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THE SILK ROAD OF ASHES:
EXPOSURE TO NAFTA AND ADULT MORTALITY

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ABSTRACT

The implementation of the North American Free Trade Agreement (NAFTA) in 1994 resulted in a great restructuring in industry composition in the US, with substantial heterogeneity across local areas. In this paper, we investigate the effects of NAFTA on the mortality rates of the working-age population. We implement event studies and difference-in-difference analyses to examine dynamic changes in mortality rates in different years relative to NAFTA and in areas with differential exposure to NAFTA. Comparing areas with high versus low trade exposure measures, we find a 2.1 percent rise in the mortality rate of those aged 25-55. A back-of-the-envelope calculation suggests a 7.3 percent rise in mortality for the treated population, who lost their job due to NAFTA. Further analyses using a wide range of alternative data sources suggest that reductions in income-employment, reductions in wealth, increases in disability, decreases in health insurance coverage, decreases in private health insurance, and a higher likelihood of reliance on presumably lower quality public insurance as candidate mechanisms.

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1. Introduction

What factors determine the observed disparities in adulthood premature mortality across different subpopulations and geographic units across the US? One highly discussed element is local labor market conditions. The large heterogeneity and sharp dynamics of local labor markets in the US over the past decades make this link policy relevant. Indeed, a relatively old literature examines the influence of labor markets, employment, and income on mortality outcomes (Altenderfer, 1947; Lathrop, 1919; Preston, 1975; Ruhm, 2000; Snyder & Evans, 2006). These studies offer mixed evidence and inconclusive results. One possible reason is the nature of shocks they exploit, the duration and intensity of the shock, and the subpopulation under study. For instance, transfers during old age are documented to increase mortality rates, particularly in the short run, or have no impact (Evans & Moore, 2011; Snyder & Evans, 2006). On the contrary, the negative shocks to local labor markets that reduce income and employment opportunities are shown to increase mortality rates, specifically for working-age populations (Pierce & Schott, 2020). Similarly, while several studies document the positive income-longevity associations (Chetty et al., 2016), other research points to the benefits of recessions and temporary job loss for workers' health (Gerdtham & Ruhm, 2006; Ruhm, 2000).

Trade policies can shape local labor markets by differentially exposing industries to the policy-induced tariff dynamics. Therefore, they impose differential shocks to different local labor markets, with potentially distinct effects across subpopulations, including workers' health and mortality (Dix-Carneiro et al., 2017; Hakobyan & McLaren, 2016; Pierce & Schott, 2020). One of the highly debated but understudied trade policies is the implementation of the North American Free Trade Agreement (NAFTA). NAFTA has been a long-standing and extensively discussed policy in the US international trade environment. Earlier trade pacts in the 1980s had implemented

a series of bilateral trade agreements between the US and Canada. However, in 1990, the Mexican president sought a similar trade deal with the US. The trilateral trade proposal was a prominent topic in the 1992 presidential election and was the topic of heated debates in the media and political discussions. Finally, the legislatures of the US, Canada, and Mexico approved the proposal. Consequently, NAFTA was formally enacted into law in 1993 and came into effect on January 1, 1994.

The aggregate welfare analyses of NAFTA suggest small but positive net benefits for the US economy (Caliendo & Parro, 2015; Romalis, 2007). However, for local areas with a higher pre-NAFTA dependence on industries that benefited from initial tariff protection, the impacts on employment and income outcomes were negative (Choi et al., 2024; Hakobyan & McLaren, 2016, 2017). These negative shocks to the employment-income profiles of local areas provide a unique setting to examine the effects of labor market conditions on mortality outcomes. Although several studies examine the effects of general local labor market conditions on mortality outcomes (Browning & Heinesen, 2012; Finkelstein et al., 2024; Ruhm, 2000, 2019), far fewer examine mortality responses to trade-induced labor market disruptions. Notable exceptions include Pierce & Schott (2020), who study the China trade liberalization and document declines in income and employment alongside increases in overdose mortality—particularly among working-age white males—and Chatterji et al. (2026), who examine import competition from Japan and find significant increases in cardiovascular and drug-related mortality. Despite this growing evidence that trade shocks can affect adult mortality, no study has yet investigated NAFTA’s impact on mortality.⁴ This paper seeks to address this gap.

⁴ However, a narrow strand of research examines health impacts of NAFTA. Noghanibehambari (2025) employs similar method and investigate the impacts on birth outcomes. He finds significant and negative impacts on infants’ health outcomes born in high exposure areas relative to those born in low exposure areas.

We implement event study and difference-in-difference approaches to evaluate changes in mortality across different years relative to NAFTA in localities with higher versus lower exposure to the trade policy change and subsequent tariff reductions. We employ the universe of death records in the US over the years 1980-2010 to examine the impacts on mortality rates. We find that exposure to NAFTA was associated with rises in adulthood mortality rates, that the effects are primarily concentrated among whites in the age group of 25-55, and that the observed impacts are more pronounced for deaths due to malignant neoplasm (specifically, health behavior-related cancers), cardiovascular diseases, and suicide.

Moreover, we document that areas with higher vulnerability to trade liberalization with Mexico revealed sharp and permanent reductions in income and employment, specifically due to job losses of industries for which Mexico had a comparative advantage relative to the US. To further explore the pathways, we utilize additional data sources, including the Current Population Survey, decennial censuses, and the American Community Survey. We find that exposure to NAFTA is associated with a lower likelihood of health insurance coverage and a compositional change toward presumably lower quality public health insurance. We also observe lower income, reduced employment, a decreased likelihood of homeownership, and lower housing values. Finally, we observe increases in reliance on welfare payments and increases in cross-county migration.

The findings of this paper carry significant policy implications. Trade liberalization generates uneven costs and benefits across subpopulations and localities, as widely documented in the international trade literature (Autor et al., 2019; Autor et al., 2013; Dix-Carneiro, 2014; Dix-Carneiro et al., 2018; Edmonds et al., 2010; Pierce & Schott, 2020; Topalova, 2010). From a policymaking perspective, designing optimal tariff schedules requires careful consideration of

these heterogeneous effects, not just aggregate welfare. This study highlights a frequently overlooked cost: the adverse consequences for mortality in communities exposed to trade-induced labor market disruptions. The responsiveness of mortality to local economic fluctuations highlights its procyclical nature, reinforcing the need for stronger social insurance mechanisms—particularly in the wake of trade shocks. Finally, while programs like Unemployment Insurance and Trade Adjustment Assistance aim to buffer economic hardship, the negative reduced-form estimates suggest they fall short in protecting health, indicating a need to reassess and strengthen the social safety net in the context of trade liberalization.

The contribution of this paper to the literature is threefold. First, to our knowledge, this is the first study to examine the impacts of NAFTA on mortality rates. Studying the health effects of NAFTA is important for several reasons. NAFTA predates trade liberalization with China, and many of the provisions of the former correlate with those of the latter. Therefore, areas that were impacted by China's import competition were already affected by NAFTA, which makes it difficult to disentangle the mortality impacts of China from NAFTA (Pierce & Schott, 2020). Further, NAFTA brought a sharp and permanent structural change to the US economy, which makes it quite distinct compared with other shocks to labor markets (Burfisher et al., 2001; Choi et al., 2024). Additionally, NAFTA differed from trade liberalization with China in the nature of local adjustment. NAFTA was implemented earlier, phased in gradually, and generated a persistent restructuring of local labor markets rather than a sharp, discrete shock. This longer and more permanent deterioration in employment, income, and wealth provides a unique setting to study the effects of sustained labor market distress on adult mortality, as opposed to short-run adjustment costs. Consistent with this distinction, we find that NAFTA exposure raises mortality from internal causes, particularly cardiovascular disease and health-behavior-related cancers, as well as suicide,

while having no effect on other external causes. This pattern contrasts with the China shock literature, which emphasizes deaths of despair and external causes (Pierce & Schott, 2020) and suggests that prolonged economic decline operates through different health channels than acute labor market dislocation. Moreover, investigating the effects of NAFTA could offer insights for future changes in trade policies with similar settings both in the US and other countries.

Second, this paper provides the hidden costs of trade liberalization, the externality for health and mortality outcomes (Romalis, 2007). This aspect of trade liberalization is understudied and hence absent from aggregate welfare analyses. Understated costs make the tariff schedules sub-optimal and policies inefficient. From the viewpoint of policymakers, achieving an optimal tariff schedule relies on assessing the net welfare benefits in the presence of all benefits and costs. The findings of this article bring to light the overlooked costs of trade liberalization for health and mortality of a particular subpopulation, aspects that are often omitted in comprehensive cost-benefit welfare analyses.

Third, the findings of this paper contribute to the literature examining the impact of income and employment on mortality rates among the working-age population (Chatterji et al., 2026; Dean & Kimmel, 2019; Fernández Guerrico, 2021; Gerdtham & Ruhm, 2006; Ruhm, 2000; Snyder & Evans, 2006). We re-evaluate this mixed literature and provide findings using the negative local labor market shocks from NAFTA.

It is important to note that the analysis focuses on relative localized impacts rather than general-equilibrium effects. While NAFTA may have had an overall effect on mortality rates, its impact likely varied across different regions. For example, NAFTA could have slightly reduced mortality in less vulnerable areas while increasing it in more vulnerable localities. Alternatively, it might have raised mortality in all areas, but to a greater extent in regions more susceptible to

import competition. Therefore, these findings capture cross-locality comparisons and do not reflect the broader general-equilibrium effects of NAFTA on mortality.

The rest of the paper is organized as follows. Section 2 reviews the background of NAFTA and related literature. Section 3 goes over data sources and sample selection. Section 4 introduces the econometric method. Section 5 reviews the main results. Section 6 explores the mechanism channels. Section 7 discusses the economic significance of the results. Section 8 concludes the paper.

2. Background

2.1. Literature Background

Local labor market conditions and changes in employment-income may affect health and mortality outcomes through several channels, which we discuss below. First, job losses might result in a healthier lifestyle. People tend to consume home-produced meals that are usually healthier than fast food, with higher caloric intake, hence reducing caloric intake and associated diseases (Lv et al., 2015). Moreover, individuals cut specific expenses during periods of income loss, including expenses on smoking and drinking, which is associated with mortality gains (Ásgeirsdóttir et al., 2016; Fu & Liu, 2019). A downturn in economic activities can also be translated into lower commute to work and reductions in fatal accidents, lower pollution and pollution-attributable mortality, and decreases in work-related stress and occupation-related fatal injuries (Bombardini & Li, 2020; Deschênes et al., 2017; Ruhm, 2000). However, these effects may reverse if periods of unemployment are long and labor market shocks are deep and structural (Coile et al., 2014; Neumayer, 2004; Ruhm, 2015).

On the other hand, negative labor market shocks and subsequent job losses may adversely affect health and raise mortality. The resulting financial hardship could limit access to essential

expenses, including healthy food (Allcott et al., 2019; Baten & Wagner, 2003). Further, job loss limits access to high-quality private health insurance and generally inhibits healthcare access, an important contributor to health and mortality outcomes (Goldin et al., 2021; Goodman-Bacon, 2018). The burden of local economic shocks may also appear in social isolation as people withdraw from social activities due to financial hardships. This is usually accompanied by depression, anxiety, and may further be exacerbated by unhealthy behaviors, such as drinking and smoking (Frese & Mohr, 1987; Pohlen, 2019; Saito et al., 2012).

Empirical studies that examine the nexus between employment, income, labor markets, and health-mortality find mixed evidence. For instance, Snyder & Evans (2006) employ data from the US and examine the effect of an income shock due to a change in the Social Security retirement benefits. They find that a reduction in income leads to mortality gains among the elderly population. Evans & Moore (2011) show that mortality rises in several days following monthly income receipt. They show this pattern for receipt of social security payments, Alaska Permanent dividend fund payments, the 2001 tax rebate, and wages paid to military personnel. Chetty et al. (2016) use administrative tax records data linked to Social Security death records and document a positive and consistent relationship between household income and longevity. Ahammer et al. (2017) employ administrative data from Austria to examine the impact of income on mortality outcomes. They fail to observe a meaningful association between income and mortality for the working-age population of 40-60 years old.

Several studies examine the role of trade liberalization on labor market conditions, income, and workers' health outcomes. For instance, Pierce & Schott (2020) employ data from the US and examine the effect of trade liberalization with China on mortality. They compare the mortality rates of counties with higher and lower exposure to import competition before versus after the

trade policy change of 2000. They find increases in “death of despair” and uptakes of disability insurance. Chatterji et al. (2026) find that increased import competition from Japan raised adult mortality—particularly from cardiovascular disease and drug-related causes, with effects that are substantially larger for Black individuals and concentrated among males. Lang et al. (2019) examine the effects of negative labor market shocks due to exposure to import competition with China on mental and physical health. They show that residents of local areas in the US with higher exposure reveal significant deteriorations in their mental health. Colantone et al. (2019) employ data from England and show that the mental distress of workers worsens in the face of import competition. They also find spillover effects in the mental health outcomes of their partners. Feng et al. (2021) examine the effects of boosting local economic conditions through reductions in export tariff rates on workers’ health outcomes. They find improvements in nutrition and health following increases in income and working hours. Lin et al. (2021) show that municipalities in China that benefited more from expansions in trade after China’s entry into the WTO in 2001 experienced a more rapid spread of the severe acute respiratory syndrome (SARS) pandemic of 2003. They also find a positive cross-country relationship between trade openness and the spread of SARS. McManus & Schaur (2016) show that increased import competition from China led to higher workplace injury rates among US manufacturing workers, with particularly large effects at smaller establishments. Adda & Fawaz (2020) find that import competition adversely affected both physical and mental health, reduced healthcare utilization, and increased mortality risks among US manufacturing workers, with effects that persist over time and are concentrated in regions more exposed to routine-intensive jobs.

2.2. Background of NAFTA

Early History of NAFTA

The period of the 1980s witnessed the sparkling ideas of trade liberalization across the world, most of which came into existence in the late 1980s or early 1990s.⁵ During this period, the US and Canada entered negotiations to initiate bilateral trade agreements. These negotiations, mainly done by the Ronald Reagan administration, resulted in the Trade and Tariff Act of 1984 and later the Free Trade Agreement (FTA) of 1989. In 1990, Salinas de Gortari, president of Mexico, started negotiations with George H. W. Bush to expand the FTA and include Mexico. The trilateral trade agreement, which was later known as the North American Free Trade Agreement (NAFTA), was drafted by 1992 and sent to the legislatures of the three countries. However, it was paused during the presidential election of 1992, in which NAFTA was hotly debated. The intensity of debates can be detected by the share of the votes that the independent candidate Ross Perot could win, who strongly opposed NAFTA. He won 20 percent of popular votes, a percentage that was not obtained by any third-party candidate after World War II and was never repeated after him. However, Bill Clinton won the election and signed NAFTA into law in 1993. It became enacted and effective in January 1994.

NAFTA's Impact on Tariffs and Imports

Phase-in of NAFTA's tariff schedule was gradual. While for some industries, it was an immediate tariff change, for many others, NAFTA was primarily an announcement of future tariff changes. Therefore, changes in imports also revealed a gradual pattern. This fact can be seen in Figure 1. This figure shows the evolution of tariffs and imports from Mexico, Canada, and all other countries between the years 1990-2000. All variables are deflated using the 1993 variable-specific

⁵ The Association of Southeast Asian Nations (ASEAN) Free Trade Area was prepared and developed mainly during the 1980s. The Single European Act of 1986 paved the way for the European Single Market and later European Zone. Similar economic integration and trade agreements occurred in South America. For instance, the Latin American Integration Association (ALADI) was established in 1980 and gained significant momentum during this decade.

value so that all equal one for that year. The right y-axis shows trends of tariffs. The so-called Most Favored Nations (MFN) tariff rates, the average tariffs of the US for other countries in the World Trade Organization (WTO), experienced reductions during this period. However, there was a sharp and substantial decrease in tariffs for Mexico (solid red line). Between 1993 and 2000, the average tariffs for Mexican imports reduced by about 90 percent. In the meantime, imports from Mexico rose by about 240 percent (dotted green line), substantially more than the change in imports from other countries, including Canada.

3. Data and Sample Selection

3.1. Mortality Data

We employ data from several sources. The primary source of data is cause-specific death records extracted from the National Center for Health Statistics (NCHS, 2020). The data reports the universe of death records in the US. The data offers limited information on demographic characteristics and the age of the deceased. The restricted-use version of this data contains the county of residence, which is essential in our setting that evaluates the local labor market conditions. We restrict the data to the years 1980-2010 to have several years pre- and post-NAFTA.

While we show the effects across ages, in our primary analysis, we focus on the mortality rate of individuals who died in the age group of 25-55. To calculate the mortality rate, we collapse the sample at the Public Use Microdata Area (PUMA) level. A PUMA is a geographic boundary defined primarily based on population and, in many cases, covers several counties that are economically interconnected. There are 543 PUMAs for the entire US. We use PUMA instead of counties because the negative shocks could have spillover effects for neighboring counties, and the county-level assignment of exposure might understate the true treatment effect. We then use

population data from SEER (2019) to calculate PUMA-level population by age, gender, and race. We then calculate mortality rates as follows:

$$MR_{pg} = \frac{Death_{pg}}{Pop_{pg}} \times 100,000$$

Where p and g represent PUMA and age-group.

3.2. Local-Level Data

We employ the County Business Pattern data extracted from Eckert et al. (2020) to construct a trade exposure measure. Import-export and tariff data are extracted from Schott (2008) and Feenstra et al. (2002), respectively. To control for China's trade exposure, we use the measures produced and provided by Pierce & Schott (2020).

County-level wage and income data are taken from the Bureau of Economic Analysis (BEA). Industry-specific employment data are extracted from the Quarterly Census of Employment and Wages (QCEW) database. Finally, the housing price index is extracted from the Federal Housing Finance Agency. We aggregate all these county-level data into PUMA-level data to be in line with our analyses on mortality.

3.3. Other Data Sources

To examine potential mechanisms linking NAFTA-induced labor market shocks to mortality outcomes, we complement the mortality analysis with additional data sources that allow us to study employment, income, wages, housing outcomes, and insurance use. Specifically, we use decennial Census microdata for 1980, 1990, and 2000 combined with the American Community Survey (ACS) for the years 2000–2010, drawn from Ruggles et al. (2024) (hereafter Census–ACS), as well as the Annual Social and Economic Supplement (ASEC) of the Current

Population Survey for the years 1980–2010, obtained from Flood et al. (2018) (hereafter ASEC–CPS).

The Census–ACS data consist of nationally representative individual-level microdata that provide detailed information on demographic characteristics, education, employment, income, and housing in the US. The data include a consistent PUMA identifier, which allows us to link individuals to PUMA-level measures of trade exposure (explained in section 3.4). The data report individual-level information on labor market outcomes, including employment and income, homeownership status and housing value, and limited information on disability outcomes, specifically whether an individual has a physical or mental condition that limited their ability to work at a job or business during the previous six months. We refer to this measure as work disability.

The ASEC–CPS data is also a nationally representative data set conducted annually that provides information on labor market, demography, poverty, and program participation in the US. The drawback of the data is that it does not include granular (below-state) geographic identifiers. As a result, we use the industry code of individuals to build the trade exposure measure. Because industry-level exposure does not capture local adjustment processes and may be attenuated by worker mobility across industries following trade liberalization, we interpret the ASEC–CPS results as supporting evidence on labor market mechanisms rather than as analogues to the mortality estimates.

3.4. Vulnerability Index

To build a measure of local exposure to foreign trade, we start by calculating the industry-level comparative advantage of Mexico. However, it is difficult to extract cost information, resource allocation, implemented technology, and overall efficiency of firms across industries and

countries. To overcome this challenge, trade economists employ the idea of the Revealed Comparative Advantage (RCA), which measures the advantage of Mexico across different industries compared to other trading partners as materialized by export-import volumes prior to NAFTA. The RCA informs outsiders about the efficiency and relative advantage of Mexico in producing different products/industries. This measure simply compares exports of Mexico to its trading partners in industry i (relative to exports of the rest of the world (row)) with total exports of Mexico to its trading partners across all industries (relative to exports of the rest of the world (row)), as follows:

$$RCA_j^{1990} = \frac{\left(\frac{X_j^{mexico}}{X_j^{row}}\right)}{(\sum_j X_j^{mexico}) / (\sum_j X_j^{row})} \quad (1)$$

A higher industry-specific RCA suggests that Mexico is likely to have a comparative advantage in that industry and so is more likely to export to the US post-NAFTA.

In the US, local areas that heavily relied on industries for which Mexico had a higher RCA are more exposed to import competition after the trade policy change, and vice versa. This so-called *vulnerability* of the local area depends on Mexico's RCA, the level of initial tariffs, and the level of employment in that area for industries with higher exposure. We define this vulnerability index in a similar manner as trade exposure measures in the literature (Autor et al., 2013; Cherniwchan, 2017; Choi et al., 2024; Hakobyan & McLaren, 2016; Pierce & Schott, 2020), as follows:

$$Vulnerability_{p_{1990}} = \frac{\sum_{j=1}^I E_{jp} \tau_j RCA_j}{\sum_{j=1}^I E_{jp} RCA_j} \quad (2)$$

Where j and p index industry and PUMA. This ratio is a weighted average of tariff rates that were protecting the combination of industries in PUMA p prior to NAFTA. The weights are the interaction of Mexico's RCA and local employment for each industry. The denominator is simply the summation of frequency weights used in the numerator.

Using this vulnerability index as a measure of exposure to trade is preferred to alternatives, such as changes in actual imports, as it measures the statutory changes in trade policy while the latter might reflect unobserved factors that change local-level demand and are also correlated with health outcomes.

3.5. Summary Statistics

Table 1 reports summary statistics of the final sample for PUMAs with below-median and above-median vulnerability index. Mortality rate for below-median and above-median PUMAs count to 257.9 and 259.2 deaths per 100,000 people aged 25-55. Vulnerability index is 0.8 and 1.9 for PUMAs below and above the median of the index.

The third and fourth panels of this table show the summary statistics for Census-ACS and ASEC-CPS samples, respectively. We observe very similar values across outcomes for both groups of PUMAs. For instance, based on the Census-ACS sample, log total income in below-median and above-median PUMAs is 9.48 and 9.45, respectively.

Top-panel of Figure 2 shows the distribution of vulnerability index across the US. PUMAs in New England, East South Central, South Atlantic, and upper West divisions are more exposed to NAFTA. The bottom panel shows the geographic distribution of the mortality rate for ages 25-55 over the sample period. Further, Figure 3 reveals the density distribution of vulnerability index for values below the median and above the median of the index across all PUMAs.

4. Econometric Method

We start our analysis by implementing event studies that compare mortality rates across different years relative to NAFTA in PUMAs with differential vulnerability to the trade policy change. In this context, the baseline identifying assumption requires that, absent NAFTA, mortality trends for PUMAs with different levels of trade vulnerability would have evolved in parallel. As discussed by Callaway et al. (2024), the continuous nature of the treatment variable invokes a stronger version of the parallel trends assumption, which requires that the evolution of outcomes for lower-exposure PUMAs provides a valid counterfactual for how higher-exposure PUMAs would have evolved had they experienced a lower degree of exposure.⁶ This comparison is formulated as follows:

$$LMR_{pt} = \alpha + Vul_p^{1990} \times \left\{ \sum_{l=\underline{T}}^{1993} \phi_l I(l = t) + \sum_{l=1995}^{\bar{T}} \Gamma_l I(l = t) \right\} + \beta Z_{pt} + \zeta_p + \eta_t + \varepsilon_{pt} \quad (3)$$

In which the outcome is the log mortality rate in PUMA p and year t .⁷ Pre-event and post-event coefficients (ϕ and Γ , respectively) are interacted with the vulnerability index to measure dynamic changes in outcomes across PUMAs and over the years prior to and after NAFTA.⁸ In Z , we include PUMA-level share of females, whites, and blacks in each cell. PUMA fixed effects (represented by ζ) account for time-invariant unobserved characteristics of local areas that

⁶ Consistent with this assumption, Appendix Figure A-1 presents event-study estimates of the interaction between year indicators and the vulnerability index, estimated separately for PUMAs below and above the median level of exposure, and shows no evidence of differential pre-NAFTA trends while revealing larger post-NAFTA mortality increases among more exposed PUMAs.

⁷ In column 2 of Appendix Table A-2, we show the robustness of the results to using level of mortality rate rather than log of mortality rate.

⁸ Although in this formulation we use a continuous measure of vulnerability, in Appendix Table A-1, we show the effects using a top-tercile vulnerability dummy. We observe significant effects and considerable pattern to those of the main results reported in Table 2. Moreover, in Appendix Figure A-1, we report event study results separately for PUMAs below and above the median vulnerability. The estimates show no evidence of differential pre-trends and reveal substantially larger post-NAFTA increases in mortality among high-vulnerability PUMAs, consistent with trade-induced labor-market exposure driving the observed effects.

influence mortality outcomes. Year fixed effects, η , capture observed and unobserved time-varying shocks that affect mortality outcomes of all individuals. Finally, ε is a disturbance term. All regressions are weighted using the mean population of PUMA. We cluster standard errors at the PUMA and year level to account for serial correlation within local areas over time and for common shocks affecting all PUMAs within a given year.

We further examine the overall change in the outcome post-NAFTA versus pre-NAFTA using the following difference-in-difference equation:

$$LMR_{pt} = \alpha + \lambda Vul_p^{1990} \times Post_t + \beta Z_{pt} + \zeta_p + \eta_t + \varepsilon_{pt} \quad (4)$$

Where *Post* is a dummy that takes a value of one for post-NAFTA (post-1994) years and zero otherwise. All other parameters are as in equation 3. The parameter λ measures the effect of a one-unit change in vulnerability index after versus before NAFTA on log mortality rates.

5. Results

5.1. Main Results

Event study results of equation 3 are illustrated in the top panel of Figure 4. The pre-trend coefficients do not reveal a consistent pattern of differences in mortality rates between high- and low-vulnerability areas prior to NAFTA, reducing concerns about pre-existing mortality trends and supporting the parallel trends assumption underlying our identification strategy. Following the implementation of NAFTA, the coefficient for 1995 is economically zero. From 1996 onward, mortality rates increased gradually, a pattern consistent with the phased implementation of NAFTA and the delayed adjustment of local labor markets, as tariff reductions were introduced over time and employment and income effects materialized with a lag (Dix-Carneiro, 2014; Dix-Carneiro et al., 2017). However, the effects become relatively stable for the post-2003 years.

The difference-in-difference results of equation 4 are reported in column 1 of Table 2. The difference in vulnerability index in the top versus bottom quartile PUMAs is about 2 units. Using this difference to evaluate high versus low exposure to trade competition, we observe a 4.2 percent increase in the mortality rate of the age group 25-55 post-NAFTA.

5.2. Heterogeneity by Race-Gender

Prior empirical work suggests that the mortality effects of local labor market shocks, and specifically those induced by trade liberalization, may differ systematically across demographic groups. Baseline differences in labor force attachment, occupational sorting, and access to training for alternative employment opportunities may generate heterogeneous health responses to economic distress (Chatterji et al., 2026; Finkelstein et al., 2025; Melton-Fant, 2023). Motivated by these considerations, we examine heterogeneity in mortality effects by gender and race in columns 2-5. We observe larger effects among males than females. Further, we find that negative effects are primarily concentrated among white individuals and that the effects on blacks become small and insignificant. We complement this analysis by showing the event-study results by gender and race in Figure 5. The lack of a consistent pre-trend further lends to our difference-in-difference design. The post-trend coefficients reveal a similar pattern to those of Table 2.

5.3. Effects across Other Age Groups

Changes in income and worsening local economic conditions can potentially affect all age groups. Studies suggest the role of income and financial resources for children's health and mortality (Baird et al., 2011; Hanmer et al., 2003; Waldmann, 1992). Other studies point to the benefits/costs of income shock during old age (Engelhardt et al., 2022; Salm, 2011; Snyder & Evans, 2006). Therefore, one valid argument is that NAFTA could affect the mortality of other age groups. We investigate the effects across other age-group mortality rates in event studies in

Figure 6. We do not find a consistent pre-trend or post-trend in the coefficients of mortality of age groups 0-12, 13-24, and 56 and older. It seems that the mortality effects are primarily concentrated among the working-age population.

5.4. Heterogeneity by Cause-of-Death

In Table 3, we examine the mortality effects across different causes of death. In column 1, we report column 1 of Table 2 for all-cause mortality. In columns 2-9, we report mortality effects due to internal causes, and in columns 10-11, for external causes and suicide. We observe increases in mortality from cardiovascular diseases, health-behavior-related cancers, and suicide, causes that are plausibly responsive to prolonged economic distress through pathways such as income loss, employment disruption, reduced access to healthcare, stress, and changes in health behaviors, such as smoking and drinking. In contrast, we find no systematic effects on mortality from infectious diseases, diabetes, non-health-behavior-related (largely genetic or biologically driven) cancers, or other external causes, outcomes for which there is little reason to expect trade-induced labor market shocks to exert an effect. This pattern aligns with mechanisms operating through chronic stress, reduced preventive care, and behavioral responses to economic hardship. The absence of effects for causes of death that are unlikely to be affected by trade policy, therefore, reinforces the interpretation that the estimated impacts reflect meaningful labor-market-mediated pathways rather than broad or mechanical changes in mortality risk.

These observed heterogeneous effects are in line with several studies that highlight the relevance of socioeconomic factors in determining adult mortality, specifically due to internal causes and diseases (Clark et al., 2009; Marmot et al., 1987; Power et al., 2007; Stringhini et al., 2017). Moreover, the observed increases in suicide and health-behavior-related cancers are consistent with a broader literature documenting a link between adverse labor market conditions

and suicide mortality, as well as related health behaviors, including smoking and alcohol consumption (Arcaya et al., 2014; Blakely et al., 2003; Breuer, 2015; Charles & DeCicca, 2008; Cylus et al., 2014; Everding & Marcus, 2020; Kaiser et al., 2018; Mullahy & Sindelar, 1996; Noghanibehambari et al., 2021).

5.5. Robustness Checks

Appendix Table A-2 reports a series of robustness checks to assess the sensitivity of the baseline estimates. Column 1 reproduces the baseline difference-in-differences estimate from Table 2. Column 2 replaces the log outcome with mortality rates per 100,000 population and yields a statistically significant increase of 3.3 deaths per 100,000, corresponding to an economically similar effect size. This similarity indicates that the results are not sensitive to the functional form of the dependent variable.

Columns 3 and 4 introduce additional fixed effects to account for potential confounding factors from broader geographic trends and contemporaneous policy changes. Specifically, column 3 adds census-region-by-year fixed effects, while column 4 includes state-by-year fixed effects, thereby comparing outcomes across PUMAs within the same region or state in a given year. In both cases, the estimated effect of NAFTA exposure on mortality remains positive, statistically significant, and similar in magnitude to the baseline estimate, suggesting that the results are not driven by region- or state-level time-varying shocks.

NAFTA increased not only import competition from Mexico but also export opportunities for US firms and access to imported intermediate inputs, both of which could generate positive shocks to local labor markets that might be correlated with import exposure. To account for this possibility, we employ a PUMA-level export exposure measure based on pre-NAFTA industrial composition and industry-level growth in US exports to Mexico and Canada during the 1990s

(taken from Noghanibehambari (2025)). We then include this measure interacted with year fixed effects in the main mortality regressions. This specification flexibly controls for differential time trends associated with export-side gains from NAFTA. As shown in column 5, the estimated effect of NAFTA exposure on mortality remains positive, statistically significant, and similar in magnitude to the baseline estimate.

Another concern is the confounding influence of contemporaneous trade liberalization with China around the year 2000. We construct a China trade exposure measure using the same conceptual framework and empirical approach as the vulnerability index employed for trade with Mexico, relying on pre-2000 industrial composition to capture differential local exposure. This measure is interacted with year fixed effects and included in the main mortality regressions to flexibly account for time-varying effects of China-related trade shocks. As shown in column 6, the estimated effect of NAFTA exposure on mortality remains comparable to the main results.

The estimated effects of NAFTA may also capture earlier trade liberalization between the US and Canada associated with the Canada–US Free Trade Agreement (CUSFTA), which was implemented in 1988. To address this concern, we construct a PUMA-level measure of exposure to trade with Canada using the same conceptual framework as the vulnerability index and the China trade exposure measure, relying on pre-CUSFTA industrial composition to capture differential local exposure to Canada trade liberalization. This measure is interacted with year fixed effects and included in the main mortality regressions to flexibly control for time-varying effects associated with Canada-related trade shocks. As reported in column 7, the estimated effect of NAFTA exposure on mortality remains similar in magnitude to the baseline estimate.

Columns 8-10 address the possibility that differential pre-existing trends across PUMAs, such as demographic shifts or industrial decline, may bias the estimates by allowing the effects of

baseline local characteristics to vary flexibly over time. These specifications interact year fixed effects with pre-NAFTA local characteristics, including total employment per capita in 1990, manufacturing employment per capita in 1990, and baseline demographic composition. The estimated NAFTA effect remains robust to these controls, providing evidence against the presence of differential pre-trends correlated with baseline local economic or demographic conditions.

Because NAFTA was implemented nationally in 1994, there is no staggered treatment adoption across PUMAs, and the baseline two-way fixed effects specification does not suffer from the negative weighting problems associated with staggered difference-in-differences designs. We nonetheless report estimates based on the interaction-weighted estimator of (Sun & Abraham, 2021) and the estimator proposed by (Wooldridge, 2021) as robustness checks to allow for heterogeneous treatment effects and alternative weighting schemes. As shown in columns 11 and 12, the resulting estimates are very similar to the baseline two-way fixed effects results.

6. Mechanisms

6.1. PUMA-Level Analysis

The primary candidates for the pathways between trade liberalization and mortality are changes in income and employment outcomes. We investigate this in a series of event studies and difference-in-difference estimations that employ a PUMA-year panel of socioeconomic characteristics and include PUMA and year fixed effects. First, we examine the change in employment per capita in Figure 7. To ease comparison across graphs, we standardized all outcomes in this figure. For industries, such as mining and utility, which were less exposed to NAFTA, we do not observe a significant pre- and post-trend. The negative effects are, however, mainly concentrated among manufacturing industries, particularly textile and apparel, which also attracted large media attention in the years following NAFTA. Columns 1-10 of Table 4 report the

difference-in-difference estimates. Across all industries, a one-unit cross-PUMA increase in vulnerability is associated with a reduction of approximately 10 units in employment, corresponding to a 3.3 percent decline in per capita employment relative to the pre-NAFTA mean. The effects are much larger for employment in manufacturing, textile, and apparel. However, we observe improvements in the employment of the machinery section, for which the US has an advantage over Mexico. This beneficial aspect of NAFTA has also been documented by other studies (Burfisher et al., 2001).

In Figure 8, we show the event study results for per capita income and per capita wages. We observe a very similar pattern of effects across both measures: no pre-existing trends in outcomes, gradual phase-in of negative impacts, and stabilizing for post-2000 years. We observed a similar pattern for mortality outcomes, suggesting that income is a likely pathway between NAFTA and mortality. In columns 11-12 of Table 4, we report the difference-in-difference results. For a one-unit shock to vulnerability, we observe reductions in income and wages by about \$1.5K and \$1.1K, equivalent to 4.5 and 2.7 percent decreases with respect to the pre-NAFTA outcomes' mean, respectively.

Another potential pathway is changes in wealth. Several studies point to the influence of wealth and specifically housing wealth on mortality outcomes (Bond Huie et al., 2003; Laaksonen et al., 2008, 2009). In Figure 9, we show the evolution of event study coefficients of the housing wealth price index (standardized with respect to the mean and standard deviation over the sample). The coefficients remain at the same level as those prior to NAFTA up to the year 1997, suggesting that the negative impacts of NAFTA are not passed to the housing market for several years. However, starting from the year 1998, the effects start to rise (in magnitude) and become

distinguishable from zero. The difference-in-difference estimate, reported in column 13 of Table 4 suggests a 19 percent reduction in the index with respect to its pre-NAFTA mean.

To link the mortality effects to labor market mechanisms, we examine whether the impacts of NAFTA are systematically stronger in PUMAs with higher pre-NAFTA exposure to manufacturing. Appendix Figure A-2 presents estimated coefficients of the interaction between post-NAFTA exposure and vulnerability separately for PUMAs with low and high baseline manufacturing employment, defined using per capita manufacturing employment in 1990. The results reveal a clear pattern: PUMAs with high baseline manufacturing exposure experience substantially larger increases in working-age mortality, alongside sharper declines in manufacturing employment, total employment, wages, and housing prices. This alignment between stronger labor market disruptions and larger mortality responses provides suggestive evidence that the observed increases in mortality are closely tied to employment, income, and wealth channels.

Although these negative impacts point to mortality rises, other channels may suggest the opposite direction. Social insurance programs add benefits and resources to those who were affected by job losses and labor market shocks. Studies suggest that cash transfer programs such as Unemployment Insurance benefits and Trade Adjustment Benefits may improve longevity and health outcomes, reducing the mortality toll of negative labor market shocks (Barham & Rowberry, 2013; Kuhn et al., 2020; Wu & Evangelist, 2022). In Figure 10 and columns 14-16 of Table 4, we show the effects on measures of social insurance. We observe an increase of \$210 in per capita transfer receipts, off a mean of \$4.5K. Finally, we observe reductions in employer contributions to social insurance, which is a further indication of employment losses.

Another potential channel through which trade-induced local labor market shocks may affect mortality is through changes in demographic composition and migration patterns. Because different demographic groups exhibit different baseline mortality risks, selective migration or demographic shifts could mechanically alter observed mortality rates. We examine this possibility by using PUMA-level demographic characteristics as outcomes, reported in columns 17-24 of Table 4.

We find small changes in demographic composition following NAFTA exposure, including modest increases in the share of whites and males, slight shifts toward adult and older age groups, and no statistically significant change in total population. Importantly, these effects are economically small. For example, the implied percentage changes relative to pre-NAFTA means are approximately 1.4 percent for the share of whites, 0.2 percent for the share of males, and 0.2 percent for the share of individuals aged 26–55. Moreover, because mortality rates are lower on average for whites than for other demographic groups, the observed increase in the share of whites would, if anything, bias the estimated mortality effects downward. Finally, the absence of a meaningful population response is consistent with prior evidence showing limited migration responses to trade-induced labor market shocks (Choi et al., 2024), suggesting that selective migration is unlikely to explain the observed increases in mortality.

6.2. Census-ACS Analysis

To examine the effects at the individual level and for alternative socioeconomic measures, we employ Census-ACS data, implement regressions similar to equation 4, and report the results in columns 1-5 of Table 5. We observe a reduction in employment status of about 1.3 percent relative to the mean for a one-unit change in vulnerability (column 1). We find a reduction of about

2.3 percent in total personal income (column 2). Moreover, we observe significant drops in housing value and the likelihood of being a homeowner (columns 3-4).

Another outcome that could correlate with or be a pathway to mortality is disability outcomes (Forman-Hoffman et al., 2015; Gruenewald et al., 2007). In column 5, we observe a significant increase in work disability of about 40 basis points, off a pre-NAFTA mean of 0.083.

6.3. ASEC-CPS Analysis

In columns 6-10 of Table 5, we explore the effects on alternative outcomes using the ASEC-CPS sample. We observe reductions in health insurance use (column 1). However, this decrease is small in magnitude, suggesting a 1 percent change with respect to the outcome mean. Further, we observe a change in the composition of health insurance. Higher exposure is associated with losing private health insurance and relying on presumably lower quality public health insurance (columns 7-8). Further, we observe a 2.3 percent reduction in wage income, almost identical to the effect we find for the Census-ACS sample (column 9). Finally, consistent with columns 14-15 of Table 4, which suggest increases in welfare payments, in column 10 of Table 5, we observe increases in reliance on public welfare income. The coefficient suggests a 0.4 percent increase in welfare income.

7. Discussion

7.1. Comparison with Previous Studies

The effects we find on measures of employment and income are in line with previous studies of NAFTA (Choi et al., 2024; Hakobyan & McLaren, 2016, 2017). For instance, Choi et al. (2024) suggest that moving from the bottom to the top quartile of vulnerability results in the employment effects of about a 3-7 percent decrease in employment per working age population.

Using the same shock (2 units of vulnerability index) and the results of column 1 of Table 4, we reach a reduction of about 6.6 percent in employment per population.

The effects on mortality are also in line with several studies that document the positive income-longevity relationship (Chetty et al., 2016; Hupfeld, 2011; Kinge et al., 2019; Salm, 2011), negative associations between income and mortality (Gordon & Sommers, 2016; Lindahl, 2005; Ruhm, 2019), and the small literature that shows negative health effects of trade liberalization (Bombardini & Li, 2020; Feng et al., 2021; Pierce & Schott, 2020). However, our findings contradict a strand of research that documents the benefits of reductions in income and negative local economic shocks on health and mortality outcomes (Evans & Moore, 2011; Gerdtam & Ruhm, 2006; Ruhm, 2000; Snyder & Evans, 2006). Specifically, the results differ from the findings of Pierce & Schott (2020) in the causes of deaths that are affected by local economic shocks. While they find no effects on internal causes or suicide and instead document increases in alcohol-related and drug overdose mortality, we observe significant effects across several internal causes, including cardiovascular diseases and health-behavior-related cancers, as well as suicide, but no effects on other external causes. This contrast suggests that the mortality consequences of trade-induced labor market disruptions may vary across trade episodes and institutional settings. Moreover, our results indicate larger effects among whites, a pattern that is consistent with the heterogeneous findings reported by Choi et al. (2024).

7.2. A Discussion on Magnitudes of Effects

We can put the observed effects into perspective by comparing them with the impacts of other shocks in the literature. For instance, Lindahl (2005) examines the effects of income on health and mortality outcomes. His estimates suggest that a 10 percent rise in income due to winning a lottery prize is associated with a 20 basis-point reduction in the 5-year cumulative

mortality rate, roughly a 3 percent change with respect to the mean of the outcome. Based on column 11 of Table 4, a one-unit change in vulnerability is associated with about a 4.5 percent drop in per capita income. Based on Lindahl (2005)'s estimate, this is equivalent to mortality reductions of about 1.35 percent. This is about 36 percent lower than our reduced-form estimates in Table 2 for two reasons. First, the effects of NAFTA run through many channels, including employment and income, while those of Lindahl (2005) are only income effects. Second, Lindahl (2005) bases his method on lottery prizes, which are a temporary income shock, while NAFTA brings structural changes and permanent changes in local labor markets.

We should note that the observed impacts are at the PUMA-level and across the whole population, regardless of their actual treatment status. Therefore, the results indicate intent-to-treat effects and provide a lower bound for true estimates. One way to convert these into treatment-on-treated effects is to use the estimates on employment as a first-stage influence and inflate the reduced-form effects. Assuming a labor force participation of 60 percent and using the employment effects of column 1 of Table 4, we estimate a treatment-on-treated effect of about a 7.6 percent rise in mortality of those who lost their job due to NAFTA.⁹

Between 1980 to 2010, mortality rate of age group 25-55 years old experienced a decrease of about 26 deaths per 100K (from 331 to 305 deaths per 100K). The negative intent-to-treat effects of NAFTA (for a one-unit vulnerability) are equivalent to about 12.5 percent of the observed increases in mortality over the sample period.

⁹ Since the effects of Table 4 are estimated on employment per 1,000 population, we need to convert them into 100k population to be in line with mortality rates (per 100K). Further, we use the estimate of column 2 of Appendix Table A-2 which reports the effect on level of mortality rate. Therefore, the treatment-on-treated calculation is as follows: $\frac{3.255}{0.1002/0.6}$ or about 19.5 deaths per 100K. This is equivalent to roughly 7.6 percent rise from the mean of mortality rate of aged 25-55.

8. Conclusion

The implementation of NAFTA brought a large-scale restructuring in the US economy with substantial heterogeneous effects across local areas. Many areas with pre-NAFTA dependence on industries that were protected by tariff rates experienced large reductions in income, employment, and wealth. Although it was arguably one of the most hotly debated and controversial policies in the US trade policy history, very few empirical studies have been devoted to investigating its effects. Specifically, limited attention has been paid to studying its health effects and spillover influences on non-economic outcomes (Choi et al., 2024; Hakobyan & McLaren, 2016). This paper aimed to do so by evaluating the impacts of NAFTA on local labor markets and mortality outcomes.

We implemented event-studies to examine the changes in mortality rates of local areas with differential exposure to trade competition across several years preceding and following NAFTA. We employed the universe of death records in the US over the years 1980-2010 and documented significant increases in the mortality rate of the working-age population aged 25-55. We found that these effects are primarily concentrated among whites. Further, we observed that mortality increases are driven by changes in deaths due to cardiovascular diseases, health behavior-related cancers, and suicide. Contrary to the previous literature, we did not find effects of other external causes or “deaths of despair”.

Moreover, we showed a reduction in employment, income, wages, and housing price index at the PUMA level. Analyses using alternative data sources suggested reductions in individuals’ income, employment, and health insurance, and a move toward reliance on presumably lower-quality public health insurance. Although we observe higher usage and dependency on welfare

income both at the individual level and PUMA level, these welfare transfers did not appear to be large enough to insulate individuals against trade-induced labor market shocks.

Finally, we should note that the analyses of this paper focused on localized impacts, as the effects likely varied across regions. For example, NAFTA may have reduced mortality in less vulnerable areas but increased it in more vulnerable ones. Thus, the presented findings reflect regional differences and do not capture broader general-equilibrium effects of NAFTA on mortality.

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Tables

Table 1 - Summary Statistics of the NCHS Sample

	Below-Median Vulnerability Index		Above-Median Vulnerability Index	
	Mean	SD	Mean	SD
Mortality Rate	257.88	76.52	259.18	87.59
Log Mortality Rate	5.51	.29	5.52	.27
Log Female Mortality Rate	5.15	.29	5.17	.28
Log Male Mortality Rate	5.77	.31	5.77	.29
Log White Mortality Rate	5.45	.26	5.47	.25
Log Black Mortality Rate	5.89	.5	5.9	.56
Vulnerability Index	.76	.22	1.86	.72
Vulnerability Index × Post	.4	.41	.97	1.06
Log Mortality Rate, Due to the Following Causes:				
TB, Syphilis Other Infectious Diseases	1.96	1.05	1.73	.99
Neoplasm Diseases	4.11	.24	4.14	.24
Health-Behavior-Related Cancer	2.89	.41	2.93	.42
Non-Health-Behavior-Related Cancer	2	.41	2.02	.45
Diabetes	1.65	.59	1.71	.57
Cardiovascular Diseases	4.02	.38	4.1	.36
Influenza, Pneumonia, Peptic Ulcer, Nephritis	2.8	.48	2.78	.49
All other Diseases	3.41	.47	3.37	.47
External Causes	3.79	.46	3.8	.39
Suicide	2.71	.42	2.69	.39
<i>Observations</i>		7,467		7,548
Census-ACS Data:				
Employed	.77	.42	.77	.42
Log Total Income	9.48	1.11	9.45	1.1
House Value	93.92	88.78	92.17	92.66
House Owner	.74	.44	.74	.44
Work Disability	.09	.29	.09	.29
<i>Observations</i>		14,960,116		14,935,216
ASEC-CPS Data:				
Having Any Insurance	.86	.35	.86	.34
Having Private Insurance	.82	.38	.83	.38
Having Public Insurance	.06	.24	.06	.24
Log Wage Income	7.71	4.08	7.74	4.04
Log Welfare Income	.08	.8	.1	.88
<i>Observations</i>		216,785		208,747

Notes. All mortality rates are per 100K Age Group: [25,55]. The mortality data covers the years 1980-2010. The mortality data are collapsed at the PUMA-year level. The number of pre-collapse observations is 70,007,170 deaths.

The Annual Social and Economic Supplement (ASEC) of the Current Population Survey (CPS) data covers the years 1980-2010. Census-ACS sample covers censuses 1980, 1990, and 2000, and American Community Survey (ACS) data of 2001-2010. All dollar values are in 2017 real dollars.

Table 2 - The Effects of Exposure to NAFTA on Adult Mortality Rates

	<i>Outcome: Log Mortality Rate for Age Group 25-55</i>				
	Total	Female	Male	White	Black
	(1)	(2)	(3)	(4)	(5)
Vulnerability Index × Post	.021*** (.007)	.014** (.007)	.022*** (.008)	.024*** (.007)	-.003 (.01)
Observations	15015	15014	15015	15015	13646
R-Squared	.804	.764	.808	.717	.684
Mean DV Pre	5.503	5.503	5.503	5.503	5.503
Mean DV Post	5.523	5.523	5.523	5.523	5.523

Notes. Standard errors, clustered on PUMA and year level, are in parentheses. All regressions include PUMA fixed effects, year fixed effects, and controls. Controls include PUMA-level shares of females, whites, and blacks. Regressions are weighted using the PUMA population. The data covers the years 1980-2010. Pre refers to the period before NAFTA, i.e., prior to 1994, while Post refers to the period after NAFTA, 1994 and onward.

*** p<0.01, ** p<0.05

Table 3 – Heterogeneity in The Effects of Exposure to NAFTA on Adult Mortality Rates by Causes of Death

<i>Outcome: Log Mortality Rate for Age Group 25-55, Due to the Following Causes:</i>											
Total	Infectious Diseases	Neoplasm Diseases	Health-Behavior-Related Cancer	Non-Health-Behavior-Related Cancer	Diabetes	Cardiovascular Diseases	Influenza, Pneumonia, Peptic Ulcer, Nephritis	All other Diseases	External Causes	Suicide	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	
Vulnerability	.021***	.001	.022***	.032***	.01	.003	.023***	.018*	.009	-.008	.02**
Index × Post	(.007)	(.015)	(.007)	(.009)	(.012)	(.013)	(.008)	(.01)	(.01)	(.01)	(.009)
Observations	15015	13767	15014	15004	14915	14576	15014	15003	15013	15014	15005
R-Squared	.804	.894	.681	.707	.216	.557	.813	.671	.731	.753	.63
Mean DV Pre	5.503	1.852	4.153	2.913	1.962	1.471	4.132	2.718	3.182	3.796	2.686
Mean DV Post	5.523	1.839	4.105	2.910	2.044	1.840	4.007	2.854	3.562	3.794	2.716

Notes. Standard errors, clustered on PUMA and year level, are in parentheses. All regressions include PUMA fixed effects, year fixed effects, and controls. Controls include PUMA-level shares of females, whites, and blacks. Regressions are weighted using the PUMA population. The data covers the years 1980-2010. Pre refers to the period before NAFTA, i.e., prior to 1994, while Post refers to the period after NAFTA, 1994 and onward.

Health-behavior-related cancers are those whose incidence and mortality are strongly linked to modifiable behaviors, particularly smoking and alcohol consumption, and include cancers of the lip, oral cavity, and pharynx, esophagus, liver and intrahepatic bile ducts, larynx, and the trachea, bronchus, and lung. Non-health-behavior-related cancers are those not primarily driven by smoking or alcohol use and are more plausibly associated with genetic factors, biological processes, immune function, or non-behavioral environmental exposures, including cancers of the small intestine, brain and other parts of the nervous system, and lymphomas, multiple myeloma, and leukemias.

External causes in column 10 excludes suicide deaths.

*** p<0.01, ** p<0.05

Table 4 - The Effects of NAFTA on Local Labor Markets, Socioeconomic Measures, Welfare Payments, and Demographics

	<i>Outcomes:</i>							
	Per Capita Employment in All Industries	Per Capita Employment in Agriculture	Per Capita Employment in Mining	Per Capita Employment in Utility	Per Capita Employment in Manufacturing	Per Capita Employment in Textile	Per Capita Employment in Apparel	Per Capita Employment in Machinery
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Vulnerability	-10.02***	-.18**	.13	.13	-6.88***	-4.45***	-4.31***	.51***
Index × Post	(2.31)	(.07)	(.15)	(.08)	(1.21)	(.67)	(.59)	(.18)
Observations	15292	15292	15292	15292	15292	15292	15292	15292
R-Squared	.97	.84	.82	.79	.89	.84	.77	.82
Mean DV Pre	298.751	1.529	3.269	2.887	67.358	3.913	3.852	6.356
Mean DV Post	344.080	1.049	2.368	2.471	54.655	1.946	1.282	4.784
	Per Capita Employment in Other Manufacturing	Per Capita Employment in All Other Industries	Per Capita Pre-Transfers Income	Per Capita Wages	Housing Price Index	Per Capita Current Transfer Receipts	Per Capita Income Maintenance Benefits	Per Capita Employer Contribution to Social Insurance
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Vulnerability	-.13*	-5.61***	-1.49***	-1.11***	-35.41***	.21***	.01	-.09***
Index × Post	(.08)	(2.03)	(.29)	(.32)	(11.22)	(.05)	(.01)	(.02)
Observations	15292	15292	15254	15254	14824	15254	15254	15254
R-Squared	.8	.98	.93	.92	.77	.96	.94	.96
Mean DV Pre	2.234	145.291	33.185	40.450	186.180	4.461	0.458	1.290
Mean DV Post	1.984	197.907	41.841	45.141	322.952	6.704	0.662	1.599
	Share of Whites	Share of Blacks	Share of Males	Share Aged 0- 15	Share Aged 16-25	Share Aged 26-55	Share Aged 56- More	Population
	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
Vulnerability	.012***	-.006***	.001*	-.003**	-.001	.001*	.002*	-1.482
Index × Post	(.002)	(.002)	(0)	(.001)	(.001)	(.001)	(.001)	(3.766)
Observations	15316	15316	15316	15316	15316	15316	15316	15316
R-Squared	.982	.989	.925	.892	.94	.957	.941	.988
Mean DV Pre	0.882	0.093	0.489	0.237	0.162	0.392	0.209	44.100
Mean DV Post	0.853	0.106	0.493	0.220	0.139	0.417	0.225	52.295

Notes. Standard errors, clustered on PUMA and year level, are in parentheses. All regressions include PUMA fixed effects and year fixed effects. Regressions are weighted using the PUMA population. The data covers the years 1980-2010. All dollar values are in 2017 real dollars. Pre refers to the period before NAFTA, i.e., prior to 1994, while Post refers to the period after NAFTA, 1994 and onward.

*** p<0.01, ** p<0.05

Table 5 - The Effects of Exposure to NAFTA and Individuals' Insurance, Socioeconomic, and Disability Outcomes

	<i>Samples and Outcomes:</i>				
	<i>Census-ACS Data:</i>				
	Employed	Log Total Income	House Value	House Owner	Work Disability
	(1)	(2)	(3)	(4)	(5)
Vulnerability Index × Post	-.01*** (.002)	-.023*** (.005)	-8.259*** (1.879)	-.011*** (.002)	.004*** (.001)
Observations	22252715	20084716	15516030	21889662	19159460
R-Squared	.039	.11	.306	.069	.013
Mean DV Pre	0.763	9.374	77.469	0.723	0.083
Mean DV Post	0.775	9.531	104.175	0.749	0.099
	<i>ASEC-CPS Data:</i>				
	Any Insurance	Any Private Insurance	Any Public Insurance	Log Wage Income	Log Welfare Income
	(6)	(7)	(8)	(9)	(10)
Vulnerability Index × Post	-.008*** (.003)	-.01*** (.003)	.002** (.001)	-.023*** (.006)	.004** (.002)
Observations	295604	295604	295604	425529	425529
R-Squared	.043	.047	.013	.097	.014
Mean DV Pre	0.878	0.847	0.053	7.293	0.122
Mean DV Post	0.855	0.817	0.063	8.164	0.063

Notes. Standard errors, clustered on PUMA level, are in parentheses. All regressions include PUMA fixed effects, year fixed effects, and controls. Controls include dummies for female, white, and black. Regressions are weighted using IPUMS person weights. The Annual Social and Economic Supplement (ASEC) of the Current Population Survey (CPS) data covers the years 1980-2010. Census-ACS sample covers censuses 1980, 1990, and 2000, and American Community Survey (ACS) data of 2001-2010. All dollar values are in 2017 real dollars. Pre refers to the period before NAFTA, i.e., prior to 1994, while Post refers to the period after NAFTA, 1994 and onward.

*** p<0.01, ** p<0.05

Figures

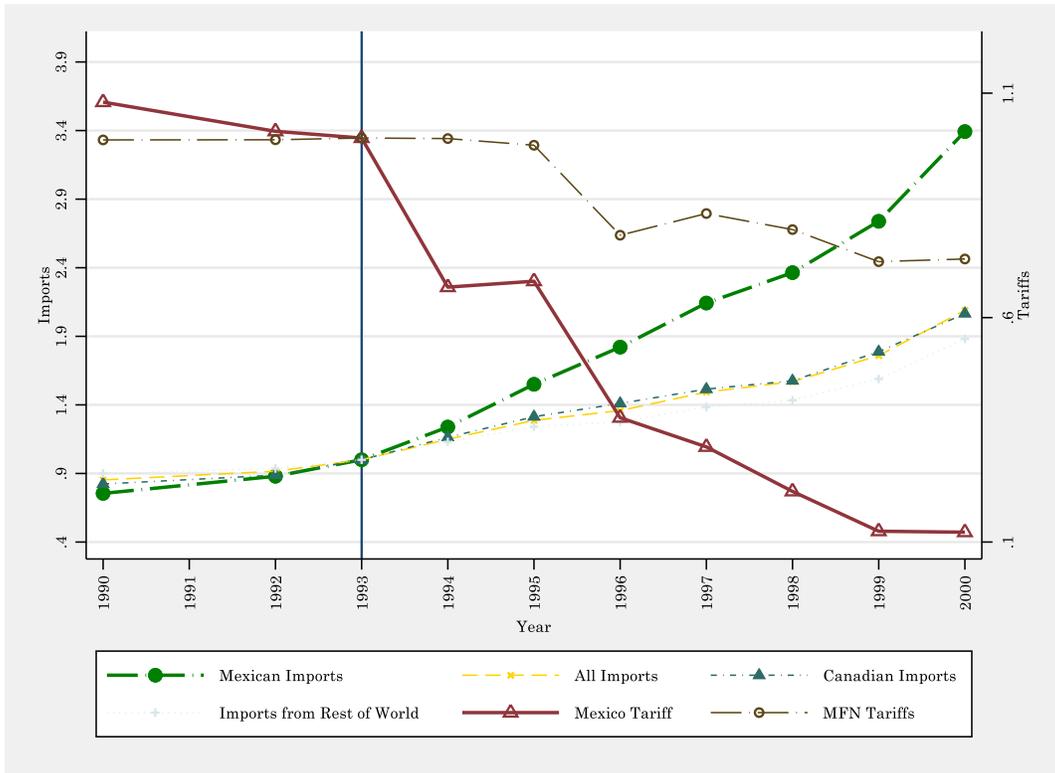


Figure 1 - Evolution of Imports and Tariffs from Mexico, Canada, and Other Countries into the US over the Years 1990-2000.

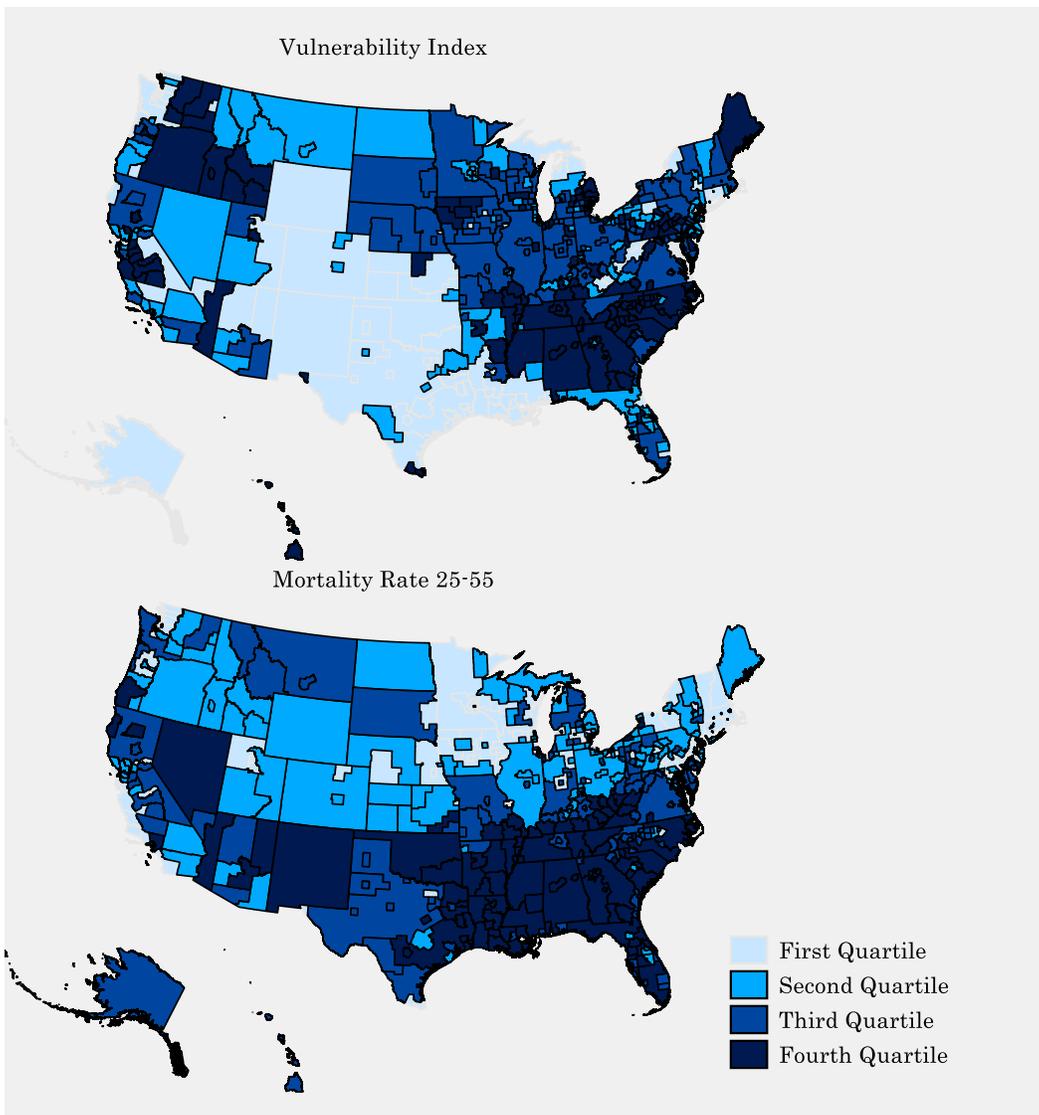


Figure 2 - Distribution of Vulnerability and Mortality across Public Use Microdata Areas

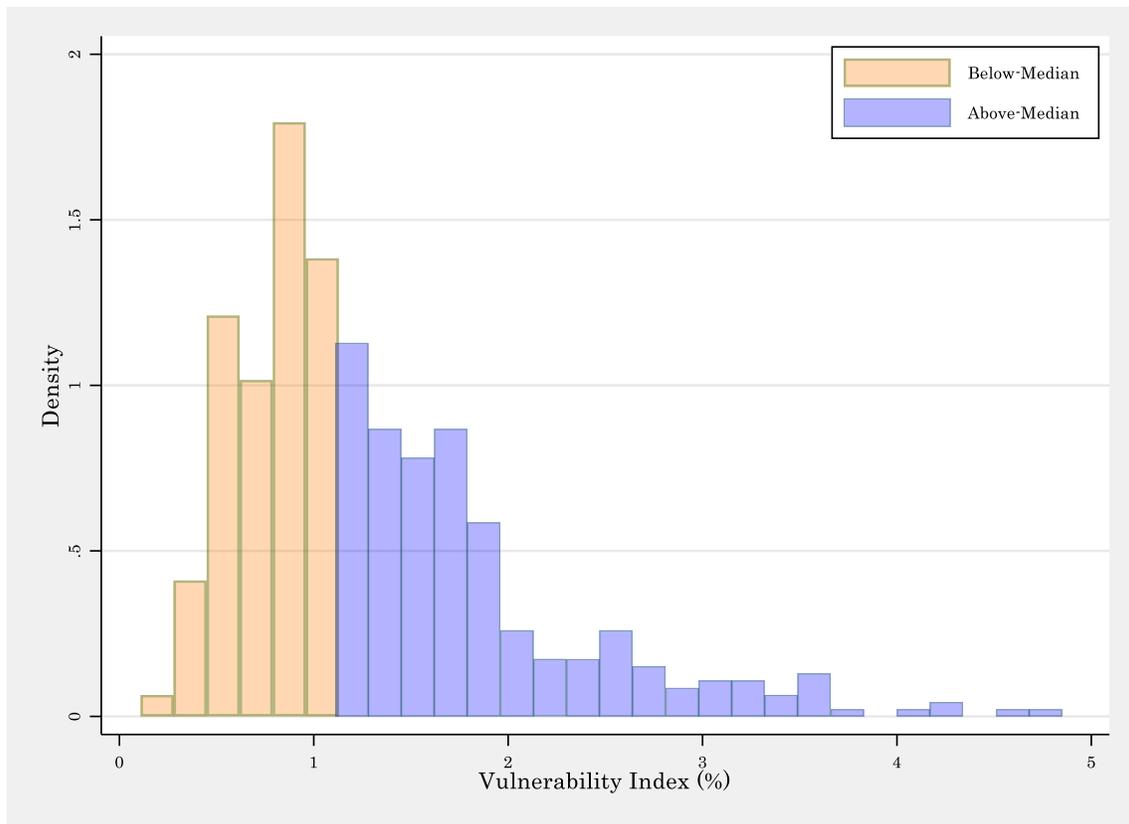


Figure 3 - Density Distribution of Vulnerability Index

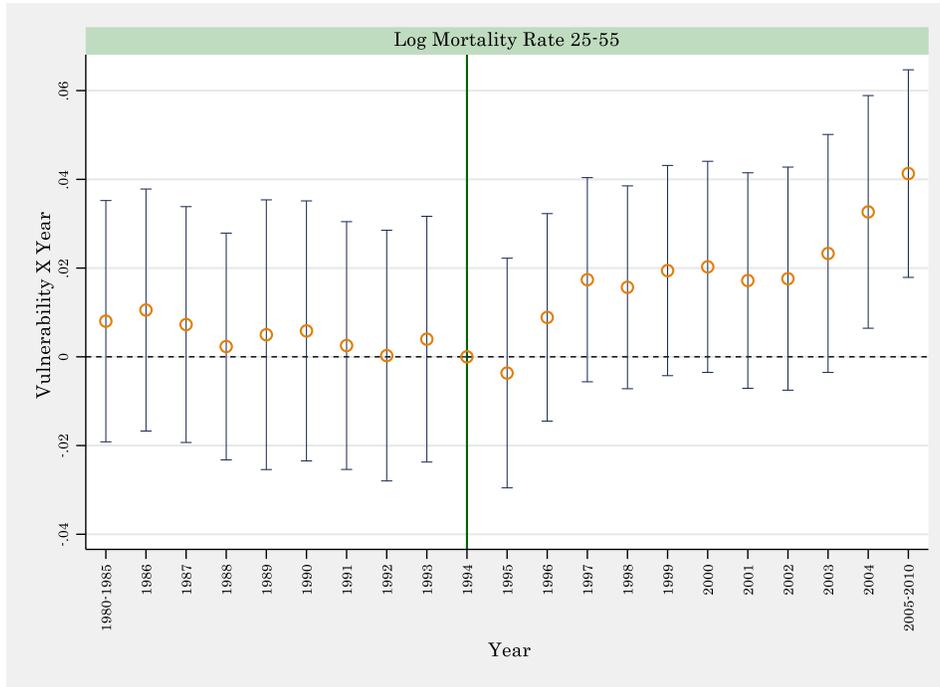


Figure 4 - Event Study Results to Evaluate the Exposure to NAFTA and Adult Mortality

Notes. Point estimates and 95 percent confidence intervals are depicted. Standard errors are clustered on PUMA and year level. Regressions include PUMA and year fixed effects. Controls include PUMA-level shares of females, whites, and blacks. Regressions are weighted using PUMA population. The data covers the years 1980-2010.

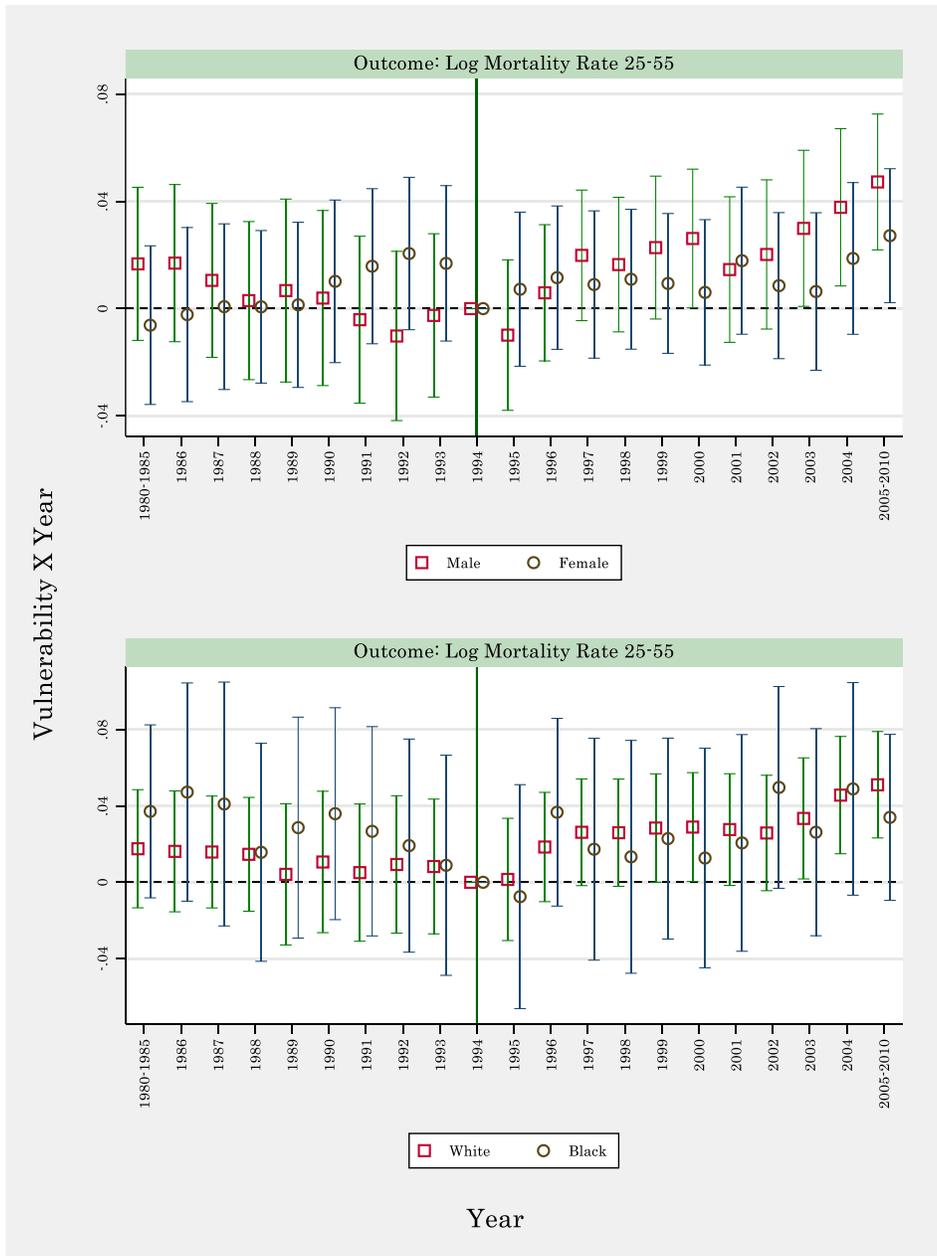


Figure 5 - Event Study Results to Evaluate the Exposure to NAFTA and Adult Mortality by Race and Gender

Notes. Point estimates and 95 percent confidence intervals are depicted. Standard errors are clustered on PUMA and year level. Regressions include PUMA and year fixed effects. Controls include PUMA-level shares of females, whites, and blacks. Regressions are weighted using PUMA population. The data covers the years 1980-2010.

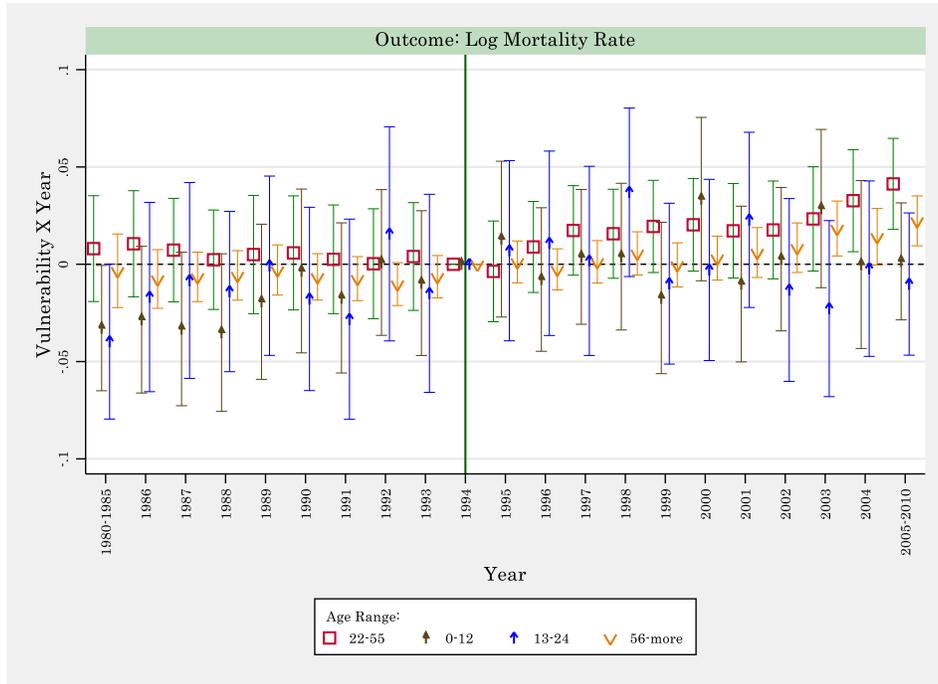


Figure 6 - Event Study Results to Evaluate the Exposure to NAFTA and Adult Mortality across Different Age Groups

Notes. Point estimates and 95 percent confidence intervals are depicted. Standard errors are clustered on PUMA and year level. Regressions include PUMA and year fixed effects. Controls include PUMA-level shares of females, whites, and blacks. Regressions are weighted using PUMA population.

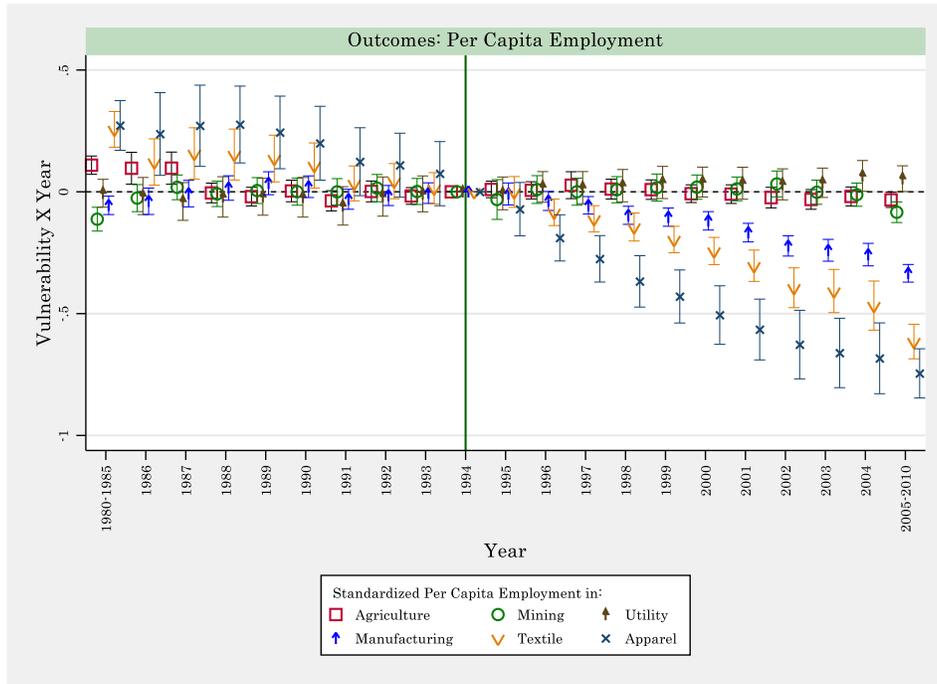


Figure 7 - Event Study Results to Evaluate the Effects of NAFTA on PUMA-Level Employment

Notes. Point estimates and 95 percent confidence intervals are depicted. Standard errors are clustered on PUMA and year level. Regressions include PUMA and year fixed effects. Regressions are weighted using PUMA population.

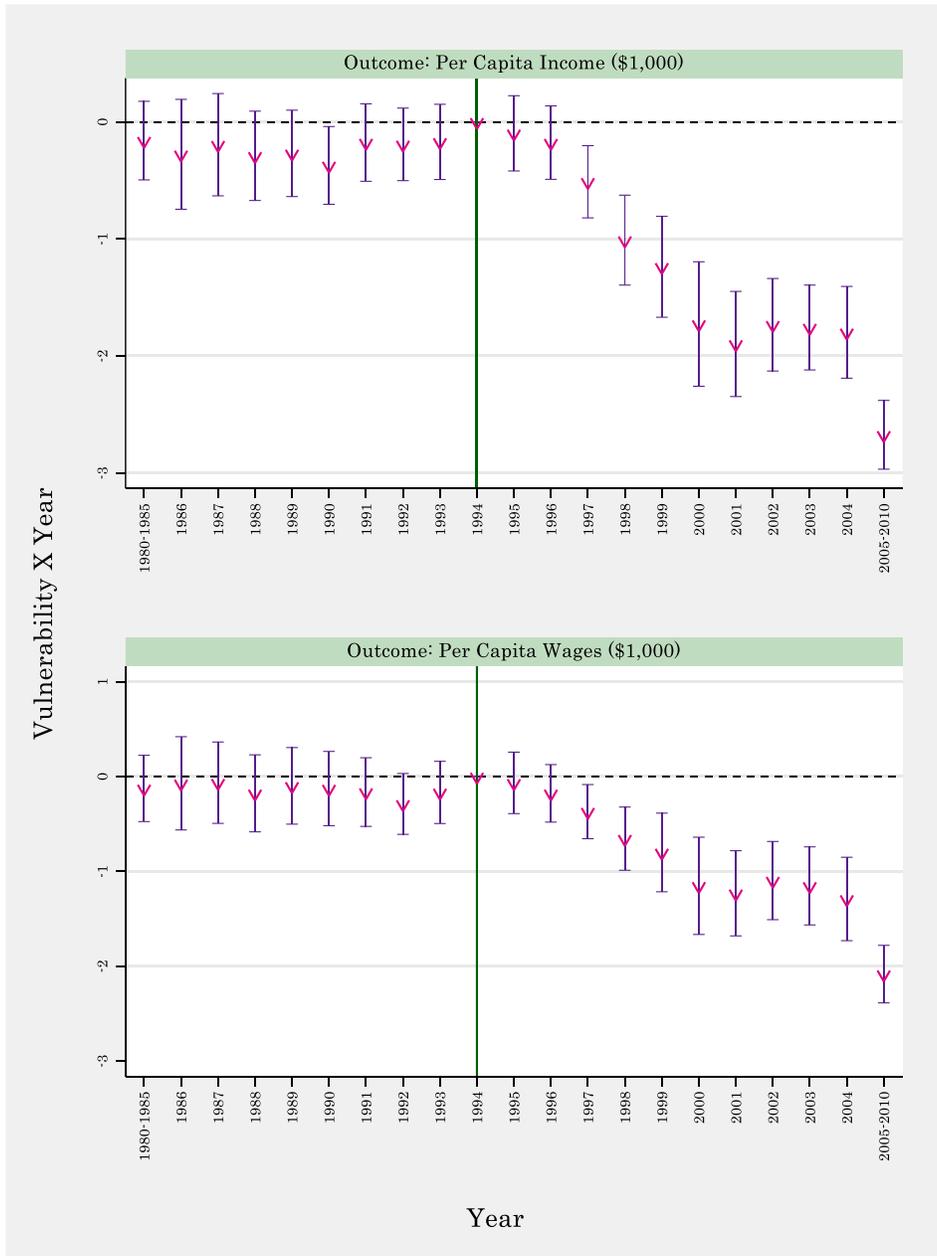


Figure 8 - Event Study Results to Evaluate the Effects of NAFTA on PUMA-Level Income and Wages

Notes. Point estimates and 95 percent confidence intervals are depicted. Standard errors are clustered on PUMA and year level. Regressions include PUMA and year fixed effects. Regressions are weighted using PUMA population.

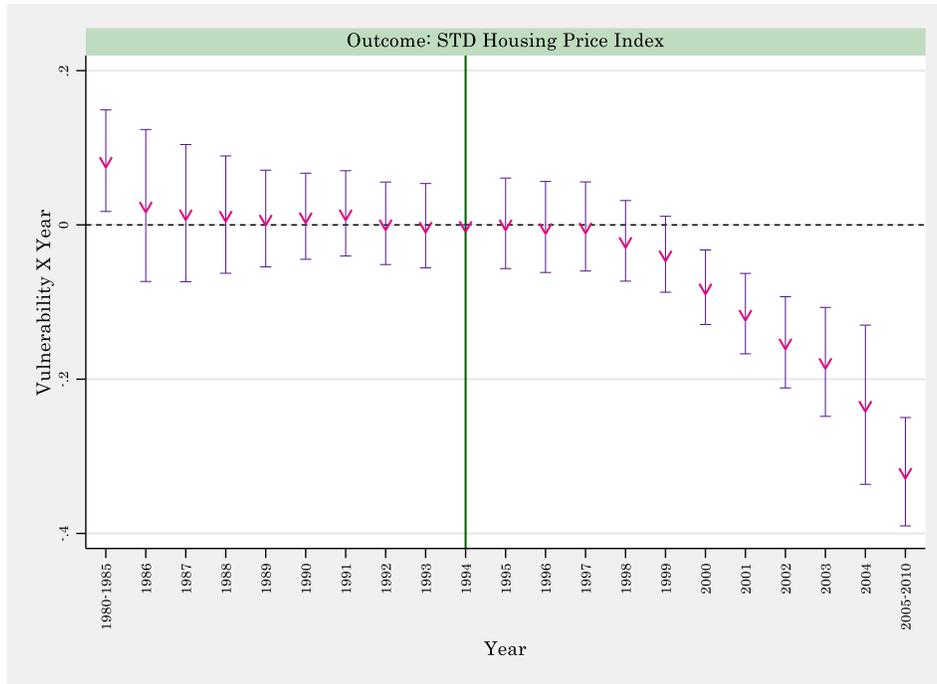


Figure 9 - Event Study Results to Evaluate the Effects of NAFTA on PUMA-Level Housing Price Index

Notes. Point estimates and 95 percent confidence intervals are depicted. Standard errors are clustered on PUMA and year level. Regressions include PUMA and year fixed effects. Regressions are weighted using PUMA population.

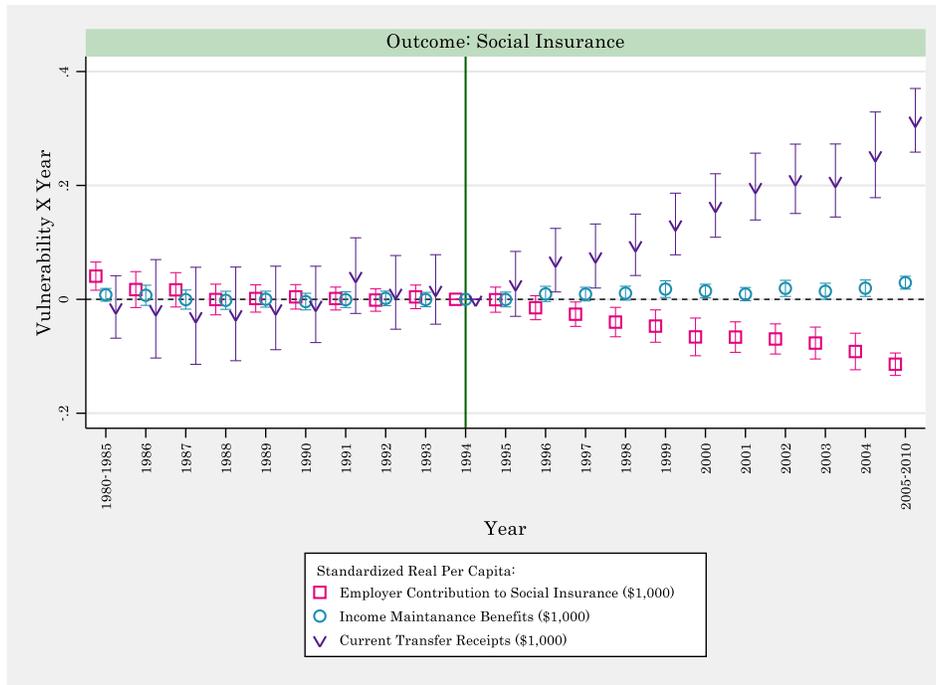


Figure 10 - Event Study Results to Evaluate the Effects of NAFTA on PUMA-Level Welfare Transfers

Notes. Point estimates and 95 percent confidence intervals are depicted. Standard errors are clustered on PUMA and year level. Regressions include PUMA and year fixed effects. Regressions are weighted using PUMA population.

Appendix A

Appendix Table A-1 – Replicating the Main Results Using a Top-Tercile of Vulnerability Index Dummy for Exposure to NAFTA

	<i>Outcome: Log Mortality Rate for Age Group 25-55</i>				
	Total	Female	Male	White	Black
	(1)	(2)	(3)	(4)	(5)
Top-Tercile Vulnerability	.06***	.045***	.065***	.066***	-.003
Index × Post	(.008)	(.008)	(.009)	(.009)	(.014)
Observations	15015	15014	15015	15015	13646
R-Squared	.805	.765	.81	.719	.684
Mean DV Pre	5.503	5.120	5.780	5.440	5.998
Mean DV Post	5.523	5.197	5.767	5.474	5.820

Notes. Standard errors, clustered on PUMA and year level, are in parentheses. All regressions include PUMA fixed effects, year fixed effects, and controls. Controls include PUMA-level share of female, whites, and blacks. Regressions are weighted using PUMA population. The data covers the years 1980-2010. Pre refers to the period before NAFTA, i.e., prior to 1994, while Post refers to the period after NAFTA, 1994 and onward.

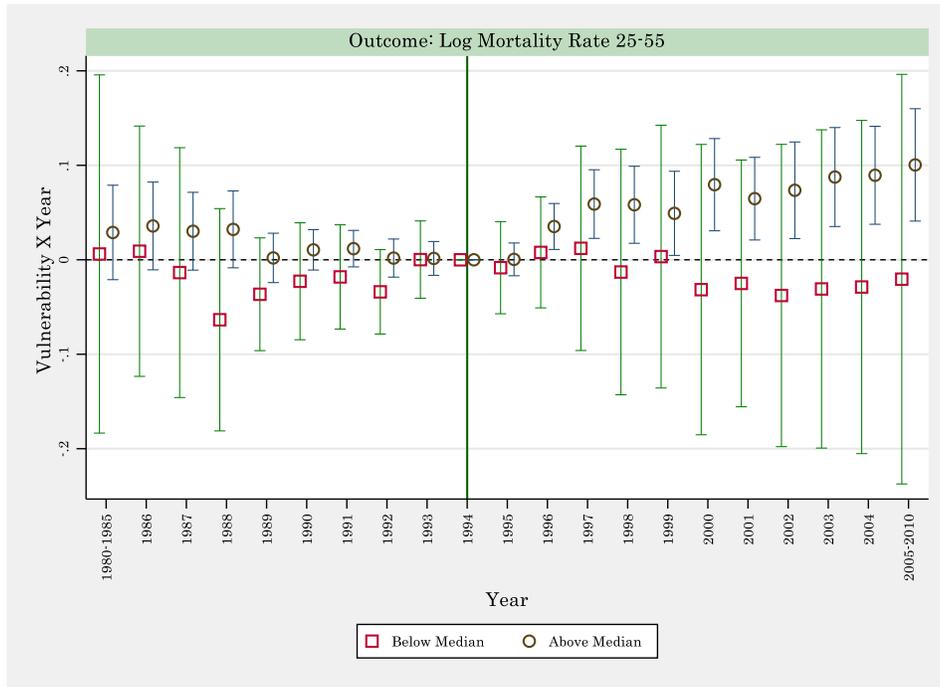
*** p<0.01, ** p<0.05

Appendix Table A-2 - Robustness Checks

	Column 1 Table 2	Outcome: Mortality Rate per 100K, Age 25-55	Adding Region-Year FE	Adding State-Year FE	China Trade Exposure Index × year FE	US Export Advantage Index × year FE
	(1)	(2)	(3)	(4)	(5)	(6)
Vulnerability Index × Post	.021*** (.007)	3.255** (1.379)	.019*** (.007)	.014** (.006)	.027*** (.008)	.021*** (.007)
Observations	15015	15015	15015	14763	15015	14995
R-Squared	.804	.825	.827	.897	.806	.805
Mean DV Pre	5.503	255.694	5.503	5.503	5.503	5.503
Mean DV Post	5.523	260.816	5.523	5.523	5.523	5.523
	Canada Trade Exposure Index × year FE	1990 Employment × Year FE	1990 Manufacturing Employment × Year FE	1990 Demographics × Year FE	(Sun & Abraham, 2021)'s Estimate	(Wooldridge, 2021)'s Estimate
	(7)	(8)	(9)	(10)	(11)	(12)
Vulnerability Index × Post	.022*** (.007)	.019*** (.007)	.023*** (.007)	.022*** (.006)	.021*** (.007)	.029** (.014)
Observations	15015	14993	14993	14995	15015	14938
R-Squared	.807	.809	.805	.834	.804	.842
Mean DV Pre	5.503	5.503	5.503	5.503	5.503	5.503
Mean DV Post	5.523	5.523	5.523	5.523	5.523	5.523

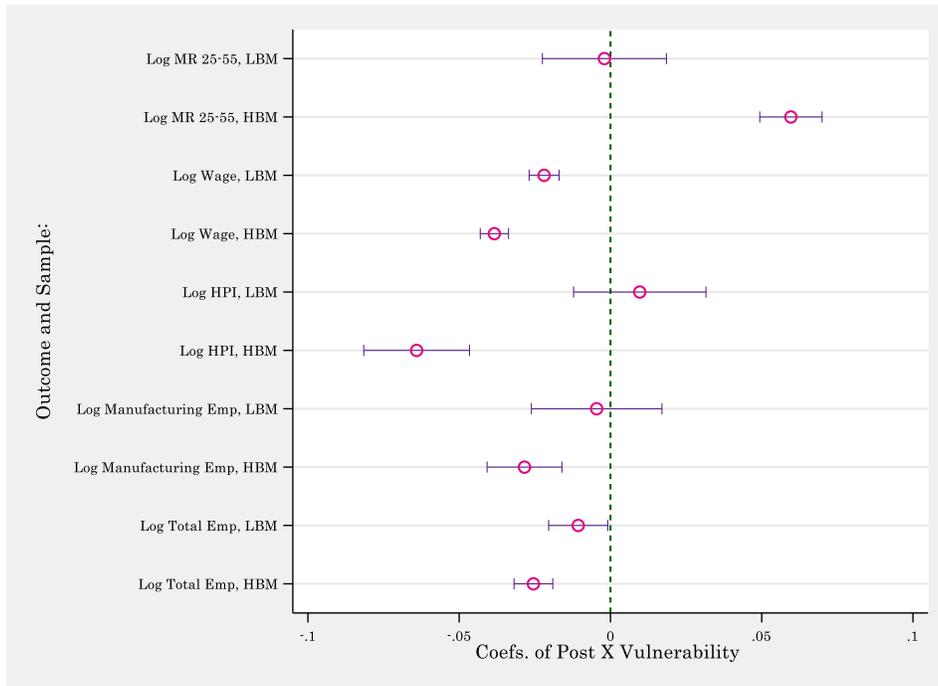
Notes. Standard errors, clustered on PUMA and year level, are in parentheses. All regressions include PUMA fixed effects, year fixed effects, and controls. Controls include PUMA-level share of female, whites, and blacks. Regressions are weighted using PUMA population. The data covers the years 1980-2010. Pre refers to the period before NAFTA, i.e., prior to 1994, while Post refers to the period after NAFTA, 1994 and onward.

*** p<0.01, ** p<0.05



Appendix Figure A-1 - Event Study Results to Show Heterogeneity by Different Levels of Vulnerability Index

Notes. Point estimates and 95 percent confidence intervals are depicted. Standard errors are clustered on PUMA and year level. Regressions include PUMA and year fixed effects. Controls include PUMA-level share of female, whites, and blacks. Regressions are weighted using PUMA population. The data covers the years 1980-2010.



Appendix Figure A-2 – Heterogeneity in the Results by Baseline Manufacturing

Notes. Point estimates and 95 percent confidence intervals are depicted. Standard errors are clustered on PUMA and year level. Regressions include PUMA and year fixed effects. Controls include PUMA-level share of female, whites, and blacks. Regressions are weighted using PUMA population. The data covers the years 1980-2010.

LBM and HBM denote low baseline manufacturing and high baseline manufacturing, respectively. Baseline manufacturing intensity is defined using per capita manufacturing employment in 1990, with LBM indicating regions below the median and HBM indicating regions above the median. MR stands for mortality rate, and HPI stands for housing price index.