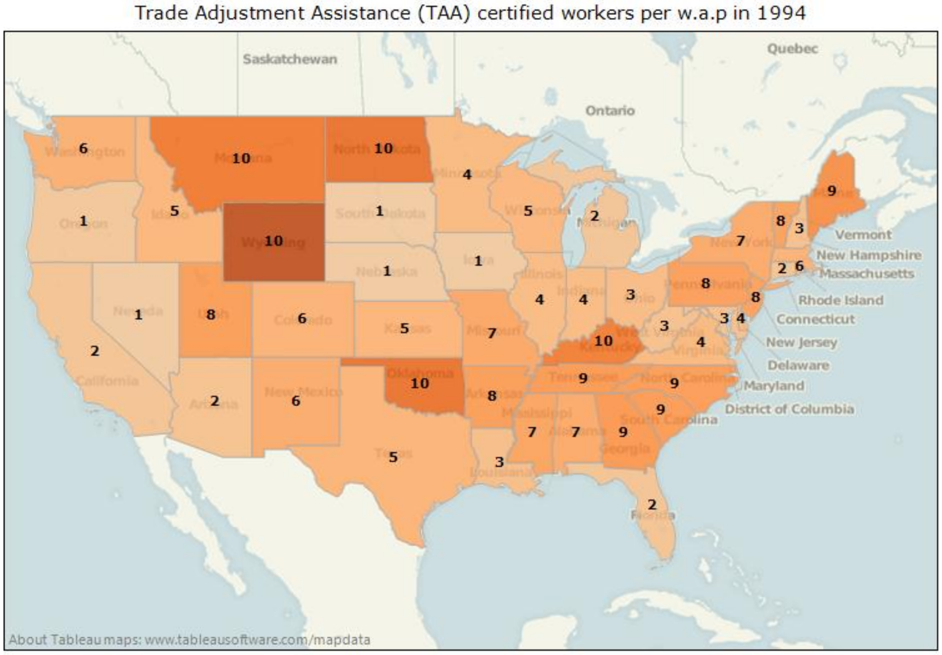


Color shows import competition as measured by using the Trade Adjustment Assistance (TAA) certifications. The numbers show the corresponding deciles of the import competition.

TAA certif. per w.a.p.

0.000000 0.002500

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



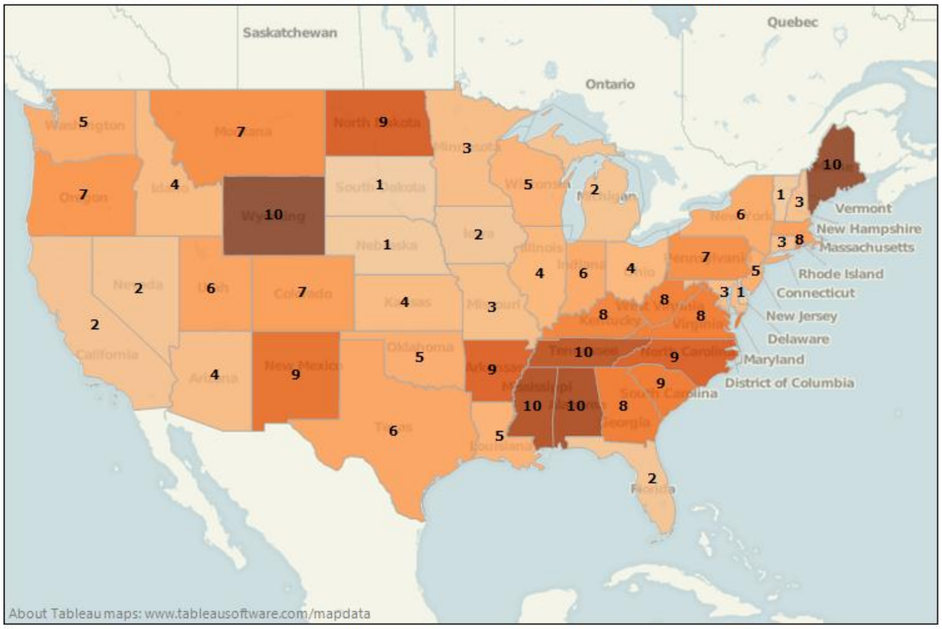
Color shows import competition as measured by using the Trade Adjustment Assistance (TAA) certifications. The numbers show the corresponding deciles of the import competition.

TAA certif. per w.a.p.

0.000000 0.002500

Figure 14: Maps of foreign competition

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

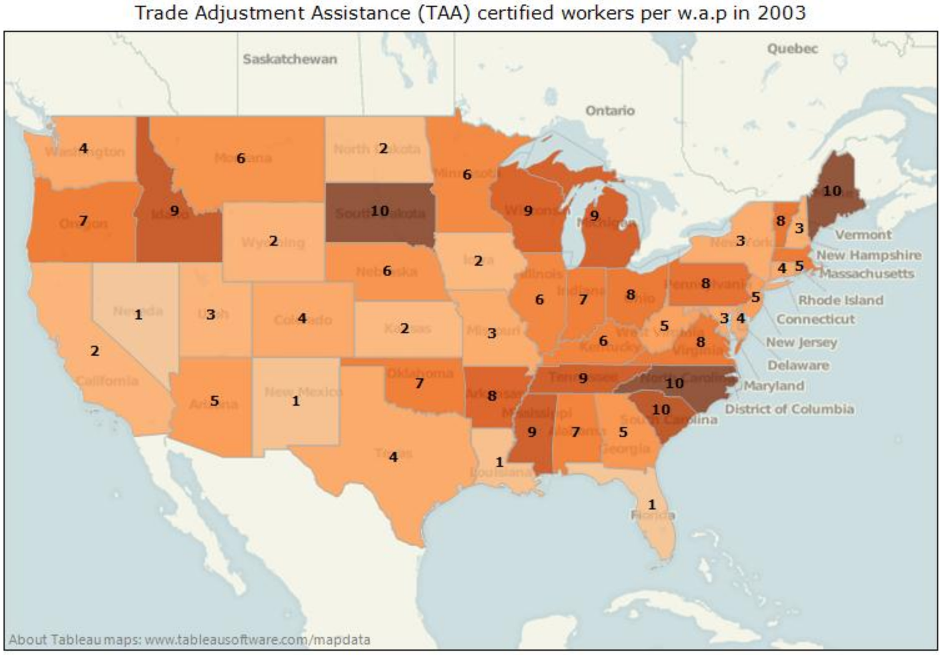


Color shows import competition as measured by using the Trade Adjustment Assistance (TAA) certifications. The numbers show the corresponding deciles of the import competition.

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 15: Maps of foreign competition