# U.S. Employment Exposure to Agricultural Trade Policy

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**Abstract**

Literature examining the effects of changes in trade agreements and import competition on U.S. employment and wages has focused primarily on non-farm industries. We propose a method for measuring worker exposure to changes in agricultural tariffs using a newly developed county-level dataset of employment shares by crop and livestock type. These detailed data permit investigation of crop-, livestock-, and non-farm product-specific natural and market-driven shocks on employment and wage outcomes across U.S. counties. We apply the method to examine the spatial concentration of U.S. county-level employment-weighted exposure to changes in tariffs caused by the North American Free Trade Agreement (NAFTA).

## Introduction

There is renewed demand for economists to examine the efficiency and distributional implications of trade policies on labor markets and local economies. Globally, barriers to trade increased in recent years (Constantinescu et al., 2019). This includes increased tariffs from trade wars and barriers to the movement of people and goods implemented in response to Covid-19 (Beckman and Countryman, 2021; Beckman, Baquedano, and Countryman, 2021; World Trade Organization, 2020). Previous literature examines the effects of trade liberalization on employment and wages in non-farm industries of the United States (Autor, Dorn, and Hanson, 2013; Autor et al., 2014; Hakobyan and McLaren, 2016). However, the lack of detailed analysis of agricultural sectors from this literature has important implications, especially for rural communities where agricultural exports are a significant source of income. This paper proposes a method for measuring worker exposure to changes in agricultural tariffs using a newly developed county-level dataset of employment shares by crop and livestock type. We use this novel dataset to examine US worker exposure to domestic and foreign import tariff changes that resulted from NAFTA. We differentiate crop, livestock, and non-agricultural tariff changes and compare the magnitude of the employment-weighted changes across these sectors. Finally, we illustrate the spatial distribution of U.S. worker exposure to changes in both agricultural and non-agricultural tariffs.

Neoclassical economic theory implies that labor will migrate across industries in response to trade liberalization, from industries or locations where the country does not have a comparative advantage to industries or locations where the country does. However, empirical studies show that there are high frictions to labor mobility following changes in trade policy or exposure to import competition (Autor, Dorn, and Hanson, 2013; Autor et al., 2014; Dix-Carneiro and Kovak, 2015, 2017; Hakobyan and McLaren, 2016; Topalova, 2007, 2010). Autor et al. (2014) find heterogeneous effects of import competition on worker mobility in the United States across workers' initial skills and wages. Low-wage workers initially employed in industries that experienced high import competition tended to migrate to firms within the same sector, thus experiencing multiple employment disruptions as import competition increased over time. In contrast, high-wage workers were better able to migrate to higher performing industries over the long run, experienced greater wage growth, and were less likely to take public disability benefits than low-wage workers. These findings show that trade liberalization can sometimes exacerbate economic inequalities. Furthermore, labor market impacts of trade policies can be persistent. Wages and formal sector employment were still depressed in industries and locations exposed to greater import competition more than 20 years after Brazil cut import tariffs in a large-scale trade liberalization effort (Dix-Carneiro and Kovak, 2017). Additional research to understand how trade liberalization or protectionist policies affect labor markets in urban and rural communities across agricultural and non-agricultural sectors is imperative for informing policy, enhancing labor market opportunities, and anticipating changes in labor migration.

Previous literature examining the effects of NAFTA on worker wages in the United States shows that NAFTA depressed the wages in industries that experienced large declines in tariff protection from 1990-2000. Service sector workers also had depressed wages if they were employed in locations where a large share of the workforce in 1990 was employed in industries that had large declines in U.S. import tariffs during the roll-out of NAFTA (Hakobyan and McLaren, 2016). However, the agricultural sector was deliberately excluded from Hakobyan and McLaren (2016)'s analysis due to lack of detailed data on labor employment by crop and location. While their findings are robust to the inclusion of the aggregate agricultural industry, agricultural tariffs changed substantially during NAFTA and this may have had unintended consequences across agricultural sectors. Canned, Frozen, and Preserved Fruits and Vegetables was the third most protected industry in the United States in 1990. After adjusting for Mexico's Revealed Comparative Advantage[1] in production of goods in each industry, it is only the fifth most protected industry, and Agricultural Crop Production is the eighth most protected industry (Hakobyan and McLaren, 2016). In rural communities, where agriculture is a more dominant employer, changes in agricultural tariffs could have important labor market implications that are not fully understood when only controlling for effects of aggregate agricultural labor exposure to tariffs that mask variation in labor intensity across individual crops and livestock. Additionally, the labor market effects of changes in foreign import tariffs should also be examined since these might benefit workers in corresponding sectors.

Little research has been devoted to understanding the effects of trade liberalization on employment and wages in rural communities of developed countries with a large agricultural presence. One notable exception is Autor et al. (2024), who show that Chinese import tariffs imposed on U.S. agricultural goods during the 2018-2019 trade war nega-

[1] Mexico's Revealed Comparative Advantage is Mexico's share of trade with the rest of the world in the select industry divided by Mexico's share of trade with the rest of the world in all goods. A Revealed Comparative Advantage greater than 1 means that Mexico exports more of the good than the average product (Hakobyan and McLaren, 2016).

tively affected U.S. agricultural employment while U.S. worker exposure to U.S. import tariffs on non-farm goods had no sizeable effect. The authors measure U.S. employment by sector using 6-digit North American Industry Classification System (NAICS) codes in the Quarterly Census of Employment and Wages (QCEW) and impute employment by sector and commuting zones using higher aggregations of industries or geographic locations when the QCEW data are suppressed. We provide an alternative method to measuring crop- and livestock-specific employment exposure to both domestic and foreign tariffs at detailed geographic levels that leverages the use of more detailed crop specifications in the U.S. Census of Agriculture. Since our data include crop employment at a more detailed level than the QCEW, we will be able to use these data to answer a wider variety of economic questions.

We create a unique dataset that combines trade data detailed to the 6-digit Harmonized System (HS) product code with county-level acreage and production data for specific crops and livestock in the U.S. Census of Agriculture, labor inputs by crop from Crop Enterprise Budgets, and wage and employment data from the Quarterly Census of Employment and Wages (QCEW). We measure county employment exposure to changes in tariffs using methods similar to Topalova (2007) and Topalova (2010), additionally weighting tariffs by the trading partner's Revealed Comparative Advantage (RCA) as in Hakobyan and McLaren (2016). We show that the decrease in U.S. tariff protection under NAFTA was much smaller in magnitude than the decrease in tariffs that Canada and Mexico imposed on imports of U.S. crops and livestock. Furthermore, the decrease in Mexican import tariffs on crops and livestock was larger in magnitude than its decrease in non-farm import tariffs. There was little change in Canadian import tariffs on U.S. crops and non-farm goods, but Canada reduced import tariffs on U.S. livestock substantially. Further, we find that U.S. tariffs on Mexican and Canadian agricultural goods declined more than those on non-farm goods during NAFTA. Finally, we show that the employment weighted workforce exposure to reduced foreign import tariffs on U.S. crops was larger in magnitude than changes in workforce exposure to reductions in U.S. or foreign import tariffs on non-farm goods following the roll-out of NAFTA for numerous counties. The geographic spread and magnitude of changes in worker exposure to foreign import tariffs on U.S. goods varied substantially across crops, livestock, and non-farm goods. Our findings illustrate the importance of investigating labor market exposure to tariffs changes in all of these sectors distinctly.

Our focus on the agricultural sector is an important distinction from previous literature since the United States was a net exporter of agricultural products during the roll-out of NAFTA, and employment and wages in agricultural communities might benefit from reduced tariffs on U.S. goods even as employment and wages declined in non-farm industries that were exposed to more foreign competition. Empirical investigation that accounts for changes in workforce exposure to U.S. and foreign import tariffs is necessary to understand the full implications of trade agreements like NAFTA. Our findings suggest that the effects might be more complex than previous literature implies, and therefore merit further exploration.

This paper proceeds as follows. In the next section, we review the relevant literature. Next, we describe the data. In the following section, we calculate county employment exposure to domestic and foreign tariffs. Then we illustrate spatial variation in changes in county exposure to domestic and foreign import tariffs by sector during NAFTA implementation. We discuss potential implications of sector-specific exposure to trade policies on labor markets, and lastly, we conclude.

## Related Literature

This section knits together literature on the distinct characteristics of agricultural and rural labor markets in the United States, the labor market effects of domestic and foreign policy changes, and the medium- to long-term effects of NAFTA and other trade agreements. Although it is well understood that NAFTA had important implications for the U.S. agricultural sector (Zahniser et al., 2015; Zahniser and Link, 2002; Zhao, Devadoss, and Luckstead, 2020), we know of no other analyses that measure worker exposure to changes in foreign and domestic import tariffs during NAFTA using detailed employment data disaggregated across space (by county) and by crop and livestock types. Autor et al.

(2024) show that the agricultural sector's exposure to changes in foreign import tariffs can have important implications for rural employment. Detailed measures of employment by crop type are essential for careful analysis of labor market effects of trade policies. We build on this literature by proposing a unique method for calculating a proxy of employment shares by detailed crop type at the county level. Not only do our data disaggregate employment by specific crops, but we also assign employees of farm labor contractors (FLCs) to specific crops so that we can measure FLC employment exposure to changes in trade policies as well. Since FLCs account for more than 14% of the crop workforce and are the fastest growing share of farm workers, it is important to include FLC workers in the analysis (Costa and Martin, 2020).

Agricultural and rural labor markets are distinct from those in metro areas of the United States, and changes in employment opportunities can have a myriad of consequences that are difficult to predict. For example, decreased employment and wages are associated with increased opioid overdoses within metro and non-metro counties of the United States. Betz and Jones (2018) find differential effects by skill level, gender, and race, which suggests that both the number and types of jobs available in a region are important. Agricultural employment has also been shown to have important implications for other social welfare outcomes. Increased seasonal fruit, vegetable, and horticultural employment within U.S. counties is associated with a significant decrease in property crime rates, even after controlling for county-by-year fixed effects (Charlton, James, and Smith, 2022). Increased economic opportunities likely deter crime during labor-intensive seasons of farm production, even if more people migrate into the region. These findings demonstrate the necessity of understanding how domestic and foreign policies impact rural and urban labor markets and sector-specific employment and wage effects.

Agricultural labor markets are distinct from other sectors, and overall employment rates often mask important distinctions in agricultural labor markets. Agricultural labor markets have important location and time dimensions, which are often determined by conditions like weather (Fisher and Knutson, 2013). Farmers must have sufficient workers during critical seasons like harvest, and workers must have access to sufficient work hours to sustain them year-round. Imbalances in either farm labor supply or demand are costly. Localized labor shortages frequently occur when there are insufficient workers with required skills, domestic workers are unwilling to perform the tasks, or workers from outside the region are unwilling or unable to migrate to the place of work (Fisher and Knutson, 2013). Farm workers have become less migratory over time (Fan et al., 2015), which likely increases the incidence of localized farm labor shortages. Fan et al. (2015) find that from 1999-2009, the share of crop workers who migrated decreased by more than 60%. These trends have important implications for the ability of farm labor markets to adjust quickly and smoothly to changes in labor demand such as following changes in foreign and domestic trade policies. Although detailed data on crop-specific employment are sparse, research on farm labor markets needs to account for important variation across crops and geographic space. The use of farm labor contractors to match workers to temporary or seasonal jobs is relatively common in California and Florida where labor-intensive specialty crops are grown in greater concentrations, but less common in other regions of the United States (Fisher and Knutson, 2013).

There is evidence that farm workers do not immediately migrate to other sectors as relative wages in other sectors rise, consistent with the notion that workers associate an option value with remaining in their current sector of work (Önel and Goodwin, 2014). However, Richards and Patterson (1998) show that workers migrate more rapidly from farm to non-farm sectors than the reverse. Immigration is also key to understanding farm labor supply and demand. Martin and Taylor (2003) found a circular relationship between farm employment and immigration within U.S. counties from 1970-1990, each reinforcing the other. In 1980, increased farm employment was associated with a decrease in county-level poverty. However, in 1990, as families more frequently began joining immigrant farm workers in the United States, farm employment was associated with an increase in poverty rates. Following NAFTA, analysis of household survey data nationally representative of rural Mexico indicates that migration from rural Mexico to U.S. farms increased (Boucher et al., 2007), but there has been little investigation of the effects of NAFTA on rural employment and wages in the United States or agricultural worker exposure to changes in foreign and domestic tariffs.

While several studies investigate the effects of import competition on U.S. employment, it is important to consider both worker exposure to domestic import tariffs and exposure to foreign import tariffs levied on U.S. exports. Feenstra, Ma, and Xu (2019) investigate overall state-level employment effects of import competition from China and find that export expansion creates employment opportunities that offset jobs lost in import-competing industries. However, Autor, Dorn, and Hanson (2016) and Kondo (2018) find unequal distribution of employment effects with workers in import-competing industries more negatively impacted than the positive employment effects for workers in export-oriented industries. While these studies provide insights into overall employment effects of trade exposure, agriculture is either not accounted for or is aggregated into one combined employment sector. Furthermore, studies show that NAFTA-related tariff reform for agricultural products led to trade creation that exceeds trade diversion (Kennedy and Rosson, 2002; Burfisher, Robinson, and Thierfelder, 2001), highlighting the need to explicitly account for changes in agricultural and non-agricultural tariffs faced by both U.S. imports and exports when considering rural employment exposure to trade protection.

Given the unique features of U.S. farm labor markets, NAFTA likely had distinct effects on employment and wages that vary across U.S. crops and regions of employment. Studies that aggregate agricultural employment mask this variation (see for example, Hakobyan and McLaren (2016)). Furthermore, research that accounts for the effects of improved access to foreign markets through the reduction of foreign import tariffs on U.S. goods is also essential. We are aware of some papers that measure the effects of U.S. tariff changes on employment and wages in Canada and Mexico using detailed geographic employment data (Chiquiar, 2008; Feliciano, 2001; Kovak and Morrow, 2022). However, literature measuring the effects of changes in foreign import tariffs on U.S. employment during NAFTA do not closely examine spatial variation in labor market exposure (Hakobyan and McLaren, 2016).

## Data

We create a unique dataset of county-level tariff exposure. We combine data from the World Integrated Trade Solution (WITS) database, the U.S. Agricultural Census, the Bureau of Labor Statistics Quarterly Census of Employment and Wages (QCEW), and farm-level crop enterprise budgets published by various U.S. universities. We create the first national dataset to our knowledge with county labor employment shares by individual crops, and we combine this with labor shares in non-farm and livestock products, and U.S., Canadian, and Mexican import tariffs by product and year.

### Trade and Tariff Data Construction

We obtain trade and tariff data from the WITS database, which accesses major international trade databases—the United Nations (UN) Comtrade database for trade and the United Nations Conference on Trade and Development (UNCTAD) Trade Analysis Information System (TRAINS) database for tariffs. From the WITS database, we derive annual bilateral trade flow at the Harmonized System (HS) 6 product level from 1993 to 2010. We use the HS6 product code level because we can more precisely match tariffs to specific crops and livestock. We use bilateral import and export trade values in nominal US dollars from Canada, Mexico, the U.S., and the rest of the World. We examine bilaterally applied import tariffs at the HS6 level, which we merge with trade flows. We focus on changes in employment weighted import tariff exposure by U.S. county from 1996 (pre-NAFTA) to 2006 (post-NAFTA), since the WITS data appear more complete in 1996 than in previous years (data are sparse prior to 1996 (see figures 1-2)), and there was little change in applied import tariff rates between the U.S., Canada, and Mexico after 2006.

Before examining the spatial distribution of labor's exposure to tariff changes, we explore change in tariff rates on average over time. To do this, we weight import tariffs by the comparative advantage of the trading partners to place greater weight on tariffs of goods that the trading partner specializes in exporting. We do this using the Revealed Comparative Advantage (RCA) as in Hakobyan and McLaren (2016). The RCA is a measure of how much a country exports a good relative to total world exports of that good as a share of the country's share of total world exports in all goods. Specifically, let $k \in 1, ..., K$ be the index of goods for which we have employment data. Some index numbers will match to multiple HS6 codes. To aggregate multiple HS6 products to the index $k$, we sum trade flows within each industry $k$ and take an average of import tariffs, weighted by 1992 import value for country $c$. The RCA is then calculated at the country-by-product $k$ level using global trade data from 1992 as follows:

$$RCA_k^c = \frac{\frac{x_{kt}^c}{x_{kt}^{ROWc}}}{\sum_n \frac{x_{nt}^c}{x_{nt}^{ROWc}}} \tag{1}$$

where $x_{kt}^c$ is country $c$'s exports of good $k$ to the rest of the world (ROW) excluding exports to the trading partner of interest (e.g., when calculating Mexico's Revealed Comparative Advantage for trade with the United States, we exclude Mexico's exports of good $k$ to the United States), and $x_{kt}^{ROWc}$ is total exports of good $k$ from countries excluding bilateral trade between the two countries of interest to one another. Thus the numerator is country $c$'s share of world trade of good $k$ excluding trade with the trading partner of interest. The denominator is country $c$'s share of total ROW exports in all goods $n \in 1, 2, ..., k, ..., N$. Thus the RCA is country $c$'s share of ROW exports of good $k$ divided by country $c$'s share of total ROW exports. If $RCA > 1$, then this indicates that country $c$ specializes in production and trade of good $k$.

Let $j \in \{crop, livestock, non-farm\}$ index the three labor sectors of interest, and each industry $k$ belongs to a sector $j$. We map crop and livestock products that involve minimal processing to crops and livestock, respectively. For example, both wheat and wheat flour are mapped to wheat production. Both live cattle and beef are mapped to cattle. (We describe this mapping in more detail in the next section.) We calculate the weighted mean import tariff that the United States imposes on country $c \in \{MX, CA\}$ for goods in sector $j$ as follows:

$$\tau_{jt}^{US-c} = \frac{\sum_{k \in j} \tau_{kt}^{US-c} \cdot RCA_k^c}{\sum_{k \in j} RCA_k^c} \tag{2}$$

where $\tau_{kt}^{US-c}$ is the tariff that the United States imposes on imports of goods in industry $k$ from country $c$ in year $t$, and $RCA_k^c$ is country $c$'s Revealed Comparative Advantage in global exports of goods from industry $k$.

We similarly calculate the weighted mean tariff that each country $c$ imposes on the United States for goods in sector $j$ as follows:

$$\tau_{jt}^{c-US} = \frac{\sum_{k \in j} \tau_{kt}^{c-US} \cdot RCA_k^{US}}{\sum_{k \in j} RCA_k^{US}} \tag{3}$$

We plot the weighted mean tariffs by sector over time in figures 1-2. Import tariffs peak around 1996, which we believe is due to incomplete reporting in prior years. There is some noise from year to year, but overall we find substantial drops in mean tariffs following implementation of NAFTA. Mean U.S. import tariffs were relatively small from the start with all mean tariffs below 10% throughout the time period and ending near zero by 2005. These represent decreases of nearly 100%. Mean Mexican tariffs on U.S. crops and livestock were over 20% in 1996 and dropped below 10% by 2005, representing a percent change of more than 50%. Canada reduced tariffs on U.S. livestock and related products from nearly 50% to only 25% from 1996-2006, also representing a change of almost 50%. There was little change in weighted mean crop and non-farm tariffs that Canada imposed on the United States, which were both low from the start. While tariff changes in the US were bigger in percentage terms, the changes in percentage points were substantially smaller. This suggests that US exporters faced larger changes in after-tax output prices compared to the price change experienced by imports from foreign companies.

### Labor Share Data and Construction

To find employment share by crop of type $k$, we take detailed acreage data by crop from the 1992 U.S. Census of Agriculture. Although, the Census of Agriculture does not record labor employment per crop, we can impute labor hours per crop by multiplying acreage by the approximate labor hours per acre required to produce each crop. We take hours per acre from crop enterprise budgets published at various universities.[2] Since many of the tasks performed on farm are hired through custom operations, the budgets do not always contain detailed labor input data. We spoke with authors of the reports to approximate percentages of costs for agricultural production activities like discing or spraying that can be attributed to labor, so that we can include these activities in total labor inputs even when they are written only as total custom line items. These budgets are based on production inputs reported for representative farms and do not reflect labor inputs on every farm. Nevertheless, they provide proxies for labor inputs per acre and generate substantial variation in labor inputs across crops. Labor-intensive crops like strawberries, for instance, have many more hours per acre than a crop, like soybeans, which is highly mechanized. We do this for every crop $k$ and compute the total implied crop labor hours in a county by taking the product of county level acreage of crop $k$ and labor hours per acre for production of crop $k$, summed across all crops. We then find crop $k$ share of total county crop labor hours by crop type. Finally, the QCEW records employment by industry using North American Industry Classification System (NAICS). NAICS 111 is crop employment and 1151 is crop support employment, which includes employment by Farm Labor Contractors (FLCs). We sum these to find the total number of crop workers in a county using the 1992 QCEW. We multiply total crop employment by crop $k$ share of total crop hours to find proxies for crop $k$ employment in the county.

For livestock employment shares, since we lack proxies of employment per animal, we approximate livestock employment shares by taking the share of total livestock value in the county for each animal (cattle, dairy, sheep, goats, dairy, hogs, poultry, and fish by type) in the 1992 Census of Agriculture. We then multiply this livestock $k$ share of

[2]Enterprise budgets used to construct our dataset are cited in the appendix.

total livestock value in the county by the sum of employment in animal production and aquaculture (NAICS 112), Fishing, Hunting and Trapping (NAICS 114), and livestock support activities (NAICS 1152) in the 1992 QCEW. For the non-farm sector, we take employment by the 3-digit NAICS industry codes, including Forestry and Logging (NAICS 113) and the remainder of Support Activities for Agriculture and Forestry (NAICS 1153) in the non-farm sector.

The QCEW includes data for all workers who worked, or received pay, during the pay period including the 12th day of the month and who were covered by the state unemployment insurance (UI) laws (and federal workers covered by the Unemployment Compensation for Federal Employees program). In some states, farms below a threshold size might be exempt, and workers who receive pay off the books will be excluded. Nevertheless, even unauthorized workers frequently borrow a social security number to receive pay on the books, and we do not expect these measurement errors to be systematically correlated with variation in county exposure to trade liberalization.

In order to merge employment share data with trade and tariff data, we map HS codes to NAICS 3-digit codes and map HS codes to crops and livestock by hand. Since we expect tariffs on minimally processed goods to impact farmers, we map crops and animals to goods with some processing. For example, an import tariff on beef affects not only meat processing facilities but also feedlot and cow-calf operations in other locations. We do not want to include high levels of processing in the crop and livestock tariffs, but we want to include minimal downstream linkages. For example, tomatoes are mapped to the HS codes as described in table 1.

## Calculating County Employment Exposure to Domestic and Foreign Import Tariffs

To examine the spatial distribution of tariff changes, we calculate county sector $j$ employment exposure to foreign import tariffs for each US county $i$ and for countries $c \in \{MX, CA\}$ as follows:

$$\tau_{it}^{cj} = \frac{\sum_{k \in j} L_{ikt} RCA_k^{US} \tau_{kt}^{c-US}}{\sum_{k \in j} L_{ikt} RCA_k^{US}} \tag{4}$$

where $L_{ikt}$ is employment in industry $k$ in county $i$ in year $t$, $RCA_k^{US}$ is the U.S.'s Revealed Comparative Advantage in world exports of product $k$, and $\tau_{kt}^{c-US}$ is the tariff that country $c$ imposes on its imports of good $k$ from the United States in year $t$. We sum the numerator and denominator over all industries $k \in j$, thus summing over all industries within the specified sector (crop, livestock, or non-farm).

We similarly calculate the U.S. county sector $j$ employment-weighted tariffs on imports from Mexico and Canada as follows:

$$\tau_{it}^{USj} = \frac{\sum_{k \in j} L_{ikt} RCA_k^{c} \tau_{kt}^{US-c}}{\sum_{k \in j} L_{ikt} RCA_k^{c}} \tag{5}$$

## Changes in County Import Tariff Exposure During NAFTA Implementation

Figure 3 shows the county-specific changes in employment-weighted mean exposure to tariffs that Mexico and Canada imposed on imports of U.S. crops and lightly processed related goods and changes in tariffs that the United States imposed on crop imports from Mexico and Canada. There were large reductions in average crop employment exposure to import tariffs imposed by Mexico across many rural U.S. counties. Numerous metro areas were also exposed to large changes in Mexican import tariffs. Reduced exposure to Canadian import tariffs were more concentrated in wheat-growing regions of the United States. There was very little change in the average tariffs that the United States imposed on its crop imports since U.S. crop import tariffs were initially low (mean U.S. import tariffs on Canadian crops were less than 1% at the start of the period). Nevertheless, there were some larger changes in a few counties in the Eastern United States.

Figures 4 maps county shares of crop acreage for wheat, corn, and soybeans. Reduced exposure to Canadian import tariffs on U.S. crop products is highly correlated with the share of wheat production in a county. Reduced exposure to Mexican import tariffs on U.S. crop products is highly correlated with county-level share of crop acreage in corn, wheat, and soybeans. There also appears to be moderate reductions in exposure to Mexican import tariffs in California, Florida, Oregon, and other regions that produce a wide variety of fruits, vegetables, and specialty crops.

Figure 5 shows the county-specific changes in employment-weighted mean tariffs that Mexico and Canada imposed on imports of U.S. livestock and animal products and that the United States imposed on imports of livestock and animal products from Mexico and Canada. Much of the United States saw relatively large declines in exposure to Mexican and Canadian livestock import tariffs. However, counties experienced very little change in protection from U.S. tariffs on livestock imports because the United States had relatively low pre-NAFTA import tariffs.

Figures 6 maps the livestock value shares of cattle, dairy, hogs, and poultry. The greatest reductions in exposure to Mexican tariffs on imports of U.S. livestock appear most concentrated in hog-producing counties. Canadian tariff reductions are most concentrated in dairy and poultry-producing counties.

Figure 7 shows the country-specific changes in employment-weighted mean exposure to tariffs that Mexico and Canada imposed on imports of U.S. non-farm goods and employment-weighted tariffs that the United States imposed on non-farm imports from Mexico and Canada. There is some substantive spatial variation in U.S. employment exposure to changes in Mexican import tariffs on U.S. non-farm goods. Previous literature has focused on changes in employment exposure to changes in U.S. tariffs on imports from Mexico rather than exposure to declines in Mexican import tariffs on U.S. non-farm goods (Hakobyan and McLaren, 2016). Workers in non-farm industries would theoretically benefit from improved access to export markets, suggesting that future work should explore how expanding export markets impact local economies across the U.S.

## Discussion

To see how tariff exposure relates to agricultural employment shares, we map crop and livestock shares of total employment by county in Figure 8. Crop employment is a substantial share of employment in very rural counties and counties that specialize in the production of labor-intensive fruits and vegetables. Livestock tends to be less labor-intensive on average and constitutes a more substantial share of employment only in very rural counties.

Figure 9 breaks down crop employment by crop type. Fruit production is often very labor-intensive and employs a large share of workers in several counties in Central Washington, the Central Valley of California, and Florida. Vegetables are also labor-intensive and constitute a substantial share of employment in a few Southwestern counties. Wheat is not as labor-intensive but is grown in many rural counties where populations are small. Finally, we map the cotton share of employment since there were relatively large decreases in cotton tariffs during NAFTA.

## Conclusion

While the field of economics consistently demonstrates that workers are not perfectly mobile across industries or geographic space (Autor, Dorn, and Hanson, 2013; Autor et al., 2014; Dix-Carneiro and Kovak, 2015, 2017; Hakobyan and McLaren, 2016; Topalova, 2007, 2010), there has been little research on US worker exposure to trade liberalization or protectionism. This can be especially important in rural communities with a large agricultural share of employment. Although the share of the U.S. population employed in agriculture and related industries is relatively small (10.4% of U.S. employment in 2022 (USDA Economic Research Service, 2023)), agriculture is still an important part of many rural communities. The findings in this paper show that reductions in U.S. tariffs imposed on imports from Mexico and Canada during NAFTA were much larger in terms of percentage point changes for crops than non-farm goods on average even though previous literature has focused almost exclusively on the labor market impacts of reduced non-farm import tariffs. Furthermore, we suggest that research should consider both exposure to tariffs on imports that increase competition in domestic markets and exposure to import tariffs in export markets that increase competitiveness in foreign markets.

NAFTA reduced foreign tariffs imposed on imports of U.S. goods by a larger magnitude in percentage point change than the U.S. reduced its tariffs on imports of Mexican and Canadian goods. Finally, we show that employment-weighted exposure to reduced foreign import tariffs on U.S. crop and livestock sectors was larger in magnitude and more geographically dispersed than exposure to reduced foreign import tariffs on the U.S. non-farm sector. Given the relatively large declines in foreign import tariffs that U.S. crop and livestock producers were exposed to, NAFTA might have benefited many industries and workers in nearby locations if there were substantial spillovers. This contrasts with previous literature that has focused primarily on losses in non-farm employment protection from U.S. tariff reductions on imports and merits further empirical investigation.

There is much yet to investigate regarding the effects of agricultural trade and tariff changes on employment and wages. This paper develops crop- and livestock-specific employment weights and calls for future work to explore changes in tariff exposure to NAFTA and other trade policies. These additional data will enable new and timely investigation of crop- and livestock-specific natural and market-driven shocks on employment and wage outcomes across U.S. counties.

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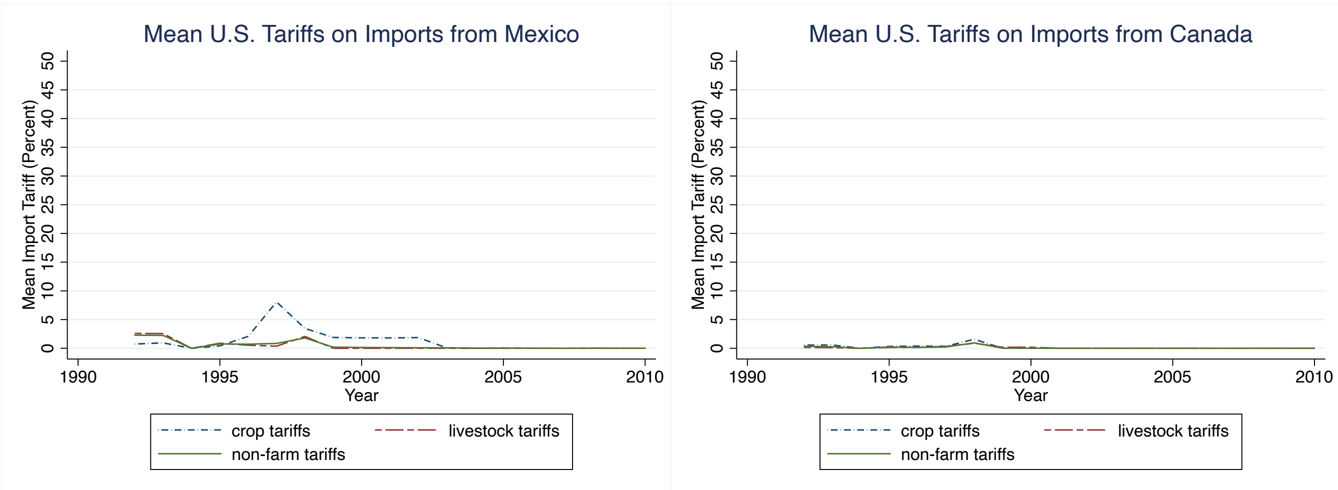



Figure 1: Weighted Mean U.S. Import Tariffs on Mexico and Canada

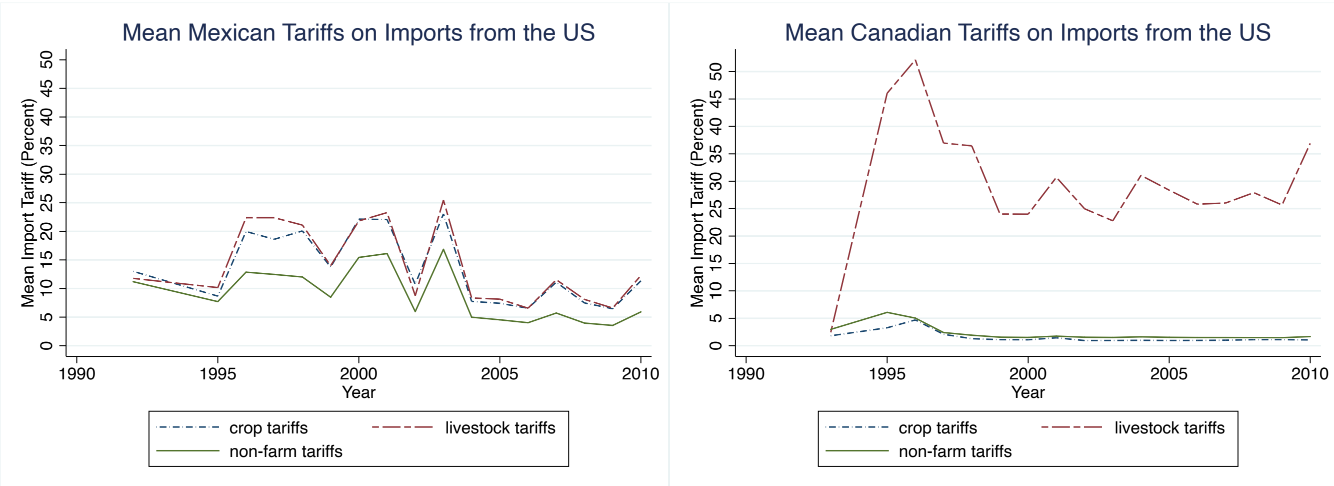



Figure 2: Weighted Mean Mexican & Canadian Import Tariffs on the U.S.

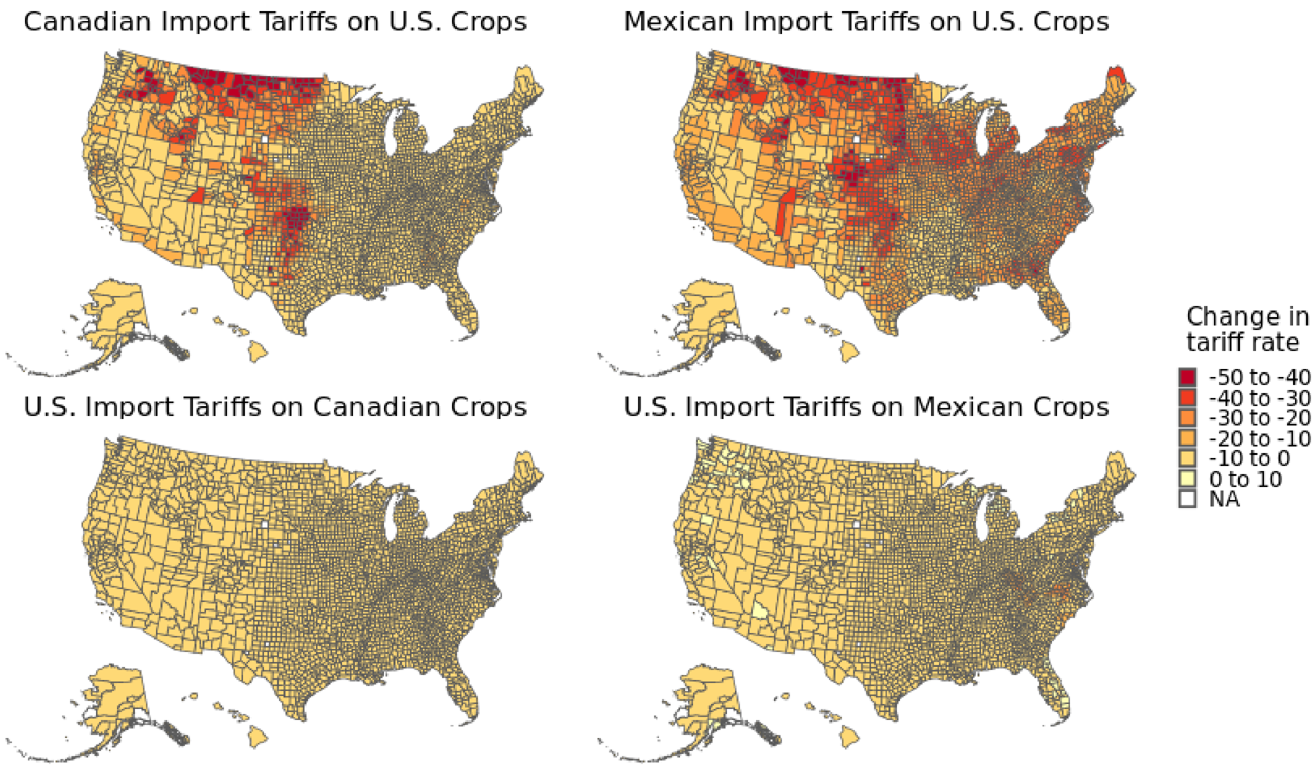



Figure 3: Change in Employment-Weighted Mean Foreign Import Tariffs on U.S Crops Produced in County and U.S. Import Tariffs on Mexican and Canadian Crops

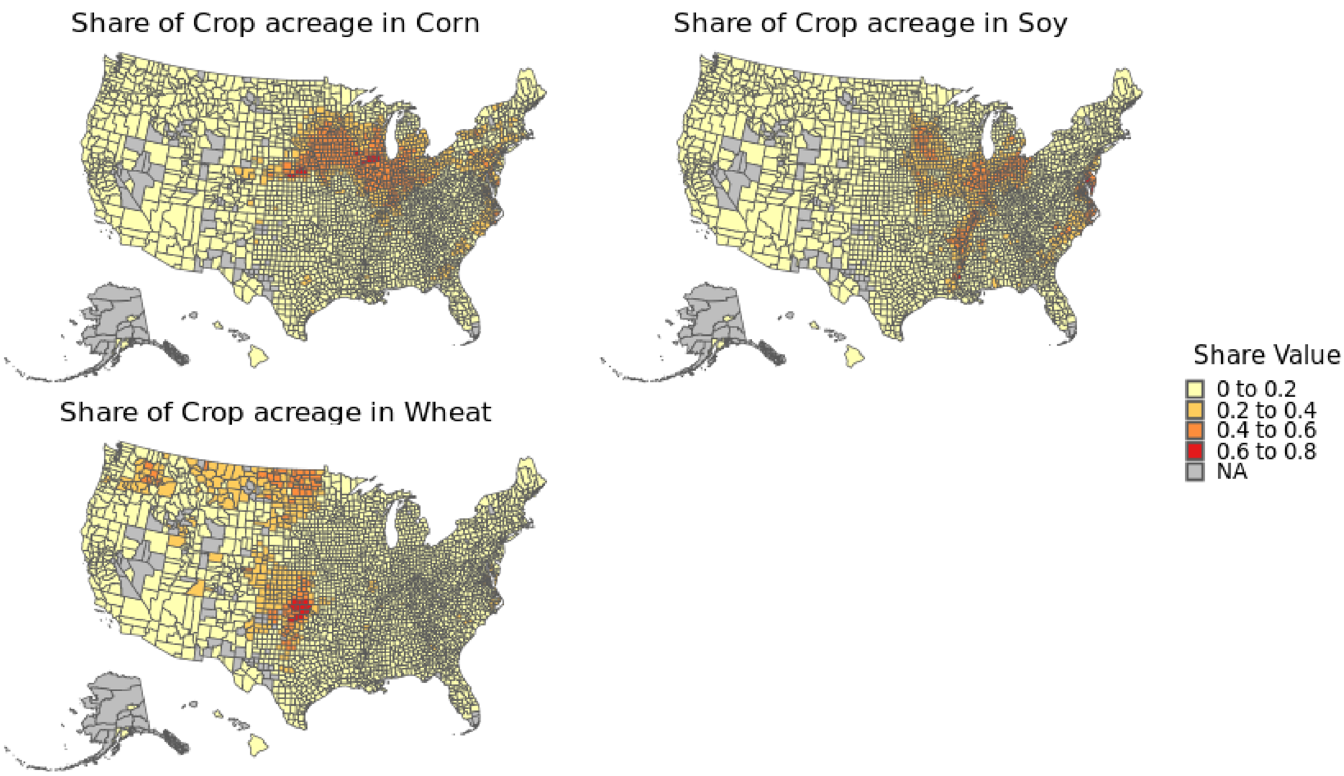
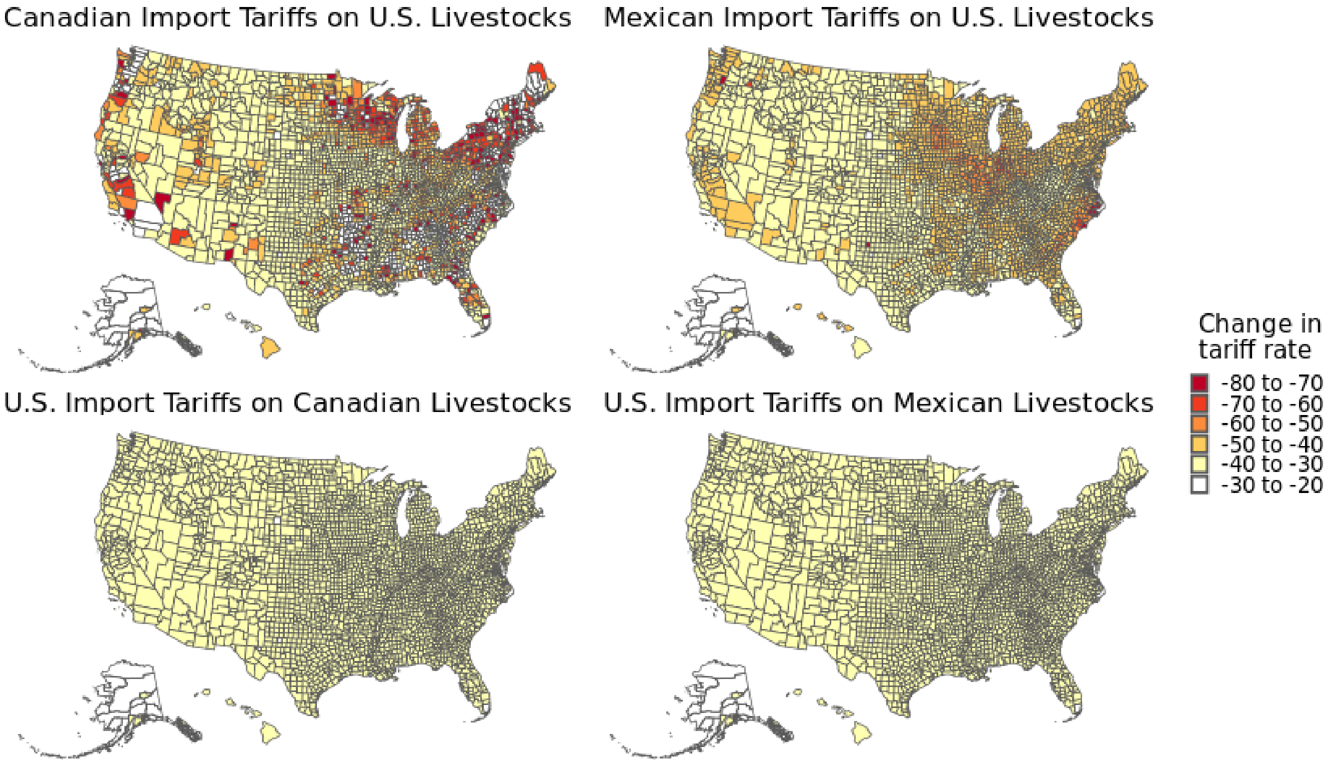



Figure 4: U.S. County Crop Acreage in Wheat, Corn and Soybeans (1992 Census of Agriculture)




Livestock and animal products include cattle, dairy, hogs, sheep, goats, poultry, rabbit, and fish.

Figure 5: Change in Employment-Weighted Mean Import Foreign Tariffs on U.S Livestock and Animal Products in County and U.S. Import Tariffs on Mexican and Canadian Livestock and Animal Products

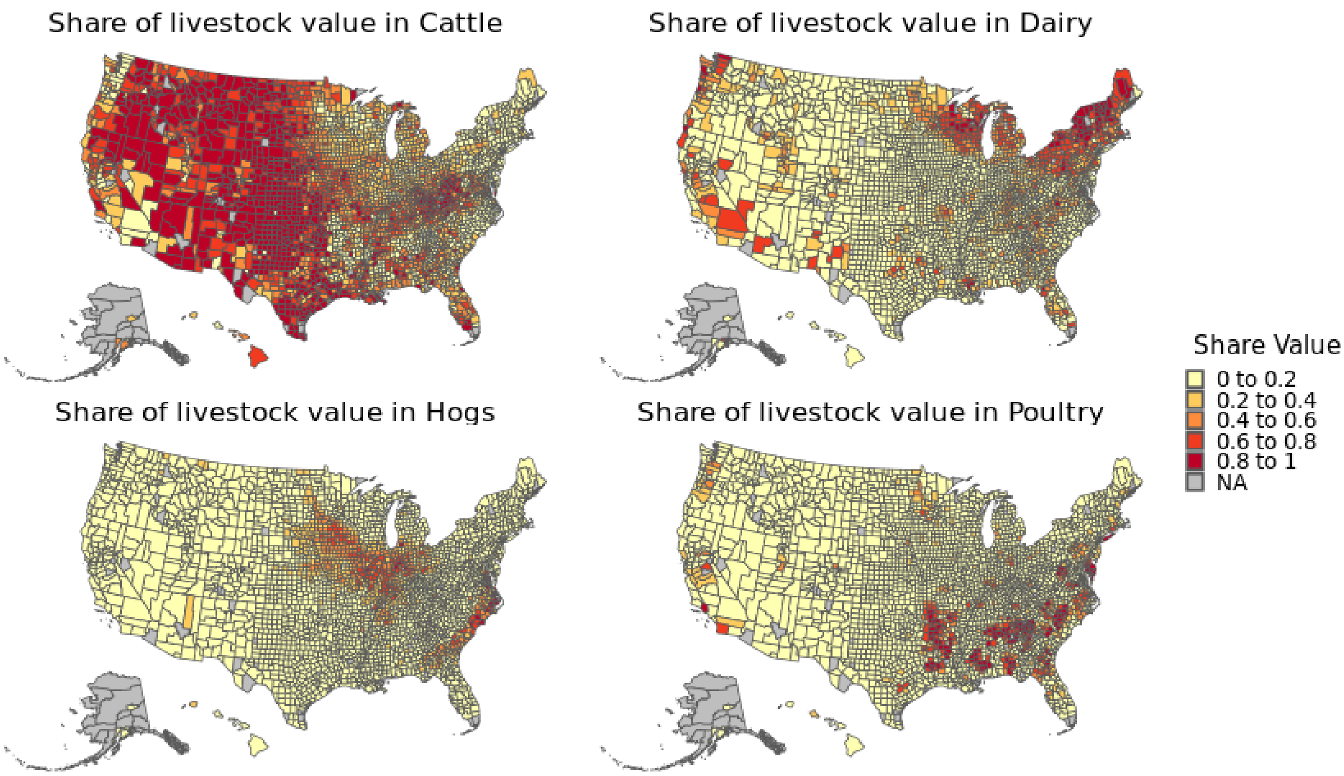



Figure 6: Share of U.S. County Livestock Value in Dairy, Cattle, Poultry, and hogs (1992 Census of Agriculture)

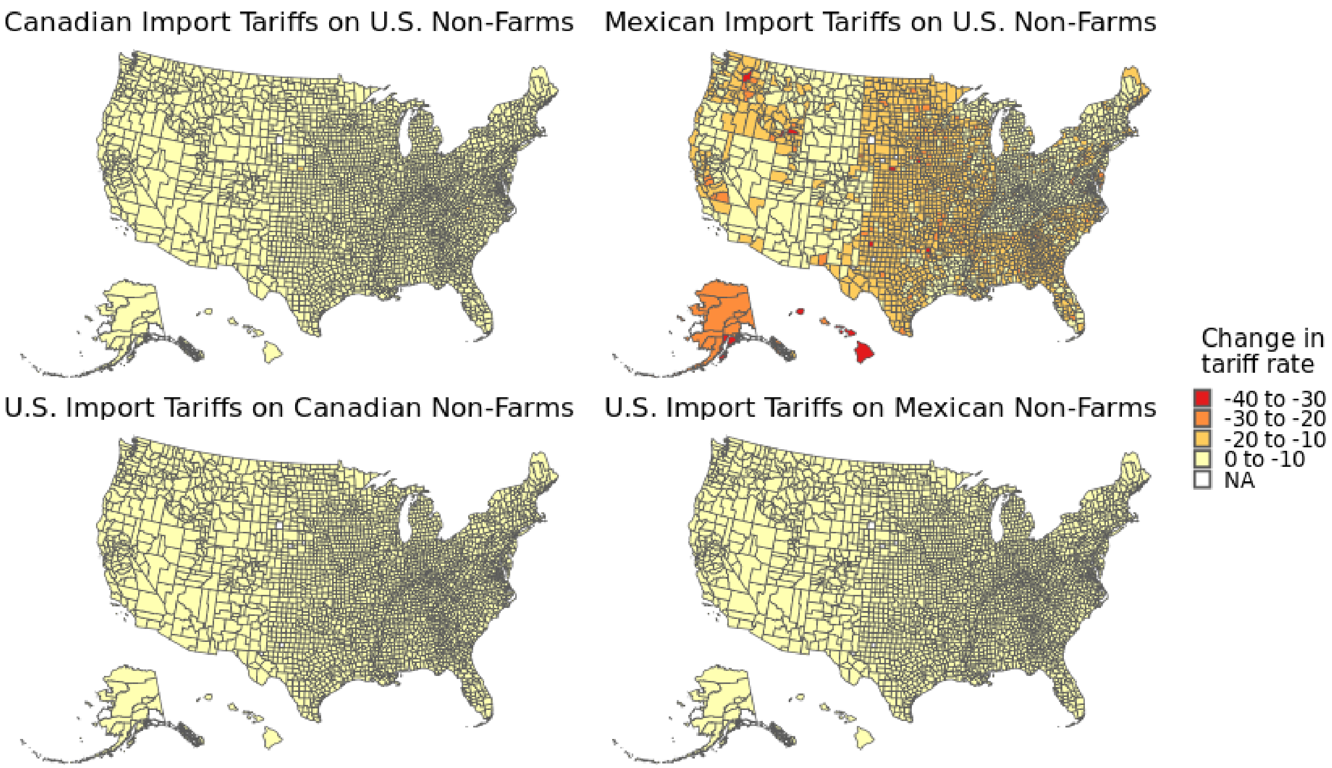



Figure 7: Change in Employment-Weighted Mean Import Foreign Tariffs on U.S Non-Farm Goods Produced in County and U.S. Import Tariffs on Mexican and Canadian Non-Farm Goods

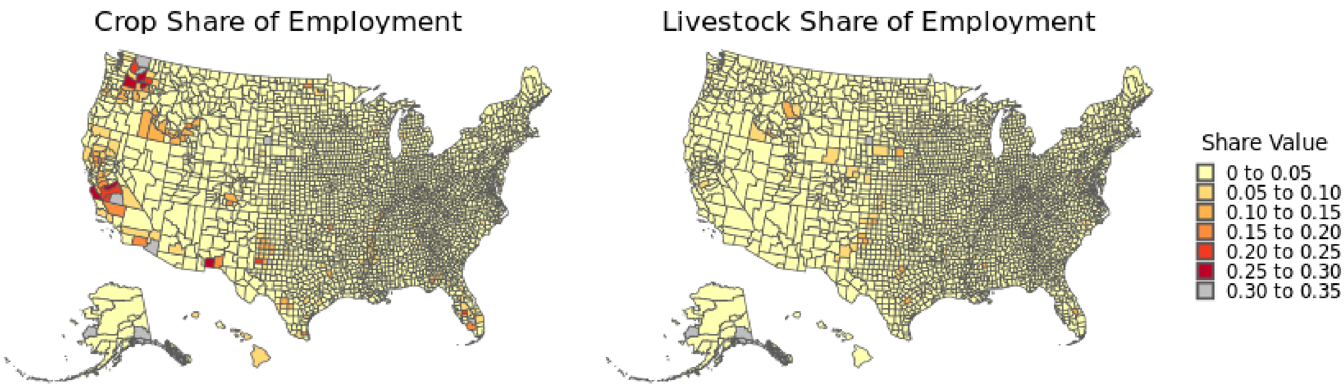



Figure 8: U.S. County Employment Share in Crop and Livestock Production (1992 QCEW)

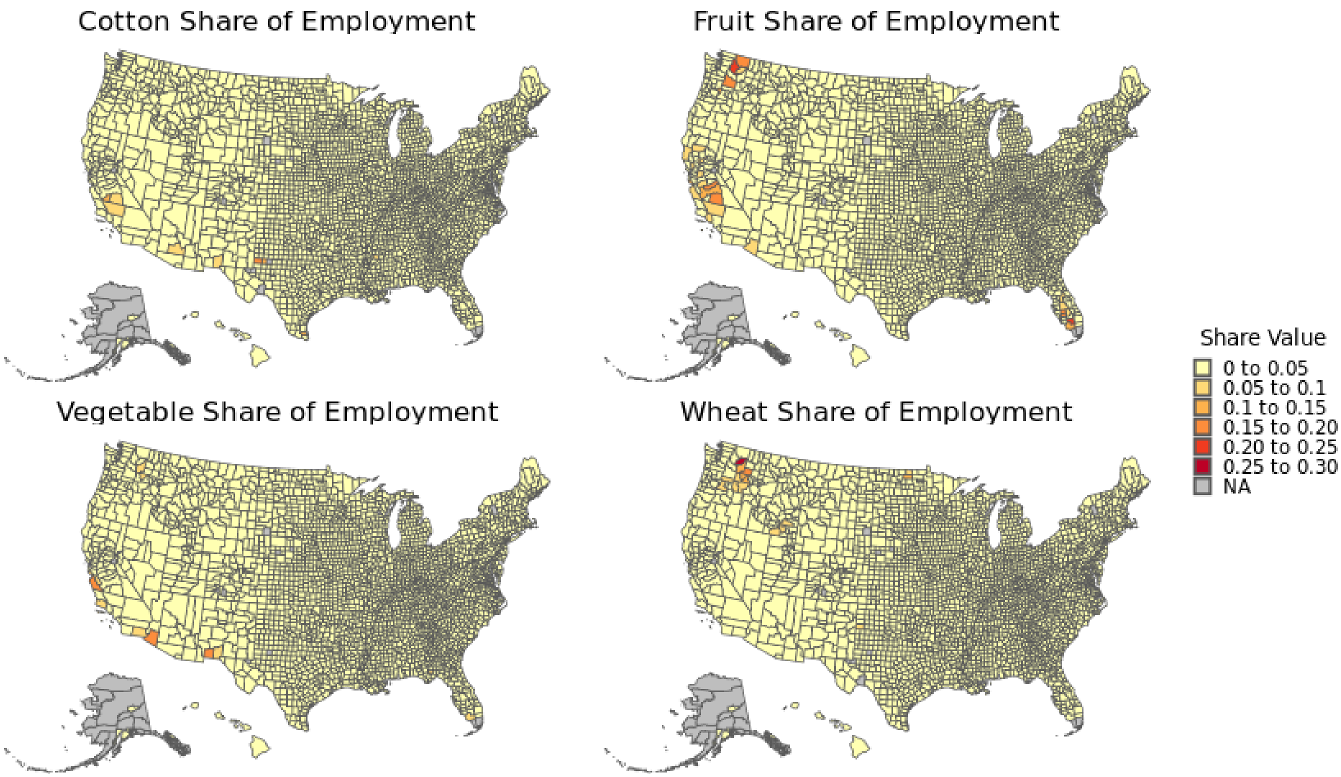



Figure 9: U.S. County Employment Share in Cotton, Fruit Vegetable and Wheat (1992 QCEW)

Table 1: Harmonized System Mapping to Tomatoes

| **HS Code** | **Definition** |
|---|---|
| 70200 | Vegetables; Tomatoes, fresh or chilled |
| 200210 | Vegetable preparations; tomatoes, whole or in pieces, prepared or preserved otherwise than by vinegar or acetic acid |
| 200290 | Vegetable preparations; tomatoes (other than whole or in pieces) prepared or preserved otherwise than by vinegar or acetic acid |
| 200950 | Juice; tomato, unfermented, not containing added spirit, whether or not containing added sugar or other sweetening matter |
| 210320 | Sauces; tomato ketchup and other tomato sauces |