Local Labor Markets and Trade Policy Preferences

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Abstract

Using a multi-sector Ricardian model of trade with input-output linkages, I estimate the welfare impact of the North American Free Trade Agreement that was implemented in 1994 on individual states within the United States. I find substantial variation in welfare across states and sectors in the country. The paper then explores politician voting behavior for this policy change prior to its implementation. I find no significant patterns between aggregate or sector-wise welfare and the probability of voting in favor of the bill. There is weak evidence that politicians have equity concerns, but find no effect of the median voter's welfare on politicians' voting behavior.

JEL Classification: D72, F13, F16, F66

Keywords: NAFTA, Local labor markets, Welfare, Politician voting behavior

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1 Introduction

Trade theories predict that trade liberalization is welfare improving on aggregate. However, we often observe that politicians fail to support trade liberalization and instead favor protectionist policies. A quick look at the history of voting behavior of United States politicians (both house representatives and senators) on major trade liberalization bills shows us that there is substantial variation in policy maker's preferences. First, not all of them are against liberalization episodes (Table 1) and second, even within a constituency different trade bills are considered differently and voted upon differently (Figure 1). This may not be surprising as economic theory predicts differential welfare impacts on regions that depend not only on the technological and industrial composition of the region in question, but also that of its trade partners. Studies like Autor et al. (2013) have empirically established that opening up to trade can have dissimilar effects on different local labor markets. Specifically, they examine the impact of the exposure to Chinese import competition on unemployment, labor force participation and wages in US, and find that there are winners and losers from trade and that there is variation across local labor markets in the country. A region may gain from trade in aggregate, but it is a combination of both gains and losses.

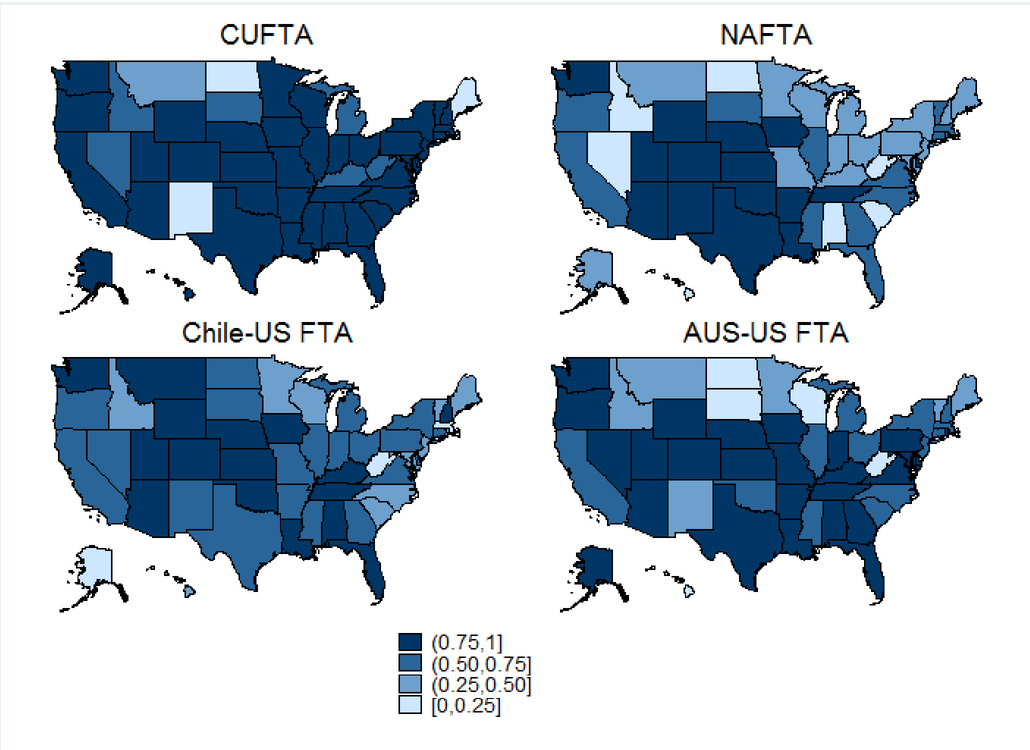
A question that follows is if policy makers care about aggregate welfare of the region they represent, or if they weigh gains and losses differently, or if their preferences are driven by other personal and political considerations. Individual politician preferences matter as voting on bills in the Congress determines whether liberalization takes effect or not, which in turn has important implications for their constituency. Recent evidence suggests that policy makers should be concerned about the consequences of trade policies. Autor et al. (2016) finds that rising integration with China has probably led to political polarization in the US. Che et al. (2016) finds that US counties with greater exposure to Chinese import competition saw relative increases in voter turnout, share of votes cast for democrats and the probability that the county is represented by a Democrat. This is consistent with Democrats more likely to support protectionist policies during

Table 1: Votes on major liberalization bills

Year	Bill	House	Senate
1988	US-Canada FTA	366-40	83-9
1993	N.America FTA	234-200	61-38
2003	US-Chile FTA	270-156	65-32
2003	US-Singapore FTA	271-155	66-32
2004	US-Australia FTA	314-109	80-16
2004	US-Morocco FTA	323-99	85-13
2005	Dom. Rep.-C.America FTA	217-215	55-45

#-# represents the number of votes for yes-no respectively. Source: Conconi et al. (2014)

Figure 1: Votes on major liberalization bills



Notes: Each map shows the fraction of politicians from each state that voted in favor of the respective bill. Source: ICPSR the period examined than Republicans. The objective of this paper is to explore politician behavior towards one such trade liberalization episode in the US, the North American Free Trade Agreement (NAFTA), and to test whether welfare effects predicted by an economic model have explanatory power over their voting behavior.

Previous research has looked at how various politician and constituency characteristics play a role in politician voting behavior on trade bills. Grossman and Helpman (1994) present a theoretical model with endogenous protection outcomes in which different interest groups lobby for desirable policy through campaign contributions, and a policy maker maximizes his contributions and aggregate social welfare. An industry's level of protection or openness depends on its political organization, its import competitiveness and the elasticity of import demand or export supply [1]. Baldwin and Magee (2000) find that labor group contributions were associated with votes against freer trade while business contributions were associated with votes in favor of liberalization.

Constituency characters as a proxy for the effect of liberalization have also been considered in the literature. For example, Conconi et al. (2014) consider the share of workers and the degree of industry concentration in export and import-competing industries. They find a significant positive effect of export ratio (ratio of export and import-competing workers). This suggests that a region with higher share of workers employed in export industries is more likely to vote for trade liberalization. This suggests that politicians understand that trade can give rise to winners and losers. Mayer (1984) uses this aspect of the Stolper-Samuelson theorem, which predicts who gains and who loses from trade, to explain endogenous tariff formation in countries. Following this factor endowment theories of trade, many studies have looked at how a region's endowments and industry specialization affects trade policy. Conconi et al. (2014) find that congressmen representing highly skilled districts are more likely to support trade liberalization measure, a result consistent with a Heckscher–Ohlin model in which U.S.

[1] For example, if an industry is import competing and is well organized in order to lobby, that industry can buy protection, i.e. successfully lobby for import tax.

imports are relatively unskilled-labor intensive [2]. In none of the previous literature however, model based predictions of the effects of a particular trade bill have been considered.

This paper uses recent models of trade theory to predict welfare effects of NAFTA, which came into effect in 1994, at the local labor market level and check if these estimates have predictive power over how the politicians voted on the trade bill in question. From table 1 above, we can see that the bill was passed with a small margin, 54% in the House and 61% in the Senate, indicating a substantial variation in the preferences of politicians from across the country. In order to predict welfare effects of NAFTA, I make use of a rich model of trade theory based on Eaton and Kortum (2002) (EK henceforth), which allows for regional differences in technology and industry concentration within a country. This multi-region and multi-sector trade model was developed by Caliendo and Parro (2015), which introduces input-output linkages, trade in intermediate goods and sectoral heterogeneity into the simple EK model in order to estimate the welfare effects of NAFTA at the country level. They find that welfare increases for Mexico and US, whereas it decreases for Canada. They consider each country as a labor market with full mobility of labor across all sectors within the country. I use a similar model but redefine my labor markets as regions within the US, and restrict labor mobility within each region. Specifically, I treat each US state as a separate region with its own labor market and production activities that trade with other US states and countries outside of the US. By expressing equilibrium conditions in terms of relative changes, I can estimate the impact of a given trade policy on the endogenous variables of the model like wages, prices, trade flows and production in relative changes.

The contribution of this paper is two fold. First, the model predicts

[2] This seems to apply to individual worker preferences as well; using National Election Studies survey, Scheve and Slaughter (2001) find that low skilled workers support trade barriers and Blonigen and McGrew (2014) find similar effects of the task routineness of a worker's occupation. This is in line with recent evidence of how trade openness and technology change affects occupations with different degrees of task routineness to different extents like Autor et al. (2003) and Autor et al. (2015).

regional differences in NAFTA's impact within the US which has not been explored before. I attempt to explain this variation in the context of the model by using regional variation in the initial industrial composition. Second, I use these predicted welfare estimates as a new explanatory variable for politician votes on the trade bill contributing to the political economy literature. Earlier studies have used imperfect proxies for potential consequences of a trade bill as covariates. I find no significant patterns between aggregate or sector-wise welfare and the probability of voting in favor of the bill. The rest of the paper is structured as follows: section 2 outlines the model used, section 3 explains how to use the model to get the effect of a policy change with details on the solution method for estimating the new equilibrium, section 4 describes the data used in the paper, section 5 contains the predicted impacts of NAFTA and the estimated effect of these welfare variables on politician votes on the bill and section 6 concludes.

2 Model

The following model is adapted from the static disaggregated economy model of Caliendo and Parro (2015), changed slightly to limit labor mobility. Production is disaggregated across regions and sectors, which are connected through input-output linkages. There are N regions and J sectors. A region is denoted by n (or i or m) and a sector by j (or k). Every region has production activity in every sector, (n, j). These regions can either be countries or states within a country. In this application of the model, the set of regions are 50 US states and 40 countries including a constructed rest of the world. Production involves the use of labor and material inputs. A local labor market is defined as a specific region-sector pair (n, j).

2.1 Consumption

Agents employed in any region-sector pair have a Cobb-Douglas utility function with preferences for goods from all sectors. An agent in region n and employed in sector j supplies a unit of labor inelastically and receives a competitive wage w_n^j. Given her income she decides how to allocate consumption over local final goods. The agent's preferences are assumed to be of Cobb-Douglas form:

$$U(C_n^j) = \prod_{j=1}^{J} (c_n^{jk})^{\alpha^k} \ , \text{ where } \sum_{k=1}^{J} \alpha^k = 1 \tag{1}$$

c_n^{jk} is the consumption of sector k product by an agent in region n and sector j, which is bought at price P_n^k. The ideal price index is given by $P_n = \prod_{k=1}^{J} (P_n^k / \alpha^k)^{\alpha^k}$.

2.2 Production

In every region-sector pair, (n, j), production happens at two stages: intermediate and final goods. A continuum of intermediate goods are produced for (in) each sector by using labor and final goods from all sectors. Final goods are in turn produced using this continuum of intermediate goods, chosen from the region that offers them at the minimum price. Therefore, final goods produced in a region are used for consumption and as *material* inputs for the production of intermediates.

2.2.1 Intermediate Goods

The production of the continuum of varieties of intermediates follows the EK framework: each variety is produced by a representative firm with idiosyncratic productivity level, z_n^j. In each region-sector, this productivity level is a random draw from a Fréchet distribution with shape parameter θ^j and location parameter 1. Apart from this region-sector-firm specific productivity, there also exists a region-sector specific productivity T_n^j, that affects all intermediate good producing firms similarly. Production follows a constant returns to scale technology of the following form:

$$q_n^j(z_n^j) = z_n^j \left[T_n^j l_n^j(z_n^j) \right]^{\gamma_n^j} \prod_{k=1}^{J} \left[M_n^{jk}(z_n^j) \right]^{\gamma_n^{jk}}$$

where $l_n^j(.)$ and $M_n^{jk}(.)$ denote the demand for labor and sector k material inputs respectively by firms in (n, j). $\gamma_n^j \geq 0$ is the share of value added and $\sum_{k=1}^{J} \gamma_n^{jk} = 1 - \gamma_n^j$.

Marginal Cost and Prices of Intermediate Goods As firms operate in a competitive market, the price of a intermediate variety should be equal to its marginal cost of production. A firm in (n, j) with idiosyncratic productivity eaqual to z_n^j faces a unit cost of production equal to $mc_n^j(z_n^j) = x_n^j / z_n^j \left[T_n^j\right]^{\gamma_n^j}$, where x_n^j is the cost of the input bundle needed to produce intermediates in (n, j) (Appendix B).

$$x_n^j = B_n^j \left[w_m\right]^{\gamma_n^j} \prod_{k=1}^{J} \left[P_n^k\right]^{\gamma_n^{jk}} \tag{2}$$

$$\text{where, } B_n^j = \left[\gamma_n^j\right]^{-\gamma_n^j} \prod_{k=1}^{J} \left[\gamma_n^{jk}\right]^{-\gamma_n^{jk}}$$

Given the above marginal cost of production, the price offered by a firm in region n and sector j to region i is equal to its marginal cost adjusted for by trade costs between the two regions. Let $\kappa_{in}^j \geq 1$ be the trade costs associated with transporting sector j intermediate goods from region n to region i, with $\kappa_{ii}^j = 1$. Thus the price faced by region i of intermediates produced in (n, j) by a firm with productivity level z_n^j is given by:

$$p_{in}^j(z_n^j) = \kappa_{in}^j mc_n^j(z_n^j) = \frac{\kappa_{in}^j x_n^j}{z_n^j \left[T_n^j\right]^{\gamma_n^j}}$$

2.2.2 Final Goods

Final good j is produced by combining all varieties in the continuum of intermediate goods in sector j. Let $\tilde{q}_n^j(z^j)$ be the demand for a particular variety in the continuum of intermediates in sector j, given that firms producing that variety have idiosyncratic productivities given by the vector $z^j = (z_1^j, z_2^j, \ldots z_N^j)$. Specifically, final good producers in (n, j) can buy intermediate goods from any region after observing the prices offered by each i, which in turn depend on their idiosyncratic productivity draws as described in the previous section. The production function is given by:

$$Q_n^j = \left[\int \tilde{q}_n^j(z^j)^{1-1/\eta_n^j} \phi^j(z^j) dz^j\right]^{\eta_n^j/(\eta_n^j - 1)}$$

where $\phi^j(z^j) = \exp\left\{-\sum_{n=1}^{N}\left(z_n^j\right)^{-\theta^j}\right\}$ is the joint density of vector z^j defined over $\mathbb{R}_+^N$.

Demand for Intermediates Final good producers in (n, j) face a vector of prices for each variety of intermediate goods from region $i = (1, 2, \ldots N)$, given by $\left\{p_{ni}^j(z_i^j)\right\}_i$ (Refer to Section 4). After observing this vector of prices, they choose to buy intermediates from that location that offers the minimum price. Hence, the price that a final good firm in (n, j) pays for a particular intermediate variety given the vector of idiosyncratic productivity draws z^j, is:

$$p_n^j(z^j) = \min_i \left\{p_{ni}^j(z_i^j)\right\} = \min_i \left\{ \frac{\kappa_{ni}^j x_i^j}{z_i^j \left[T_i^j\right]^{\gamma_i^j}} \right\}$$

The above gives the cost of inputs faced by a final good producer, and let P_n^j be the price received for the final good (n, j). Then, the demand for intermediate inputs is given by the following (Appendix C.1)

$$\tilde{q}_n^j(z^j) = \left[\frac{p_n^j(z^j)}{P_n^j}\right]^{-\eta_n^j} Q_n^j$$

2.2.3 Prices of Final goods

In the previous section, final good producers take prices in the market as given and solve the production problem. Since final goods market is also competitive, prices are set equal to the marginal cost. Given the production function which combines all intermediate inputs and the costs of these intermediate inputs, the unit cost of final good production is set as the price of the final good (Appendix C.2).

$$P_n^j = \left[\int p_n^j(z^j)^{1-\eta_n^j} \phi^j(z^j) dz^j\right]^{1/(1-\eta_n^j)}$$

From the properties of the Fréchet distribution, the price of the final good is (Apendix C.4),

$$P_n^j = \Gamma(\psi_n^j)^{1-\eta_n^j} \left[\sum_{m=1}^{N} \left[x_m^j \kappa_{nm}^j \right]^{-\theta^j} \left[T_m^j \right]^{\theta^j \gamma_m^j} \right]^{-1/\theta^j} \tag{3}$$

where, $\Gamma(\psi_n^j)$ is the Gamma function evaluated at $\psi_n^j = \frac{\theta^j + 1 - \eta_n^j}{\theta_n^j}$

2.3 Trade Flows

From the above setup of intermediate and final goods production, note that only intermediate goods are traded between regions and final goods are not traded. Let π_{ni}^j denote the share of region n's total expenditure on sector j's intermediate goods purchased from region i. Using properties of the Fréchet distribution, we can derive the shares to be (Appendix C.5),

$$\pi_{ni}^j = \frac{\left[x_i^j \kappa_{ni}^j \right]^{-\theta^j} \left[T_i^j \right]^{\theta^j \gamma_i^j}}{\sum_{m=1}^{N} \left[x_m^j \kappa_{nm}^j \right]^{-\theta^j} \left[T_m^j \right]^{\theta^j \gamma_m^j}} \tag{4}$$

2.4 Market Clearing

Goods Market Let X_n^j be the total expenditure on final goods j in region n. Goods market equilibrium requires that this be equal to total material requirement for intermediate goods production and final goods for consumption.

$$X_n^j = \sum_{k=1}^{J} \gamma_n^{kj} \sum_{i=1}^{N} \pi_{in}^k \frac{X_i^k}{\kappa_{in}^k} + \alpha^j \left[\sum_{k=1}^{J} w_n^k L_n^k + \sum_{k=1}^{J} \sum_{i=1}^{N} (1 - \kappa_{ni}^k) \pi_{ni}^k \frac{X_n^k}{\kappa_{ni}^k} \right] \tag{5}$$

The first term represents the demand for final good j in region n as material inputs. The second term denotes total income in region n that is spent on sector j goods. A region's income is made up of wage income from all sectors and import tariff income applied on all goods imported from all other regions.

Labor Market Labor compensation is the corresponding share of gross output in every region-sector:

$$w_n^j L_n^j = \gamma_n^j \sum_{i=1}^{N} \pi_{in}^j X_i^j \tag{6}$$

2.5 Equilibrium

Given a distribution of labor allocation $\{L_n^j\}$, the equilibrium of the above described static production and trade problem is given by equations (2) - (6), which determines prices, wages , output and trade flows in every region-sector pair.

3 Analyzing trade policy impacts

Let $\hat{y} = y'/y$ be the relative change in a variable y, where y' and y are next period's value and the present period's value respectively. The above defined equilibrium conditions are dependent on a set of fundamentals of the economy like T_n^j. In order to analyze the impact of a given trade policy, $\hat{\kappa}_{ni}^j$, we can use these equilibrium conditions expressed in relative changes instead of levels. The resulting equations describes how the main variables of the model change in response to a policy change. A result of this exercise [3] is that the fundamentals of the model no longer need to be estimated as they cancel out. In deriving the following equations an implicit assumption is made, that the total labor is constant. Further, depending on the extent of labor mobility within or across local labor markets, the labor market clearing conditions would vary. The equilibrium conditions in relative changes are given by:

Price of input bundles

$$\hat{x}_n^j = [\hat{w}_m]^{\gamma_n^j} \prod_{k=1}^{J} \left[\hat{P}_n^k\right]^{\gamma_n^{jk}} \tag{7}$$

[3] also known as the exact hat algebra method developed by Dekle et al. (2008)

Price of final goods

$$\hat{P}_n^j = \left[\sum_{i=1}^{N} \pi_{ni,t}^j \left[\hat{x}_i^j \hat{\kappa}_{ni}^j \right]^{-\theta^j} \right]^{-1/\theta^j} \tag{8}$$

Trade flows

$$(\pi_{ni}^j)' = \pi_{ni,t}^j \left[\frac{\hat{x}_i^j \hat{\kappa}_{ni}^j}{\hat{P}_n^j} \right]^{-\theta^j} \tag{9}$$

Goods market clearing

$$(X_n^j)' = \sum_{k=1}^{J} \gamma_n^{kj} \sum_{i=1}^{N} (\pi_{in}^k)' \frac{(X_i^k)'}{(\kappa_{in}^k)'} + \alpha^j \left[\sum_{k=1}^{J} \hat{w}_n^k w_n^k L_n^k + \sum_{k=1}^{J} \sum_{i=1}^{N} (1 - \kappa_{ni}^k)' (\pi_{ni}^k)' \frac{(X_n^k)'}{(\kappa_{ni}^k)'} \right] \tag{10}$$

Labor market clearing [4]

$$\hat{w}_n^j w_n^j L_n^j = \gamma_n^j \sum_{i=1}^{N} (\pi_{in}^j)' \frac{(X_i^j)'}{(\kappa_{in}^j)'} \tag{11}$$

3.1 Solution Method

Given the data for policy change of NAFTA, $\hat{\kappa}_{ni}^j$, data for the initial allocations, i.e. π_{ni}^j and $w_n^j L_n^j$ and data on structural parameters γ_n^j, γ_n^{jk}, α^j and θ^j, we can solve for the static trade equilibrium in relative changes in the following way:

1. Guess an initial matrix for $\hat{w}_n^j$
2. Solve for $\hat{x}_n^j$ and $\hat{P}_n^j$ using the non-linear system of equations (7) and (8)
3. Use the solution from step 2 to solve for $\pi_{ni,t+1}^j$ using equation (9)
4. Solve for $X_{n,t+1}^j$ using the system of equations in (10)

[4] This condition assumes zero labor mobility across sectors within a region. If labor is allowed to move freely between sectors within a given region the labor market clearing condition would then be: $\hat{w}_n w_n L_n = \sum_{j=1}^{J} \gamma_n^j \sum_{i=1}^{N} (\pi_{in}^j)' \frac{(X_i^j)'}{(\kappa_{in}^j)'}$. In this case, a local labor market would just be the region n and $w_n^j = w_n$.

5. Check if labor market clearing condition holds in equation (11). If not, then update the values of $\hat{w}_n^j$ and repeat steps 1 to 5.

4 Data

Since the objective of this paper is to estimate welfare effects of NAFTA at the local labor market level in order to analyze politician behavior, data for each local market is required. The above exercise is carried out by considering the US states as separate regions which are involved in production activities in all sectors. A total of 90 regions (50 US states and 40 other countries including a constructed rest of the world) and 19 industries (including a residual sector) form the basis of my analysis. Agriculture and manufacturing sector industries are tradable, and service sector industries are non tradable in my analysis . Production and trade data is taken from different sources, which use different industrial classification systems. The selection of the sectors is based on the maximum level of dis-aggregation at which I was able to construct data for the analysis.

The base year is 1993, the year before NAFTA was implemented. Production and trade data at the country level is taken from the Eora multi-region input-output table (MRIO) database (Lenzen et al., 2012). Gross output, expenditure on sectoral imports and domestic expenditure are calculated from this table. This dataset also allows me to calculate the IO parameters (γ_n^j and γ_n^{jk}) of the model. Trade flows across US states is constructed using the 1993 Commodity Flow Survey (CFS) taken from the Bureau of Transportation Statistics. Trade flows between US states and other countries is constructed using the MRIO table and employment data from the 1990 US Census microdata (Integrated Public Use Microdata Series - IPUMS). Tariff data comes from the UNCTAD Trade Analysis Information System (TRAINS). Appendix D gives details on the data construction.

Data for politician votes on the NAFTA bill regressions (both Senators and House representatives) is taken from different studies of the Inter-university Consortium for Political and Social Research (ICPSR). Roll call data and politician characteristics (like political party, gender and age) are merged from different datasets using the unique member ID given by ICPSR to every politician.

5 Results

5.1 Welfare effects of NAFTA

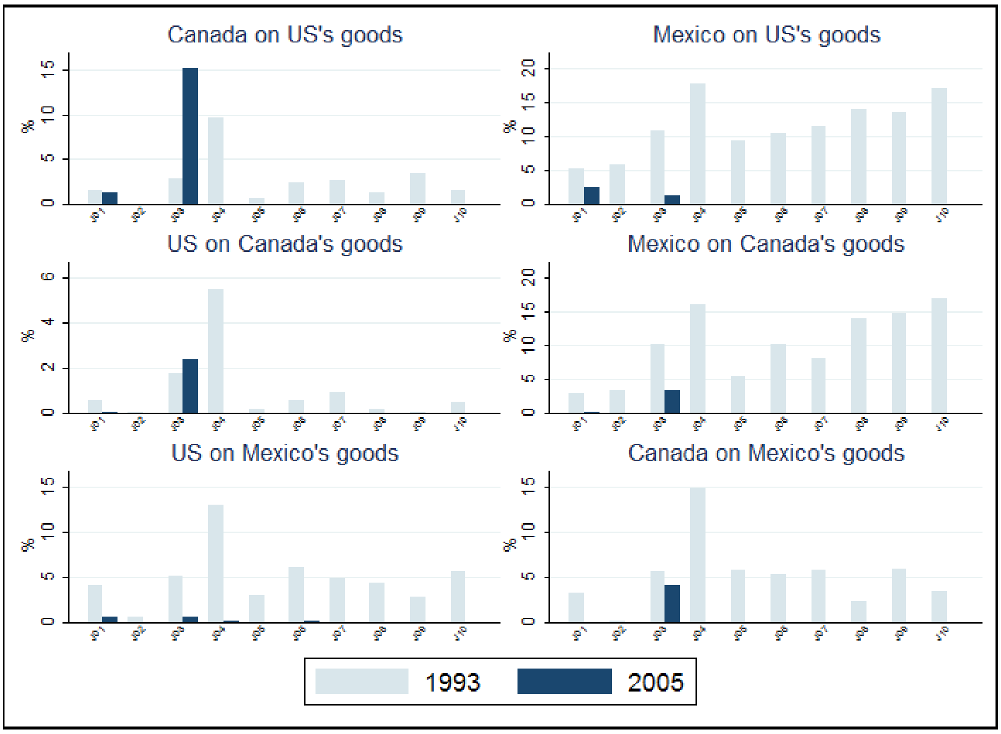
I estimate the impact of NAFTA on local labor markets as described above. I present the results of the model with region-sector labor markets for the US states and a country wide labor market for the other countries. The policy change ($\hat{\kappa}$) considered is the change in tariffs from 1993 to 2005 between the NAFTA countries, i.e. Canada, US and Mexico, while keeping the world tariff changes to be constant. Figure 2 shows the import tariff levels before and after NAFTA for the three countries. Before NAFTA all three countries had positive tariff levels on imports with Mexico imposing the highest levels of import tariffs on goods from the US and Canada. After NAFTA, with the exception of a few industries, tariff levels are close to zero. The textile industry seems to have the most notable decrease, as the industry had the highest levels of tariffs in all countries and are now zero. Mexico also eliminated the high tariffs in its machinery and auto industry. An exception to this rule is the food manufacturing industry where tariff rates have increased between the US and Canada.

This exercise, as explained before gives changes in wages ($\hat{w}_n^j$), prices ($\hat{P}_n^j$) and trade flows ($\hat{\pi}_{ni}^j$) at the local labor market level. Welfare at the region level is given by $W_n = I_n/P_n$, where I_n is region n's income from wages and tariff rebate. Table 2 gives the percentage change in welfare, where the change in welfare is calculated as follows:

$$\begin{aligned} \hat{W}_n &= \hat{I}_n/\hat{P}_n \\ &= \left(\frac{\sum_{j=1}^{J} \hat{w}_n^j w_n^j L_n^j + \sum_{k=1}^{J} \sum_{i=1}^{N} (1-\kappa_{ni}^k)' (\pi_{ni}^k)' \frac{(X_n^k)'}{(\kappa_{ni}^k)'}}{\sum_{j=1}^{J} w_n^j L_n^j + \sum_{k=1}^{J} \sum_{i=1}^{N} (1-\kappa_{ni}^k) \pi_{ni}^k \frac{X_n^k}{\kappa_{ni}^k}} \right) \frac{P_n}{P_n'} \end{aligned} \quad (12)$$

The model predicts positive real income effects for all states within the US ranging from 0.115% (Nebraska) to 0.277% (Wyoming). As expected,

Figure 2: Effectively Applied Tariffs before and after NAFTA



Notes: J01-Agriculture, J02-Mining, J03-Food Manu., J04-Textile & Leather, J05-Wood & Paper, J06-Petrol & Mineral, J07-Basic & Fab. Metal, J08-Machinery nec., J09- Auto & Transport, J10-Other Manu. Source: UNCTAD-TRAINS

there is significant variation in the impact of NAFTA on the welfare of US states arising due to the differences in technological and industrial composition of the states. The states in the top 20% of welfare gains are Wyoming, Alaska, Delaware and Vermont. The change in welfare can further be disaggregated into sector level components which is useful in analyzing this variation. This expression for welfare can be written as:

$$\hat{W}_n = \sum_{j=1}^{J} \frac{w_n^j L_n^j}{I_n} \left(\frac{\hat{w}_n^j}{\hat{P}_n} \right) + \textit{Tariff rebate component} \tag{13}$$

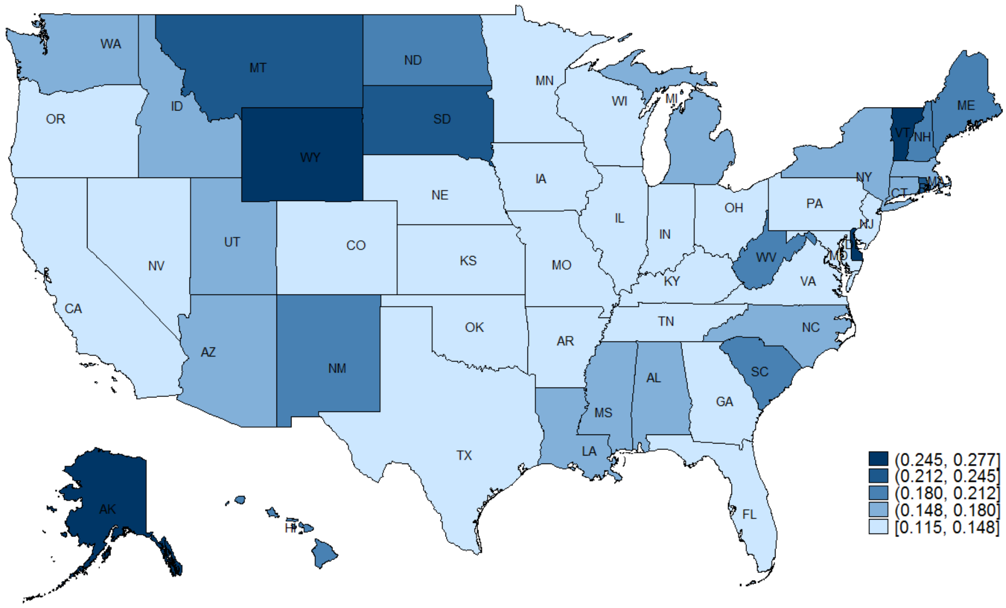
Welfare change is just a weighted average of the change in real wages in different industries weighted by the respective industry's initial share of wage income. Therefore if a given region's income is mostly derived from an industry that was adversely affected by the policy change, that region will have lower welfare gains. On the other hand, if a region had most of its value added in an industry with large positive real wage effects, it will

Table 2: Welfare effects of Nafta on US States

State	Welfare	State	Welfare	State	Welfare
Alabama	0.172%	Louisiana	0.161%	North Dakota	0.192%
Alaska	0.266%	Maine	0.205%	Ohio	0.136%
Arizona	0.156%	Maryland	0.141%	Oklahoma	0.147%
Arkansas	0.128%	Massachusetts	0.155%	Oregon	0.140%
California	0.129%	Michigan	0.177%	Pennsylvania	0.139%
Colorado	0.130%	Minnesota	0.126%	Rhode Island	0.237%
Connecticut	0.170%	Mississippi	0.153%	South Carolina	0.201%
Delaware	0.253%	Missouri	0.119%	South Dakota	0.215%
Florida	0.134%	Montana	0.213%	Tennessee	0.133%
Georgia	0.124%	Nebraska	0.115%	Texas	0.122%
Hawaii	0.210%	Nevada	0.130%	Utah	0.162%
Idaho	0.157%	New Hampshire	0.209%	Vermont	0.249%
Illinois	0.122%	New Jersey	0.129%	Virginia	0.139%
Indiana	0.142%	New Mexico	0.183%	Washington	0.158%
Iowa	0.118%	New York	0.155%	West Virginia	0.191%
Kansas	0.126%	North Carolina	0.165%	Wisconsin	0.123%
Kentucky	0.117%			Wyoming	0.277%

Notes: The table reports percentage changes in state-level welfare

Figure 3: Welfare effects of NAFTA on US states



Notes: The map reports percentage changes in state-level welfare, divided into five equal intervals

Table 3: Real wage changes: Summary Statistics

Industry	Mean	Std. Dev	Min	Max
Agriculture	-0.455	0.265	-1.018	0.137
Mining	-0.019	0.203	-0.483	0.402
Food Manu	-0.465	0.150	-0.967	-0.070
Textile & Leather	0.742	1.022	-0.990	3.809
Wood & Paper	0.328	0.176	-0.113	0.902
Petrol & Mineral	0.406	0.114	0.197	0.671
Basic & Fab. Metal	0.619	0.208	0.113	1.212
Machinery nec.	0.344	0.198	-0.037	0.940
Auto & Transport	0.344	0.445	-0.319	1.875
Other Manu	0.489	0.233	0.042	1.632
Utilities	0.164	0.032	0.104	0.253
Construction	0.084	0.027	0.023	0.149
Wholesale & Retail	0.118	0.029	0.054	0.176
Acc. & Food Services	0.092	0.028	0.029	0.159
Transport & Wearhousing	0.131	0.030	0.046	0.193
Post & Telecom	0.135	0.024	0.086	0.186
Finanace, Real Estate & Other Bus.	0.128	0.026	0.083	0.194
Educ., Health & Other Services	0.072	0.029	0.009	0.143

Notes: All values are in percentage changes (Eg. For agriculture, the mean change in real wage is -0.455%).

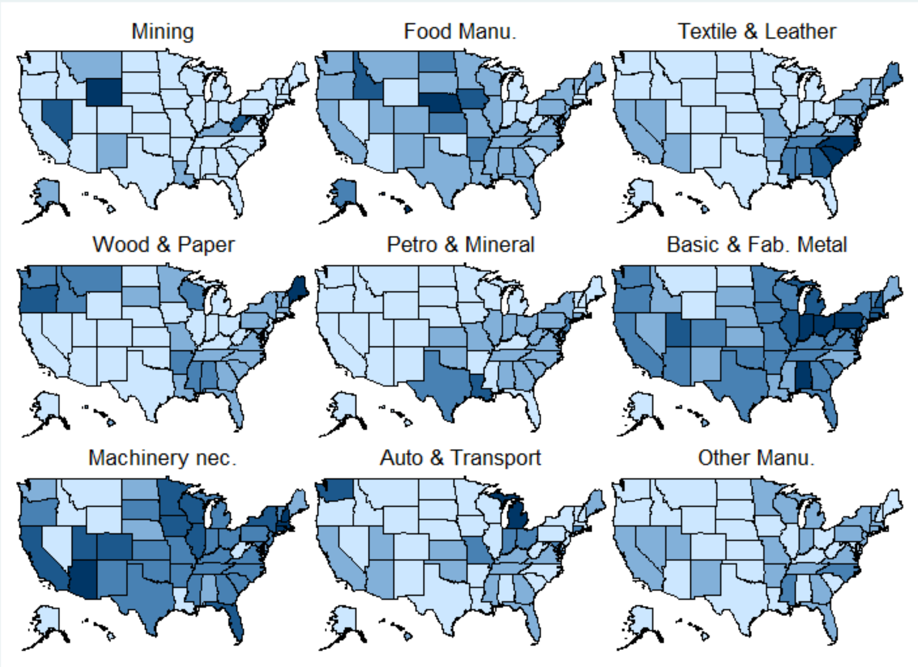
have higher welfare gains. This shows that initial industry composition is an important factor in determining welfare changes. Industrial real wages are determined by the extent of policy change interacted with the complex input output structure in the demand for final goods. Table 3 has the summary statistics for the industry-level real wage changes.

All industries except agriculture, food manufacturing and mining experience increased real wages on average. The negative real wage effects in the food industry for all US states is probably a result of the large increase in tariff rates between the US and Canada as opposed to the reduced tariffs in all other sectors. This in turn seems to have affected the real wages in the agriculture industry as well due to I-O linkages. The food manufacturing industry uses 30% of its intermediate inputs from the agricultural sector in the US ($\gamma_{US}^{Food,Agri}/(1-\gamma_{US}^{Food}) = 0.26/0.86 = 0.30$). Therefore, decreased production activity in the food industry leads to decreased demand for agricultural output leading to lower wages in that sector. On the other hand, we notice very high gains in the textile and leather industry (0.75% on average, with a maximum of 3.81%) as is expected from the large reductions in tariff rates in the industry. Elimination of high tariffs by Mexico in other manufacturing industries also has noticeable impacts on the respective real wages.

Figures 4 and 5 show the variation across states in the initial shares of sectoral wage income and changes in sectoral real wages, all divided into five equal intervals. Looking at the initial distribution of sectoral income gives a potential explanation for the variation in the welfare gains across states. For example, most of Wyoming's welfare gains seem to be drawn from the mining industry; Wyoming has the largest initial share of income in mining and also large real wage gains in mining. Those states with large industrial shares in food manufacturing that has negative real wages, like Nebraska, have low aggregate welfare gains.

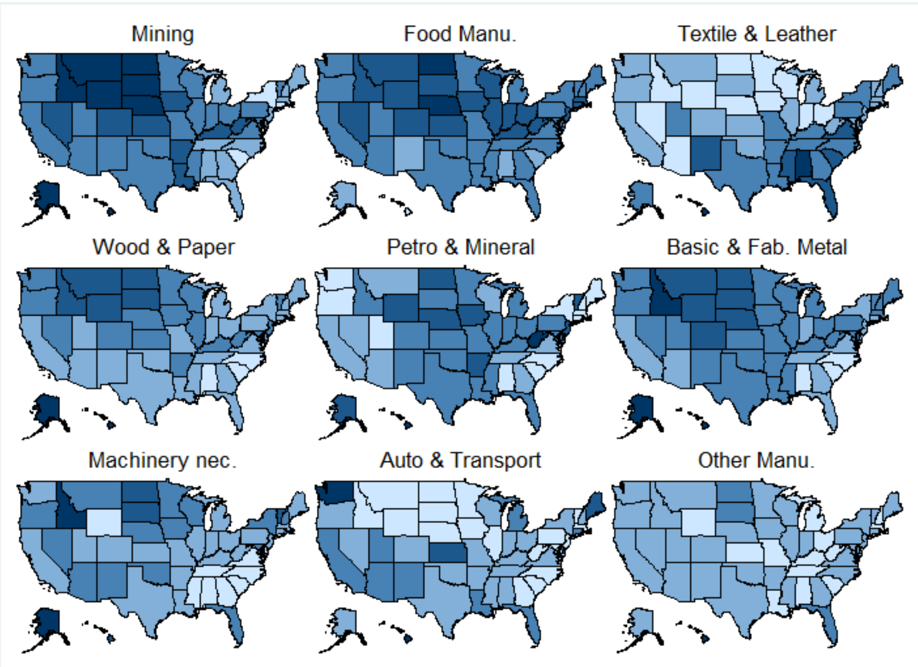
To understand the contribution of the complex I-O structure of the model, I also analyzed a simpler model with no I-O linkages. Specifically, I set the share of value added in the production function to 1 ($\gamma_n^j = 1$), and the share of all intermediate inputs to zero ($\gamma_n^{jk} = 0$). Welfare changes from such a model are much lower, in the range of 0.006% to 0.141% with an average of 0.073% (as opposed to 0.115% to 0.277% with an average of 0.163% for the I-O model). Figure 6 shows the difference in welfare gains from a model with I-O linkages and a model with only labor, thus showing the contribution of the I-O linkages to welfare. The difference is positive, and is the highest for those states that had the highest welfare gains previously, implying a magnifying effect of I-O linkages in production (correlation of 0.7).

Figure 4: Initial shares of sectoral wage income



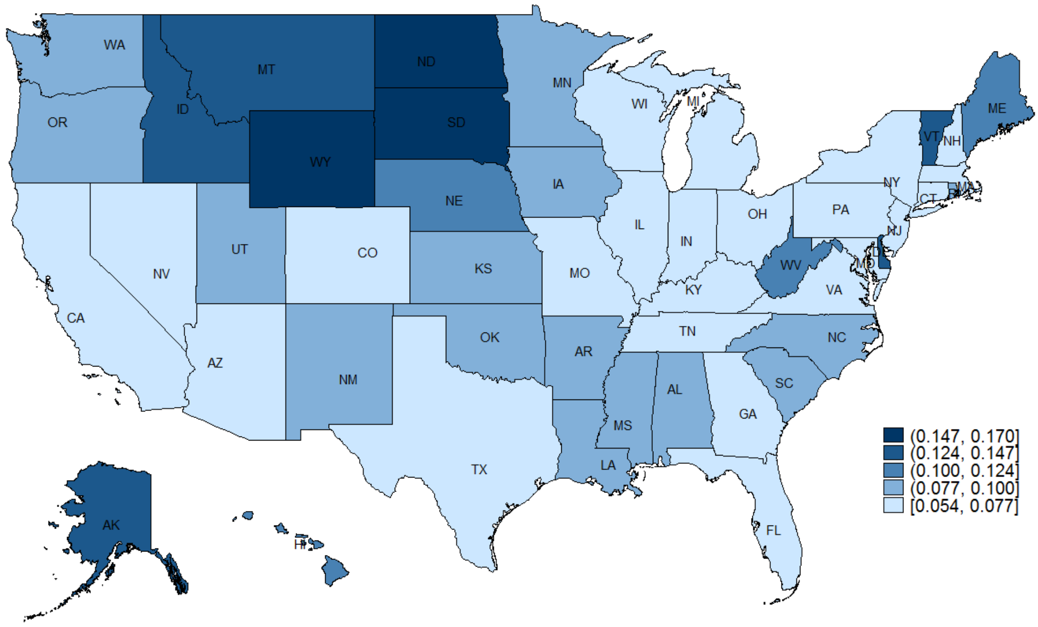
Notes: Each map depicts the initial shares of sectoral wage income divided into five equal intervals, with higher values taking a darker shade

Figure 5: Changes in sectoral real wages



Notes: Each map depicts the percentage changes in real wages across states divided into five equal intervals, with higher values taking a darker shade

Figure 6: Contribution of I-O linkages to Welfare



Notes: All values are in percentage changes divided into five equal intervals. Each value is the difference between welfare gains from the I-O model and welfare gains from the labor only model.

5.2 Politician preferences

This section presents the results of regressing politician votes on the bill passed in the House and the Senate for NAFTA on the welfare estimates from the previous section. Senators represent a state where as the house representatives represent districts within a state. There are mostly 2 senators per states and the number of house representatives vary from state to state; there are an average of 8.7 representatives from states ranging from 1 to 52. Note that the exercise in the previous section gives only state level welfare estimates, and not at the district level. These effects are an appropriate variable to use for the regressions on senators' votes, but not for the house representatives. A more appropriate variable would contain information on the impact of NAFTA at the district level. In order to get welfare estimates for districts I construct a weighted average of the respective state-level real wage changes using district-level industrial employment shares from County Business Patterns (CBP) for the year 1993 as weights.

I estimate a linear probability model, with the following baseline specification for the votes in senate:

$$V_{i,s}^{senate} = \alpha_0 + \alpha_1 Wel_s + \alpha_3 X_i + \epsilon_i \tag{14}$$

The specification used for the votes in the house is:

$$V_{i,d,s}^{house} = \beta_0 + \beta_1 Wel_{d,s} + \beta_3 X_i + \eta_i \tag{15}$$

where, $V_{i,s}^{senate}$ is the vote of senator i of state s in the senate and $V_{i,d,s}^{house}$ is the vote of representative i of district d in state s in the house, which takes value 1 if politician voted in favor of the NAFTA bill, Wel_s and $Wel_{d,s}$ are welfare variables for state s and district d in state s respectively as a result of NAFTA, and X_i is a set of covariates for individual i. Welfare variables (Wel) used in different specifications are explained below. Politician specific covariates (X_i) considered are: dummy variable for being a Republican (Rep_i), dummy for male (Male_i) and age (Age_i).

Table 4: Welfare variables used in different specifications

Variable	Description (all changes in %)
$\hat{W}$	Welfare (real income) change in aggregate
$\hat{w}^{j\max}$	Real wage change in the largest industry
$\hat{w}^{j\min}$	Real wage change in the smallest industry
$\hat{w}^{j\text{med}}$	Real wage change in the industry of the median voter
$\max \hat{w}^j$	Maximum of industrial real wage changes
$\min \hat{w}^j$	Minimum of industrial real wage changes
$\hat{W}^{\text{agri}}$	Welfare change in agricultural sector
$\hat{W}^{\text{manu}}$	Welfare change in manufacturing sector
$\hat{W}^{\text{ser}}$	Welfare change in service sector

Notes: All variables are constructed for states and districts

I run two sets of regressions; Tables 5 and 6 test for the effect of constituency-level aggregate welfare changes and it's distribution, and tables 7 and 8 test for the effect constituency-level aggregate sectoral welfare changes on the probability of the respective politician's probability of voting in favor of the trade bill. All regressions are linear probability models, and standard errors are clustered at the state level. The results do not change when I use probit and logit specifications. I report the probit estimates in the appendix.

Table 5: Senate: Aggregate welfare and Welfare distribution

	Dependent Variable: $V_{i,s}^{senate}$, OLS							
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\hat{W}$	0.117				1.731			0.089
	(1.147)				(2.401)			(1.292)
$\hat{w}^{j\max}$		0.406			-7.305			
		(2.431)			(11.00)			
$\hat{w}^{j\min}$			0.165**		0.140*			
			(0.066)		(0.083)			
$\hat{w}^{j\text{med}}$				1.553	7.617			
				(2.210)	(8.099)			
$\max \hat{w}^j$						-0.027		-0.031
						(0.082)		(0.090)
$\min \hat{w}^j$							-0.034	-0.053
							(0.378)	(0.440)
Indv. Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	99	99	99	99	99	99	99	99
R-squared	0.133	0.134	0.178	0.141	0.201	0.134	0.133	0.135

Notes: Linear Probability Models. Dependent variable is bi-variate. The set of Indv. Controls are Rep_i, $Male_i$ *and* Age_i*. Standard errors are clustered at the state level*

Table 6: House: Aggregate welfare and Welfare distribution

	Dependent Variable: $V_{i,d,s}^{house}$, OLS							
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\hat{W}$	-1.372				-0.500			-0.112
	(1.037)				(0.828)			(0.979)
$\hat{w}^{j\max}$		-1.728			-1.484			
		(1.494)			(1.399)			
$\hat{w}^{j\min}$			0.080**		0.069*			
			(0.036)		(0.038)			
$\hat{w}^{j\text{med}}$				0.096	0.375			
				(0.453)	(0.419)			
$\max \hat{w}^j$						-0.015		0.034
						(0.048)		(0.043)
$\min \hat{w}^j$							0.604***	0.646***
							(0.190)	(0.228)
Indv. Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	434	434	434	434	434	434	434	434
R-squared	0.135	0.136	0.140	0.130	0.146	0.130	0.156	0.157

Notes: Linear Probability Models. Dependent variable is bi-variate. The set of Indv. Controls are Rep_i, $Male_i$ *and* Age_i*. Standard errors are clustered at the state level*

Table 7: Senate: Aggregate sectoral welfare

	Dependent Variable: $V_{i,s}^{senate}$, OLS			
VARIABLES	(1)	(2)	(3)	(4)
$\hat{W}^{\text{agri}}$	-0.155			-0.153
	(0.224)			(0.314)
$\hat{W}^{\text{manu}}$		-0.201		-0.001
		(1.286)		(1.433)
$\hat{W}^{\text{ser}}$			1.064	0.024
			(2.448)	(3.284)
Indv. Controls	Yes	Yes	Yes	Yes
Observations	99	99	99	99
R-squared	0.139	0.133	0.136	0.139

Notes: Linear Probability Models. Dependent variable is bi-variate. The set of Indv. Controls are Rep_i, $Male_i$ and Age_i. Standard errors are clustered at the state level

Table 8: House: Aggregate sectoral welfare

	Dependent Variable: $V_{i,d,s}^{house}$, OLS			
VARIABLES	(1)	(2)	(3)	(4)
$\hat{W}^{\text{agri}}$	0.402**			0.370
	(0.171)			(0.247)
$\hat{W}^{\text{manu}}$		-0.164		-0.147
		(0.244)		(0.219)
$\hat{W}^{\text{ser}}$			-2.812*	-0.397
			(1.636)	(2.371)
Indv. Controls	Yes	Yes	Yes	Yes
Observations	434	434	434	434
R-squared	0.149	0.131	0.141	0.150

Notes: Linear Probability Models. Dependent variable is bi-variate. The set of Indv. Controls are Rep_i, $Male_i$ and Age_i. Standard errors are clustered at the state level

5.2.1 Aggregate welfare, Industry composition and Welfare distribution: Tables 5 and 6

Looking at the first set of regressions, there is no significant relationship between aggregate welfare and the probability of either senators or house representatives to vote in favor of the trade bill. It's possible that politicians are not concerned about aggregate gains of their constituency, but weigh different groups of voters differently or care about groups that may potentially lose due to the liberalization episode. One hypothesis is that the impact on the largest group of voters is more important than the impact on a smaller group. This makes sense since politicians also maximize their chances of getting re-elected, and should thus care about the gains or losses of their largest set of voters. Another hypothesis is that since most industries gain from liberalization, politicians care about the extent of losses in those industries that have negative welfare changes; in other words the distribution of the welfare gains and losses.

In order to test for the above hypotheses I look at the industrial composition of a politician's constituency (state/district). I construct changes in real wages for the largest ($\hat{w}^{j\max}$) and smallest ($\hat{w}^{j\min}$) industries in each state and district using initial labor compensation (wage income) for industry size. While the welfare gains in the largest industry do not seem to matter, those in the smallest industry have a significant positive effect on politician's voting behavior in both senate and house (columns 2 and 3). The regression estimates would lead one to believe that politician's care about the group of people whose labor compensation is small to begin with. This may suggest that politicians care about the group of workers that are poor to begin with, and the more this group gains, higher is the probability of voting in favor of liberalization. This effect remains even after controlling for aggregate welfare and welfare of the largest group (column 5). However, this may also be just a spurious correlation resulting from omitted variables.

I also test the median voter hypothesis by constructing the change in real wages of the industry that employs the median voter ($\hat{w}^{j\text{med}}$). From column 4 we see no effect of the median voter's welfare change on politician behavior. In columns 6, 7 and 8, I use the maximum and minimum real wage changes (max $\hat{w}^j$ and min $\hat{w}^j$) to check for the effect of welfare distribution on politician voting behavior. Neither variable have an impact on senator's voting behavior, but the minimum change variable has a positive and highly significant effect on the probability of voting in favor of the trade bill for house representatives. Note that the minimum real wage change for all regions are negative (food manufacturing industry has negative real wage changes for all states). This suggests that politicians try to minimize potential losses the liberalization episode may cause.

5.2.2 Aggregate sectoral welfare: Tables 7 and 8

It is possible that politicians care about the impact on certain sectors more than others irrespective of the region. To test this hypothesis, I construct the aggregate welfare changes for the agriculture ($\hat{W}^{\text{agri}}$), manufacturing ($\hat{W}^{\text{manu}}$) and service ($\hat{W}^{\text{ser}}$) sectors separately, which is just the weighted average of real wage changes in all industries that belong to a sector. Again I find no significant correlations between sectoral welfare changes and voting behavior.

6 Conclusion

This paper tries to analyze politician preferences for a particular trade policy, the North American Free Trade Agreement between the US, Canada and Mexico. Specifically, I try to test if predicted welfare estimates from a Ricardian based trade model can explain the observed variation in the politician votes on the trade bill. Using a multi-sector EK model with input-output linkages in production, I estimate the effect of NAFTA on the welfare of different states within the US. Though all states gain from NAFTA, some gain more that others. An analysis of these welfare estimates shows that changes in the tariff rates between the three countries interact with the initial industry composition and the complex I-O structure of the model to give rise to the predicted welfare. The model not only predicts substantial variation in welfare gains across states, but also variation in real wage changes across sectors within each state. I then regress politician roll call votes for the policy in question on these predicted welfare estimates to understand if policy makers internalize these effects of the policy before choosing to implement it or not.

There is no evidence that suggests that potential aggregate and sectoral welfare changes that result from the liberalization episode are significant determinants of politicians voting in favor or against the trade bill. On the other hand, there seems to be weak evidence that politicians have equity concerns, i.e. the potential distributional effects of the trade policy. This could mean two possibilities: 1) policy makers are forward looking and have a basic understanding of trade, but are more concerned about maximizing welfare of poorer groups of voters and minimizing losses in their constituencies rather than maximizing aggregate welfare, or 2) policy makers do not really understand how liberalization affects their constituencies and base their voting decisions on proxies that may or may not capture these effects and also have other personal and political considerations. Identifying and separating these two possibilities is the next step for future work on this paper.

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A Utility and Price Index

Agents in region n maximize utility ($U(C_n)$) subject to their budget constraint $\sum_{j=1}^{J} P_n^j C_n^j = I_n$. The FOC of this optimization problem, with λ as the lagrangian multiplier, is:

$$\frac{\alpha^j U(C_n)}{c_n^j} = \lambda P_n^j \implies c_n^j = \frac{U(C_n)}{\lambda} \frac{\alpha^j}{P_n^j}$$

Substituting into the utility function gives:

$$\lambda = \prod_{j=1}^{J} (P_n^j / \alpha^j)^{\alpha^j} = P_n$$

Using the FOC, and substituting into the budget constraint gives:

$$\sum_{j=1}^{J} P_n^j c_n^j = I_n = \frac{U_n}{\lambda} \implies U_n = \frac{I_n}{P_n}$$

B Unit Cost of Production

Lets drop all region and sector specific suffixes. Unit cost of producing an intermediate good produced in a region-sector with productivity level T, by a firm with idiosyncratic productivity level z is given by the following optimization problem:

$$\min_{h,l,\{M^k\}_{k=1}^{J}} wl + \sum_{k=1}^{J} P^k M^k$$
$$\text{s.t. } Y = z\,[Tl]^{\gamma} \prod_{k=1}^{J} \left[M^k\right]^{\gamma^k} = 1$$

From the FOCs, the following relative demand equations can be derived:

$$\frac{M^k}{l} = \frac{\gamma^k}{\gamma} \frac{w}{P^k} \quad \forall \;\; k$$

Substituting the above into the unit output constraint, we get:

$$\frac{wl}{\gamma} = \frac{1}{zT^\gamma} \frac{[w]^\gamma \prod_{k=1}^J \left[P^k\right]^{\gamma^k}}{[\gamma]^\gamma \prod_{k=1}^J [\gamma^k]^{\gamma^k}}$$
$$\implies \frac{wl}{\gamma} = \frac{x}{zT^\gamma}$$

Substituting the relative demand equations into the cost function,

$$\begin{aligned} wl + \sum_{k=1}^J P^k M^k &= wl + \sum_{k=1}^J \gamma^k \frac{wl}{\gamma} \\ &= wl + \frac{1-\gamma}{\gamma} wl \\ &= \frac{wl}{\gamma} \\ &= \frac{x}{zT^\gamma} \end{aligned}$$

C Final Good Production

C.1 Demand for Intermediates

Given cost of inputs, $p_n^j(z^j)$, and price for final good, P_n^j, the optimization problem of the firm is given by:

$$\max_{\tilde{q}_n^j(z^j)} \; P_n^j Q_n^j - \int p_n^j(z^j) \tilde{q}_n^j(z^j) \phi^j(z^j) dz^j$$
$$\text{where,} \;\; Q_n^j = \left[\int \tilde{q}_n^j(z^j)^{1-1/\eta_n^j} \phi^j(z^j) dz^j\right]^{\eta_n^j/(\eta_n^j - 1)}$$

The FOC for the above is:

$$P_n^j \left[Q_n^j\right]^{1/\eta_n^j} \left[\tilde{q}_n^j(z^j)\right]^{-1/\eta_n^j} = p_n^j(z^j)$$
$$\implies \tilde{q}_n^j(z^j) = \left[\frac{p_n^j(z^j)}{P_n^j}\right]^{-\eta_n^j} Q_n^j$$

C.2 Unit Cost of Final Good

The unit cost of producing a final good in (n, j) is given by the following optimization problem:

$$\min_{\tilde{q}_n^j(z^j)} \int p_n^j(z^j)\tilde{q}_n^j(z^j)\phi^j(z^j)dz^j$$
$$\text{s.t.} \quad Q_n^j = \left[\int \tilde{q}_n^j(z^j)^{1-1/\eta_n^j}\phi^j(z^j)dz^j\right]^{\eta_n^j/(\eta_n^j-1)} = 1$$

The FOC, with λ as the Lagrangian multiplier, is,

$$p_n^j(z^j) = \lambda\left[\tilde{q}_n^j(z^j)\right]^{-1/\eta_n^j}$$
$$\implies \quad p_n^j(z^j)\tilde{q}_n^j(z^j) = \lambda\tilde{q}_n^j(z^j)^{1-1/\eta_n^j}$$

Substituting the above into the unit output constraint shows that λ is the unit cost.

$$\int p_n^j(z^j)\tilde{q}_n^j(z^j)\phi^j(z^j)dz^j = \lambda\int \tilde{q}_n^j(z^j)^{1-1/\eta_n^j}\phi^j(z^j)dz^j = \lambda Q_n^j = \lambda$$

The FOC also gives the demand function in terms of $p_n^j(z^j)$ and λ, which can be substituted into the cost function to derive the form of λ.

$$\tilde{q}_n^j(z^j) = \left[\frac{p_n^j(z^j)}{\lambda}\right]^{-\eta_n^j}$$
$$\implies \lambda = \int p_n^j(z^j)\tilde{q}_n^j(z^j)\phi^j(z^j)dz^j = \frac{1}{\lambda^{-\eta_n^j}}\int p_n^j(z^j)\left[p_n^j(z^j)\right]^{-\eta_n^j}\phi^j(z^j)dz^j$$
$$\implies \lambda^{1-\eta_n^j} = \int p_n^j(z^j)^{1-\eta_n^j}\phi^j(z^j)dz^j$$

Thus, unit cost of producing the final good is given by:

$$\lambda = \left[\int p_n^j(z^j)^{1-\eta_n^j}\phi^j(z^j)dz^j\right]^{1/(1-\eta_n^j)}$$

C.3 Distribution of Intermediate Goods Prices

Given that idiosyncratic productivities are drawn from a Fréchet distribution, we can derive the distribution of the prices of intermediate goods in sector j that region i presents to region n as, $(p^j_{ni} \sim G^j_{ni})$, where

$$G^j_{ni}(p) = 1 - \exp\left(- \left[\kappa^j_{ni} x^j_i\right]^{-\theta^j} \left[T^j_i\right]^{\theta^j \gamma^j_i} p^{\theta^j} \right) = Prob\left(p^j_{ni} \leq p\right)$$

Then, the distribution of the lowest price of sector j's intermediate goods in region n is given by $p^j_n \sim G^j_n$, which is derived as the probability that some region's offered price is lower than p. That is, $p^j_{ni} \leq p$ for some i.

$$\begin{aligned}
G^j_n(p) = 1 - \prod_{i=1}^{N} \left(1 - G^j_{ni}(p)\right) = Prob\left(p^j_n \leq p\right) \\
\implies G^j_n(p) = 1 - \prod_{i=1}^{N} \exp\left(- \left[\kappa^j_{ni} x^j_i\right]^{-\theta^j} \left[T^j_i\right]^{\theta^j \gamma^j_i} p^{\theta^j} \right) \\
\implies G^j_n(p) = 1 - \exp\left(\sum_{i=1}^{N} \left[\kappa^j_{ni} x^j_i\right]^{-\theta^j} \left[T^j_i\right]^{\theta^j \gamma^j_i} p^{\theta^j} \right) \\
\implies G^j_n(p) = 1 - \exp\left(-\Phi^j_n p^{\theta^j} \right)
\end{aligned}$$

G^j_n is the distribution of intermediate goods prices that (n, j) faces.

C.4 Final Good Prices

Using above distribution of intermediate goods and the final good price integral, we get:

$$\begin{aligned}
P^j_n = \left(\int p^{1-\eta^j_n} dG^j_n(p) \right)^{1/(1-\eta^j_n)} \\
\implies P^j_n = \left(\int \left[\Phi^j_n\right]^{(\eta^j_n - 1)/\theta^j} t^{(1-\eta^j_n)/\theta^j} \exp(-t) dt \right)^{1/(1-\eta^j_n)} \\
\implies P^j_n = \Gamma(\psi^j_n)^{1/(1-\eta^j_n)} \left[\Phi^j_n\right]^{-1/\theta^j}
\end{aligned}$$

where $\psi^j_n = 1 + (1 - \eta^j_n)/\theta^j$. The second step is derived by making the following substitution: $\Phi^j_n p^{\theta^j} = t$.

C.5 Trade Flows

The share of region n's expenditure on sector j's intermediate goods that is purchased from region i, can be derived as the probability that region i's offered price is the minimum among the vector of prices that region n faces.

$$
\begin{aligned}
\pi_{ni}^j &= Prob\left(\min_m \left\{p_{nm}^j\right\} = p_{ni}^j\right) \\
\implies \pi_{ni}^j &= \int Prob\left(p_{ni}^j = p\right) \prod_{m \neq i} Prob\left(p_{nm}^j > p\right) dp \\
\implies \pi_{ni}^j &= \int \prod_{m \neq i} \left(1 - G_{nm}^j(p)\right) dG_{ni}^j(p) \\
\implies \pi_{ni}^j &= \frac{\left[x_i^j \kappa_{ni}^j\right]^{-\theta^j} \left[T_i^j\right]^{\theta^j \gamma_i^j}}{\Phi_n^j}
\end{aligned}
$$

D Data

D.1 International trade flows and Production data

The main feature of the model I am trying to analyze is the input-output linkages and a rich dataset is required to carry out the exercise. The base year is 1993, the year before NAFTA came into force. Trade flows and I-O data is obtained from EORA Multi-Region Input-Output (MRIO) database for the year 1993. This dataset contains 189 countries including a constructed rest of the world and 26 sectors including all agriculture, manufacturing and service sectors. Input-output tables from individual countries are used to construct this world input-output table. From this table, I calculate bilateral trade flows between the 40 countries in my sample (including Canada and Mexico) and the US, X_{ni}^j for each sector. Note that in order to carry out the analysis at the US state level, trade flows data into and out of US states is required and not US as a whole.

Gross output in each sector and country is also calculated from the table, and shares of value added γ_n^j and material inputs γ_n^{jk} are subsequently calculated using the same data source.

D.2 US domestic trade flows and Production data

From the input output tables, I calculate the domestic expenditure for the US, $X^j_{US,US}$, in each sector. From this the sectoral bilateral trade flows across all US states are calculated by using the 1993 Commodity Flow Survey (CFS). The CFS contains national and state-level data on domestic freight shipments by American establishments in mining, manufacturing, wholesale, auxiliaries, and selected retail and services trade industries. Using this data, expenditure shares of each state in each sector is first calculated and multiplied by the US domestic sectoral expenditure to get sectoral expenditure on each state on goods from across all US states. Again using CFS, I calculate how much of this expenditure is spent on goods coming from each of the 50 US states, by using bilateral trade shares between states from the CFS data. Note that this gives only the trade flows across US states and not the bilateral trade flows between the states and other countries.

I assume all regions within the US have the same production function, i.e. the same values for γ^j_n and γ^{jk}_n. I use the values calculated from the MRIO dataset for the US.

D.3 Trade flows between US states and other countries

Each state within the US has different exposure to international markets as they differ in industrial specialization. States that are specialized in a certain sector would be more involved in the export of those goods to other countries, and imports of the goods that are used as material inputs to that sector. The trade flows data between states and other coutries are calculated based on this assumption. For exports, the share of each state's employment in a given sector is multiplied by the total US exports to other countries, i.e. $X^j_{mn}(L^j_n/L^j_{US})X^j_{m,US}$, where n is US state and m is other country.

For imports, I use the input output structure of each labor market. Since goods coming into a region are used as material inputs in other sectors and consumption purposes, I multiply US imports from other countries into different sectors by the share of each states employment in that sector, $X^j_{nm} = \sum_{k=1}^{J}(L^k_n/L^k_n)X^{k,j}_{US,m}$

D.4 Bilateral trade shares

Having obtained bilateral trade flows, $X^j_{n,i}$, for all regions and sectors in my sample, trade shares are calculated as, $\pi^j_{n,i} = X^j_{n,i}/\sum_{m=1}^{N} X^j_{n,m}$.

D.5 Gross Output and Labor compensation

Using sectoral expenditure data, $X^j_{n,i}$ calculated as explained above, I calculate gross output data of each region-sector as follows: $GO^j_n = \sum_{m=1}^{N} X^j_{m,n}$. Using the share of value added and share of labor compensation in value added data from the MRIO table, I calculate labor compensation as, $w^j_n L^j_n = \gamma^j_n(1-\xi^j_n)GO^j_n$.

D.6 Tariff Data

The first policy counterfactual exercise I carry out keeps tariff levels constant between all countries other than NAFTA members (USA, Canada and Mexico). Tariff data before and after NAFTA is taken from World Integrated Trade Solutions (WITS) using the UNCTAD Trade Analysis Information System (TRAINS) database. Data for 1993 is used for before NAFTA levels except for Mexico as an importer, for which data for the year 1991 is used. After NAFTA levels data is taken for the year 2005 for all these countries. From this the relative changes in tariff levels are calculated, $\hat{\kappa}^j_{n,i} = (\kappa^j_{n,i})_{2005}/(\kappa^j_{n,i})_{1993}$.

D.7 Countries and Sectors

The set of countries considered in the analysis is: Australia, Austria, Belgium, Bulgaria, Brazil, Canada, China, Cyprus, Czech Republic, Germany, Denmark, Spain, Estonia, Finland, France, United Kingdom, Greece, Hungary, Indonesia, India, Ireland, Italy, Japan, South Korea, Lithuania, Luxembourg, Latvia, Mexico, Malta, Netherlands, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, Sweden, Turkey, Taiwan and a constructed rest of the world (ROW). The following table gives the details on the aggregated sectors used:

Table 9: Sectors

Sector	Name	NAICS 2002
J01	Agriculture	11
J02	Mining	21
J03	Food Manufacturing	311-312
J04	Textile & Leather	313-316
J05	Wood & Paper	321-323, 511
J06	Petrol & Mineral	324-327
J07	Basic & Fab. Metal	331-332
J08	Machinery nec.	333-335, 3391
J09	Auto & Transport	336
J10	Other Manufacturing	337, 339
J11	Utilities	22
J12	Construction	23
J13	Wholesale & Retail Trade	42, 44-45
J14	Accomodation & Food Services	72
J15	Transport Services, Warehousing & Storage	481-488, 493
J16	Post & Telecom	491-492, 515, 517
J17	Finance and Insurance, Real Estate & other Business Activities	516, 618, 52-55, 561
J18	Education, Health & Other Services	512, 562, 61-62, 71, 81

E Country level Welfare changes

Table 10: Country Level Welfare Changes

Country	Welfare	Country	Welfare
Australia	0.002%	Ireland	0.017%
Austria	0.003%	Italy	-0.006%
Belgium	-0.001%	Japan	-0.004%
Bulgaria	0.100%	South Korea	-0.018%
Brazil	-0.004%	Lithuania	0.250%
Canada	0.345%	Luxembourg	0.116%
China	-0.004%	Latvia	0.372%
Cyprus	0.248%	Mexico	1.405%
Czech Republic	0.021%	Malta	0.632%
Germany	-0.004%	Netherlands	-0.004%
Denmark	0.007%	Poland	0.011%
Spain	-0.005%	Portugal	0.015%
Estonia	0.436%	Romania	0.035%
Finland	0.009%	Russia	0.004%
France	-0.003%	Slovakia	0.062%
UK	-0.006%	Slovenia	0.084%
Greece	0.014%	Sweden	-0.001%
Hungary	0.032%	Turkey	0.001%
Indonesia	0.001%	Taiwan	-0.010%
India	-0.002%	ROW	-0.008%

F Probit regression

Table 11: Senate: Aggregate welfare and Welfare distribution

	Dependent Variable: $V_{i,s}^{senate}$, Probit							
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\hat{W}$	0.041				4.375			-0.116
	(3.394)				(7.578)			(3.692)
$\hat{w}^{j\max}$		0.968			-18.52			
		(6.722)			(31.34)			
$\hat{w}^{j\min}$			0.653**		0.673*			
			(0.302)		(0.375)			
$\hat{w}^{j\text{med}}$				4.384	21.81			
				(6.077)	(23.50)			
max $\hat{w}^j$						-0.088		-0.099
						(0.239)		(0.255)
min $\hat{w}^j$							-0.125	-0.215
							(1.019)	(1.151)
Indv. Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	99	99	99	99	99	99	99	99

Notes: Marginal effects from probit models. Dependent variable is bi-variate. The set of Indv. Controls are Rep_i, $Male_i$ and Age_i. Standard errors are clustered at the state level

Table 12: House: Aggregate welfare and Welfare distribution

	Dependent Variable: $V_{i,d,s}^{house}$, Probit							
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\hat{W}$	-3.777				-1.399			-0.312
	(2.897)				(2.263)			(2.698)
$\hat{w}^{j\max}$		-4.633			-3.932			
		(3.946)			(3.575)			
$\hat{w}^{j\min}$			0.238**		0.203*			
			(0.114)		(0.116)			
$\hat{w}^{j\text{med}}$				0.249	0.995			
				(1.216)	(1.149)			
max $\hat{w}^j$						-0.048		0.088
						(0.134)		(0.123)
min $\hat{w}^j$							1.777***	1.886***
							(0.593)	(0.699)
Indv. Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	434	434	434	434	434	434	434	434

Notes: Marginal effects from probit models. Dependent variable is bi-variate. The set of Indv. Controls are Rep_i, $Male_i$ and Age_i. Standard errors are clustered at the state level

Table 13: Senate: Aggregate sectoral welfare

	Dependent Variable: $V_{i,s}^{senate}$, Probit			
VARIABLES	(1)	(2)	(3)	(4)
$\hat{W}^{\text{agri}}$	-0.470			-0.485
	(0.624)			(0.896)
$\hat{W}^{\text{manu}}$		-0.971		-0.330
		(3.602)		(4.058)
$\hat{W}^{\text{ser}}$			2.873	-0.428
			(6.697)	(9.300)
Indv. Controls	Yes	Yes	Yes	Yes
Observations	99	99	99	99

Notes: Marginal effects from probit models. Dependent variable is bi-variate. The set of Indv. Controls are Rep_i, $Male_i$ and Age_i. Standard errors are clustered at the state level

Table 14: House: Aggregate sectoral welfare

	Dependent Variable: $V_{i,d,s}^{house}$, Probit			
VARIABLES	(1)	(2)	(3)	(4)
$\hat{W}^{\text{agri}}$	1.155**			1.071
	(0.520)			(0.740)
$\hat{W}^{\text{manu}}$		-0.435		-0.411
		(0.664)		(0.612)
$\hat{W}^{\text{ser}}$			-7.978*	-1.072
			(4.734)	(6.847)
Indv. Controls	Yes	Yes	Yes	Yes
Observations	434	434	434	434

Notes: Marginal effects from probit models. Dependent variable is bi-variate. The set of Indv. Controls are Rep_i, $Male_i$ and Age_i. Standard errors are clustered at the state level