NAFTA and the Gender Wage Gap*

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Abstract

Using US Census data for 1990-2000, we estimate effects of NAFTA on US wages, focusing on differences by gender. We find that NAFTA tariff reductions are associated with substantially reduced wage growth for *married* blue-collar *women*, much larger than the effect for other demographic groups. We investigate several possible explanations for this finding. It is not explained by differential sensitivity of female-dominated occupations to trade shocks, or by household bargaining that makes married women workers less able to change their industry of employment than other workers. We find some support for an explanation based on an equilibrium theory of selective non-participation in the labor market, whereby some of the higher-wage married women workers in their industry drop out of the labor market in response to their industry's loss of tariff. However, this does not fully explain the findings so are left with a puzzle.

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1 Introduction

The effect of trade on gender inequality has not ever been a prime focus of trade economists, but gender gaps in income and labor-force participation are of intense policy and political interest, and can potentially be greatly affected by trade policy. This paper explores the impact of a major trade shock – the launch of NAFTA – on the gender wage gap in the US in the 1990s.

NAFTA, the most important trade policy change in the US over the last three decades, was launched on January 1, 1994 and featured a 10-year schedule of tariff phase-out between the US, Canada and Mexico. Hakobyan and McLaren (2016) examine the effect of US tariff reductions against imports from Mexico due to NAFTA on US workers' wage growth in the 1990s. The findings suggest very heterogeneous effects across US workers of different educational class that also vary across locations and industries. In particular, NAFTA is associated with slower wage growth for less skilled workers employed in industries and residing in locations that were more vulnerable to imports from Mexico. But the paper did not address NAFTA's potential impact on the gender wage gap.

Much of the existing literature focuses on trade and the gender wage gap in developing countries (see Aguayo-Tellez (2012) and Papyrakis et al (2012) for an extensive survey), but a number of studies look at the relationship in advanced economies. Black and Brainerd (2004) study the effects of increased import competition on the gender wage gap across industries and metropolitan areas in the US using the Current Population Survey (CPS) from 1977 to 1994 and the 1980 and 1990 Censuses. They find that the residual (after controlling for individual characteristics) gender wage gap narrowed more rapidly in concentrated industries that experienced a trade shock than in competitive industries, lending support to Becker's (1957) model of discrimination according to which increased market competition reduces employer discrimination in the long run.

Using US data from 1990-91 and 2006-07, Sauré and Zoabi (2014) examine the effects of a higher exposure to trade with Mexico on female employment shares and female relative wages across US states, and find that trade expansion had a negative impact on female employment relative to male in states with greater exports to Mexico. The results remain robust for married female workers, for female workers of all educational categories (less than high school, high school graduate and advanced education), and for workers in manufacturing only. They do not find a significant difference in female relative wage due to higher trade exposure, attributing it to a selection bias whereby the measured average wages of working women do not change, while the unmeasured potential wages of nonworking women decrease (as they leave labor force). Autor et al. (2013) examine the impact of rising Chinese import competition on U.S. labor market outcomes over the period of 1990-2007 and find that both male and female employment and the corresponding wages decreased but that these changes were more pronounced for women. Brussevitch (2016) shows that some portion of the declining gender wage gap in the US can be explained by differential labor adjustment costs. She estimates a structural econometric model of dynamic labor adjustment and finds that, although men tend to have overall lower adjustment costs than women, women have an advantage in moving into service-sector jobs following a shock to traded-sector labor demand. None of these papers however addresses the differences in income distribution by gender, marital status, education, industry of employment and location simultaneously, which is the focus of this paper.

Studies of trade and the gender wage gap in developing countries are more common and tend to conclude that trade liberalization improved labor market outcomes of women. Aguayo-Tellez et al. (2010) document increased female employment rates and female relative wages in Mexico during the 1990s due to NAFTA, and using establishment-level data for the Mexican manufacturing sector, show that female wage bill shares increased in response to reductions in US tariffs on Mexican goods, particularly for skilled blue-collar female workers. Using the same data from Mexico, Juhn et al. (2014) show that tariff reductions due to NAFTA increased the ratio of female blue-collar workers to male blue-collar workers as well as the relative wage of female blue-collar workers, with little evidence for white-collar women's share and relative wages. Gaddis and Pieters (2014) find that trade liberalization in Brazil reduced male and female labor force participation and employment rates, but the effects on men were significantly larger, leading to gender convergence in labor force participation and employment rates.

This paper borrows from several advances in the literature and builds on the methodological framework developed in Hakobyan and McLaren (2016) to study the differential impact of tariff reductions on men's and women's wage growth and labor force participation decisions over the 1990s by exploiting the exogenous nature of the NAFTA shock. We use publicly available US Census data from 1990 and 2000, taken from the IPUMS project at the Minnesota Population Center (www.ipums.org; see Ruggles et. al. (2015)). The richness of our data allows us to estimate the differential impact of a trade shock within a location, industry, occupation and educational class.

To anticipate results, we find that reductions in blue-collar wage growth from NAFTA tariff reductions were much larger for women than for men, and much larger for married women than for single women. We investigate four possible explanations for this finding: differential sensitivity to shocks across occupations; household bargaining within a marriage; non-linear preferences interacted with household bargaining; and selective non-participation in the labor market on the part of married women. We are able to reject the first three with the data; the fourth appears to be plausibly a portion of the explanation, but it is unable to explain the full effect. We therefore conclude with a puzzle.

The rest of the paper proceeds in the following way. Section 2 briefly explains the methodological framework developed in Hakobyan and McLaren (2016) and presents the basic results for the wage growth over 1990s for six groups of workers: married men and women with an employed spouse, married men and women with a spouse who is unemployed or not in the labor force (NILF) and single men and women. Section 2 concludes by laying out three stylized facts. Section 3 proposes four possible explanations for our basic findings in Section 2 and develops a simple theoretical model for each explanation followed by further empirical tests of the proposed theory. Finally, Section 4 summarizes.

2 Empirical approach and basic results

Our analysis of local labor markets requires a time-invariant definition of local labor markets in the US. We take advantage of consistently defined Public Use Microdata Areas (conspumas) constructed by and available from IPUMS-USA (Ruggles et al, 2015). There are 543 conspumas covering both urban and rural areas in the US. Following the empirical specification in Hakobyan and McLaren (2016), we construct a measure of conspuma's exposure to NAFTA as 1990 employment share weighted US tariff rate (against Mexican imports) in 1990, adjusted for Mexico's relative comparative advantage. We refer to this measure as average local tariff or local vulnerability.

$$loc\tau^{c}_{1990} \equiv \frac{\sum_{j=1}^{N_{ind}} L^{cj}_{1990} RCA^{j} \tau^{j}_{1990}}{\sum_{j=1}^{N_{ind}} L^{cj}_{1990} RCA^{j}}, \tag{2.1}$$

where L^{cj}_{t} is the number of workers employed in industry j at conspuma c at date t, N_{ind} is the number of industries, and

$$RCA^{j} = \frac{\left(\frac{x^{MEX}_{j,1990}}{x^{ROW}_{j,1990}}\right)}{\left(\frac{\sum_{i} x^{MEX}_{i,1990}}{\sum_{i} x^{ROW}_{i,1990}}\right)}$$

The variation in this measure comes from three sources: differential concentration of employment across industries in each conspuma; specialization in industries in which Mexico has comparative (dis)advantage relative to the rest of the world; and the US imposed differential tariff rates. Analogously, we define industry tariff rates, adjusted for Mexico's relative comparative advantage.

The use of the Census data collected in 1990 and 2000 dictates our empirical approach to identifying the effect of NAFTA which went into effect in 1994. The agreement was framed as a gradual phase-out of tariffs between the three countries, starting in 1994 and continuing for 10 years (with a few tariffs continuing to 15 years). We focus on exposure to Mexican imports at the time of NAFTA's launch because the reduction of tariffs between the US and Canada had began much earlier with signing of a free trade agreement between the two countries in 1989. The negotiated schedule of liberalization was different for each sector of the economy. As a result, for some industries, the period from 1990 to 2000 was the period of an announcement of tariff reductions, most of which occurred after 2000. For other industries, the same period saw rapid elimination of tariffs. As a result, we deal with variation in the timing of liberalization by controlling separately for both the initial tariff rates in 1990 which capture the potential vulnerability of a location or an industry to imports from Mexico and actual change in tariffs between 1990 and 2000.

In addition to the differential responses of men and women to a trade shock, we acknowledge that married and single individuals are likely to respond differentially as well. A married worker may be more constrained in responding to a trade shock, because some forms of response, such as relocation, require agreement from all members of the household. Furthermore, the response of a married couple with both husband and wife being employed may well differ from those couples that have an unemployed spouse or a spouse not in labor force.

These considerations prompt us to consider the labor market outcomes of exposure to import competition from Mexico for six groups of workers separately: married men or women with an employed spouse, married men or women with a spouse who is unemployed or not in labor force, single men and single women. We focus initially on wage growth between 1990 and 2000. Our rich empirical specification allows for dynamic response of wages for each group of workers to vary by industry, location and education level (high school dropout, high school graduate, some college or associate degree, and college graduate). We also allow for a different rate of wage growth for locations on the US-Mexico border.

$$
\begin{aligned}
log(w_i) \;=\;& \alpha X_i + \sum_j \alpha_j^{ind} ind_{i,j} + \sum_c \alpha_c^{conspuma} conspuma_{i,c} + \sum_n \alpha_n^{occ} occ_{i,n} \qquad (2.2)\\
+& \sum_{k \neq col} \gamma_{1k} educ_{ik} + \sum_k \gamma_{2k} educ_{ik} yr2000_i \\
+& \sum_{k \neq col} \delta_{1k} educ_{ik} loc\tau_{1990}^{c(i)} + \sum_k \delta_{2k} educ_{ik} yr2000_i loc\tau_{1990}^{c(i)} \\
+& \sum_{k \neq col} \delta_{3k} educ_{ik} loc\triangle\tau^{c(i)} + \sum_k \delta_{4k} educ_{ik} yr2000_i loc\triangle\tau^{c(i)} \\
+& \sum_{k \neq col} \theta_{1k} educ_{ik} RCA^j \tau_{1990}^{j(i)} + \sum_k \theta_{2k} educ_{ik} yr2000_i RCA^j \tau_{1990}^{j(i)} \\
+& \sum_{k \neq col} \theta_{3k} educ_{ik} RCA^j \triangle\tau^{j(i)} + \sum_k \theta_{4k} educ_{ik} yr2000_i RCA^j \triangle\tau^{j(i)} \\
+& \mu Border_{c(i)} yr2000_i + \epsilon_i,
\end{aligned}
$$

where $conspuma_{i,c}$, $ind_{i,j}$ and $occ_{i,n}$ are dummy variables that take a value of 1 if worker i resides in conspuma c, works in industry j and has an occupation n, respectively; $c(i)$ is the index of worker i's conspuma, and $\triangle\tau^{j(i)}$ and $loc\triangle\tau^{c(i)}$ are the changes in tariff for industry j and location c, as defined at the beginning of this section.

The parameters of primary interest here are $\delta_{2,k}$ and $\delta_{4,k}$, which measure the initial-tariff effect and the impact effect, respectively, for the local average tariff; and $\theta_{2,k}$ and $\theta_{4,k}$, which measure the initial-tariff effect and the impact effect, respectively, for the industry tariff. If it is easy for workers to move geographically, so that local wage premiums are arbitraged away, but difficult for workers to switch industry, we will observe $\delta_{1,k}, \ldots, \delta_{4,k} = 0$ while $\theta_{1,k}, \ldots, \theta_{4,k} \neq 0$. In that case, industry matters, but location does not. On the other hand, if it is difficult for workers to move geographically but easy to switch industries within one location, we will see the opposite: $\delta_{1,k}, \ldots, \delta_{4,k} \neq 0$ while $\theta_{1,k}, \ldots, \theta_{4,k} = 0$. In reporting our results, we focus on the case when a *location* or an *industry* loses all of its protection within the sample period, thus the effect on wages within the sample period is equal to $\delta_{2,k} - \delta_{4,k}$ in a given location and $\theta_{2,k} - \theta_{4,k}$ in a given industry.

In the regressions below, we use a 5% sample from the US Census for 1990 and 2000,

Table 1: Summary statistics by gender, marital status and employment status of the spouse

	Employed spouse		Unemployed/NILF spouse		Single		Total
	Male	Female	Male	Female	Male	Female	
Age	42.42	40.71	43.48	47.59	37.80	40.40	41.21
White	0.86	0.86	0.84	0.79	0.76	0.73	0.82
English speaking	0.996	0.995	0.989	0.985	0.986	0.992	0.992
Home owner	0.82	0.83	0.76	0.79	0.55	0.55	0.72
Child(ren)	0.48	0.49	0.50	0.34	0.19	0.34	0.41
High school dropouts	0.09	0.07	0.17	0.17	0.14	0.11	0.11
High school graduates	0.31	0.33	0.32	0.40	0.34	0.32	0.33
Some college	0.30	0.33	0.25	0.26	0.28	0.33	0.30
College graduates	0.30	0.28	0.27	0.17	0.24	0.25	0.27
Log wage income	10.33	9.55	10.34	9.43	9.92	9.69	9.91
N of observations	2,484,061	2,642,608	1,225,432	410,167	1,656,555	1,809,235	10,228,339

available from IPUMS-USA, selecting workers from age 25 to 64 who report a positive pre-tax wage and salary income in the previous year.[1] In addition to constructed interaction terms and conspuma, industry and occupation fixed effects, we include the following personal characteristics: age, whether or not the worker speaks English, race, home ownership, presence of a school-aged child and educational attainment.

Table 1 shows descriptive statistics for the personal characteristics for the six groups of workers based on gender, marital status and employment status of the spouse. In our sample, single workers (both male and female) are on average younger (38 and 40 years old), more racially diverse (76 and 73 percent white), less likely to own a home (55 percent), and less likely to have a child (19 percent of men and 34 percent of women). Although high-school dropouts are 11% of the total, this fraction is considerably higher among men and women with unemployed/NILF spouse and considerably lower among both men and women with employed spouse. The remainder of the sample is about evenly split between high-school

[1] The sample includes individuals who report being employed, unemployed or not in labor force in the census year. We use the last industry of employment for the unemployed and those not in labor force. Wage/income regressions omit those workers with no reported wage/income. Labor force participation regressions include all workers in the sample.

Table 2: Summary Statistics for Industry and Local Average Tariffs

Variable	Mean	St. Dev.	Min	Max	N
Industry Tariff in 1990 (%)	1.0	2.0	0	8.8	89
Change in Industry Tariff (%)	-0.9	1.6	-7.0	0.01	89
Local Tariff in 1990 (%)	1.03	0.67	0.09	4.74	543
Change in Local Tariff (%)	-0.92	0.61	-4.30	-0.08	543

Notes: Industry level tariff variables are computed from 8-digit HS tariff data weighted by imports from Mexico and are mapped into 89 tradable goods industries based on Census industry classification. RCA is Mexico's revealed comparative advantage in a particular industry as defined in the text. Conspuma level variables are weighted by employment in industries of a given conspuma.

graduates, those with some college, and college graduates for married workers with employed spouse, while for other groups the fraction of college graduates is smaller than that of high school graduates and those with some college.

Table 2 summarizes our measures of industry and location vulnerability. The 1990 RCA-adjusted industry tariff across 89 traded-goods industries ranges from 0 to 9%, with a mean of 1%. The initial local average tariff across 543 conspumas ranges from approximately 0.09 to 4.74%, with a mean just above one percent. It is worth pointing out that when computing local average tariff we omit agriculture by setting its tariff equal to zero because a coarse aggregation of industries in Census data applies the same tariff to all agricultural crops.[2]

Table 3 shows the difference between the initial-tariff effect and the change-in-tariff effect for the main specification in equation (2.2) with all right-hand-side variables and industry, conspuma and occupation fixed effects, run separately for each of our six groups of workers. Standard errors are clustered by conspuma, industry, and year, following Cameron, Gelbach and Miller (2006). The coefficients on personal characteristics have the expected signs across all groups of workers and are not reported here. There is a concave age curve; white English speaking workers enjoy a wage premium (except for white married women with employed

[2]For further discussion, see Hakobyan and McLaren (2016).

Table 3: Wage growth: Difference between initial tariff and impact effects

	Employed spouse		Unemployed/NILF spouse		Single	
	Male	Female	Male	Female	Male	Female
Location effect						
Less than high school	-0.35	-3.8***	-1.99	-2.71*	-1.173	-1.86
High school graduate	-0.275	-0.358	-1.728***	-1.99**	-0.496	-0.87
Some college	-1.216*	-1.357*	-1.115*	-1.262	-0.876*	-0.727
College graduate	-0.219	-1.944*	-0.848	-2.423	0.299	-0.133
Industry effect						
Less than high school	-0.847	-3.797**	-0.822	-3.897**	-1.674***	-1.874*
High school graduate	-0.41*	-2.913***	0.635*	-2.704***	-0.579	-0.452
Some college	0.021	-1.491	-0.216	-1.597	0.12	0.536
College graduate	-0.083	2.041	0.531	0.585	-0.9674	0.665
N of Observations	2,484,061	2,642,608	1,225,713	410,174	1,656,555	1,809,235

spouse); workers who own a home earn higher wages; and workers with more education earn higher wages, *ceteris paribus*. Male workers with a child at home earn higher wages, whereas female workers with a child earn lower wages, *ceteris paribus*.

First examining the location variables, Table 3 shows that among conspumas that lost their protection quickly under NAFTA, those that appeared to be very vulnerable had substantially lower wage growth for married female high-school dropout workers than those with low initial tariffs. In particular, married female workers with less than high school education and an employed spouse, living in the most vulnerable conspuma with an initial local average tariff of 4.74 percent, would see a substantial drop in wage growth over 1990s of around 18 percentage points. However, we do not find a similarly strong effect for married male workers with less than high school education, nor for workers with higher level of educational attainment. Furthermore, among single workers of all educational attainment the effect on wage growth is smaller and statistically insignificant, with no significant difference between male and female workers.

Turning now to the industry effects, Table 3 shows a similarly asymmetric response of wages of married female workers with less than high school education, with the effect for married male workers being of smaller magnitude and imprecisely estimated. In particular, married female high-school dropout workers with an employed spouse, working in the most highly-protected industry with an initial tariff of 8.8 percent, would see wage growth 33 percentage points lower if it lost its protection right away than similar workers in an industry that had no protection. Unlike the location effects, the effect of industry tariffs is statistically significant for high-school dropout single workers. Again, the effect is much smaller for high-school graduates and those with some college, and negligible (and at times positive) for college graduates.

To sum up the results so far, we find that: (1) There is no real difference between the wage response of unmarried men and women. (2) There is a much more negative effect on married women's wages than married men's wages, particularly for blue-collar workers (in fact, most of the effect of NAFTA on blue-collar wages seems to be driven by married women). (3) These effects hold true whether the worker's spouse is working or not.

To be sure that our results are not driven by the way we measure our dependent variable, or how we select the sample of workers, we estimate the same regression replacing the dependent variable with self-employment income for those with no wage income; replacing the dependent variable with weekly wage; excluding workers over 55 years old; and excluding workers with spouses younger than 25 and older than 64. The results reported in Appendix Tables A1-A4 continue to be in line with the earlier findings in Table 3. We conclude that our basic results are not driven by measurement error in dependent variable, or by sample selection.[3]

[3] We also take a closer look at possible fertility effects that could bias our basic estimates for women. To address this, we split the sample of all female workers into those under 35 and over 35, and estimate separate regressions for each group of workers (married with employed spouse, married with unemployed/NILF spouse, and single). As reported in Appendix Table A5, we find similar wage responses among married women below and over 35, with some differential responses among single women below and over 35. We conclude that the fertility effects do not drive our basic results.

3 Search for explanations

Below we investigate four different possible explanations for the results presented in previous section.

(i) *Heterogeneous occupations.* It could be that different occupations have different levels of sensitivity to industry-level trade shocks, for example because the cost of inter-industry mobility differs across occupations. If women are over-represented in the more sensitive occupations, that can lead to a larger wage effect on average for women workers than for men.

(ii) *Household bargaining.* It could be that married women are less mobile than other workers because switching industries sometimes requires switching city of residence, which is a joint decision with her spouse. We investigate the possibility that if a husband has more bargaining power than a wife, this can result in asymmetries in moving frictions that result in larger wage impacts for married women than for single workers or married men. We will show that simply assuming more bargaining power for husbands is inadequate to explain the phenomena in the data, because asymmetric bargaining power within the household on its own does not lead to asymmetries in worker mobility.

(iii) *Household bargaining with non-linear preferences.* We add to the household-bargaining model to allow for non-linear interactions between consumption and locational preference, so that the marginal utility of consumption is affected by the city in which the household resides. We show that this can lead to effects of asymmetric bargaining power on worker mobility, but it still is not sufficient to explain the correlations in the data.

(iv) *Selective non-participation.* It is possible that when an industry shrinks due to a trade shock that a certain fraction of workers choose to leave the labor force. If those leavers are disproportionally married women, and disproportionally the higher-paid workers in their industry, the selection effect can result in a larger drop for average wage for the remaining married women workers in the industry, compared to other groups. We present an equilibrium model in which exactly this prediction emerges.

3.1 Heterogeneous occupations

3.1.1 Theory

Occupations vary greatly in the gender composition of their workers, with some occupations dominated by woman workers and others by men. As one example, 'textile sewing machine operators,' an occupation with more than a million workers in our dataset, has 10 female workers for every male worker. If occupations also differ in the portability of skills across industry, with some occupations very mobile across industries and others immobile, then it could be that female-dominated occupations happen to be, on average, less mobile across industries. This would imply a larger wage response to a trade shock for women workers on average even if all genders are treated equally.

A simple example can illustrate the point. Suppose that there are two industries indexed $i = 1, 2$ and two occupations indexed $j = 1, 2$. Production in each industry requires labor input from both occupations, so output of industry i is given by a concave linear homogeneous production function $f^i(L_1^i, L_2^i)$, where L_j^i is the number of workers in occupation j employed by industry i. Suppose that each worker is attached to an occupation and cannot change it.

To capture the idea that different occupations can have different degrees of mobility in a simple way, suppose that workers in occupation 2 cannot change their industry of employment, but workers in occupation 1 can change their industry freely. Perhaps occupation 2 requires mastering a particular part of a production process with particular machines that differ from one industry to another and so the skills required for it are not portable across industries (sewing machines, for example, are not useful outside of the apparel industry); while occupation 1 requires general production-floor activities that are similar across industries. Suppose that the price of output from both industries is given on world markets (for simplicity, assume that the economy in question is a small open economy), but the domestic price can differ from the world price due to trade policy. Letting good 2 be the numeraire, suppose that industry 1 is import-competing, and its domestic price, p, is equal to the world price plus an import tariff. All agents take all prices as given.[4]

Since occupation 1 is mobile, the wage w_1 paid to it must be the same in both industries. Since this will be equal to the marginal value product of labor, we have:

$$pf_1^1(L_1^1, L_2^1) = w_1 = f_1^2(L_1^2, L_2^2) = f_1^2(L_1 - L_1^1, L_2^2), \tag{3.1}$$

where subscripts on a function indicate partial derivatives and L_1 is the exogenous and fixed supply of workers in occupation 1. This determines the allocation of occupation-1 workers across the two industries, and also w_1. Further, the occupation-2 wages in the two industries must adjust to yield zero profits in both industries:

$$c^1(w_1, w_2^1) = p, \text{ and} \tag{3.2}$$

$$c^2(w_1, w_2^2) = 1, \tag{3.3}$$

where $c^i(\cdot)$ denotes the unit cost function for industry i and w_2^i is the occupation-2 wage in industry i.

Differentiating (3.1) with respect to p, allowing L_1^1 to adjust, shows that $\frac{dL_1^1}{dp} > 0$, so a reduction in the tariff on industry 1 will move labor from industry 1 to 2. This will reduce w_1 (from the industry 2 first-order condition) and increase $\frac{w_1}{p}$ (from the industry-2 first-order condition). If we write the elasticity of a variable X with respect to Y as ϵ_{XY}, then this implies:

$$0 < \epsilon_{w_1 p} < 1. \tag{3.4}$$

Differentiating the two zero-profit conditions then implies that a drop in the tariff will require a more-than-proportional drop in w_2^1 to restore industry-1 zero profits, and an increase

[4]This simple structure gives the model the same form as the Ricardo-Viner model of trade (Jones, 1971).

in w_2^2 to restore industry-2 zero profits:

$$\epsilon_{w_2^2 p} < 0 < 1 < \epsilon_{w_2^1 p}. \tag{3.5}$$

Conditions (3.4) and (3.5) together imply that the wage response for the immobile occupation in the import-competing industry will be much larger than for the mobile occupation. If it so happens that women are concentrated in occupation 2 and men in occupation 1, then a larger wage effect will be measured for women workers whose industry tariff is reduced than for men. This is true even with industry and occupation fixed effects, because the fixed effects will control for differences in the level of wage, not differences in the elasticity of wage with respect to the tariff change. We can now ask whether or not this story is consistent with the evidence.

3.1.2 Empirical test

To test whether the findings are driven by differential response of female-dominated occupations, we construct a dummy for female-dominated occupations and interact it with the industry and local tariff variables. To identify female-dominated occupations, we compute the ratio of women to men in each occupation in 1990. The ratio ranges from 0.01 (*Bus, truck, and stationary engine mechanics* – a highly male-dominated occupation) to 101 (*Secretaries* – a highly female-dominated occupation). Our dummy for female-dominated occupations takes the value of 1 if this ratio is greater than five, in other words the number of women in a given occupation is five times that of men in 1990, and zero otherwise.[5] Table 4 lists all such female-dominated occupations.

We add the dummy for female-dominated occupations to our main specification in equation (4) by interacting it with our industry and local tariff measures and year-2000 dummy. The summary results are reported in Table 5 analogous to Table 3. It is clear that the results

[5]The ranking of occupations by female-to-male ratio barely changes when we use our entire sample or only 2000 Census.

Table 4: Top female-dominated occupations in 1990

Occupation	Ratio	Number of women
Secretaries	101.4	3,851,569
Dental hygienists	62.0	72,233
Kindergarten and earlier school teachers	60.0	256,903
Dental assistants	42.3	156,596
Receptionists	36.8	647,715
Child care workers	31.6	708,023
Home economics instructors	22.6	429
Typists	21.7	576,082
Private household cleaners and servants	20.3	342,895
Teacher's aides	20.2	527,236
Registered nurses	18.0	1,841,392
Dressmakers and seamstresses	17.6	99,349
Licensed practical nurses	16.1	418,852
Bank tellers	16.1	372,053
Health record tech specialists	14.8	48,605
Speech therapists	12.9	63,613
Dietitians and nutritionists	10.9	84,485
Bookkeepers and accounting and auditing clerks	10.8	1,706,530
Billing clerks and related financial records processing	10.0	181,137
Textile sewing machine operators	9.9	748,830
Stenographers	9.6	71,826
Eligibility clerks for government programs; social welfare	9.4	44,392
Data entry keyers	8.7	488,791
Hairdressers and cosmetologists	8.7	600,769
Payroll and timekeeping clerks	8.6	158,888
Nursing aides, orderlies, and attendants	8.4	1,634,812
Occupational therapists	7.9	33,858
Telephone operators	7.8	193,031
Sales demonstrators / promoters / models	7.7	42,690
Library assistants	7.1	84,999
Crossing guards and bridge tenders	6.7	33,675
Human resources clerks, except payroll and timekeeping	6.5	66,110
Kitchen workers	6.2	132,809
Welfare service aides	6.1	41,980
General office clerks	6.0	1,107,735
File clerks	5.9	157,802
Waiter/waitress	5.9	880,093
Housekeepers, maids, butlers, stewards, and lodging quarters cleaners	5.7	657,273
Cashiers	5.6	1,518,375
Special education teachers	5.1	50,671
Librarians	5.0	154,557

Table 5: Wage growth: Difference between initial tariff and impact effects (controlling for female-dominated occupations)

	Employed spouse		Unemployed/NILF spouse		Single	
	Male	Female	Male	Female	Male	Female
Location effect						
Less than high school	-0.35	-3.33***	-1.95	-2.69*	-1.249	-2.00
High school graduate	-0.272	0.103	-1.706***	-2.03*	-0.586	-1.034
Some college	-1.219*	-0.84	-1.093	-1.33	-1.017*	-0.953
College graduate	-0.23	-1.716	-0.832	-2.463	0.186	-0.238
Industry effect						
Less than high school	-0.843**	-3.163**	-0.71	-3.358**	-1.673**	-1.223
High school graduate	-0.394	-2.217**	0.698*	-2.071*	-0.562	0.287
Some college	0.038	-0.683	-0.167	-0.933	0.17	1.331**
College graduate	-0.079	2.371*	0.561	0.935	-0.929	1.064
N of Observations	2,484,061	2,642,608	1,225,713	410,167	1,656,555	1,809,235

are not affected in any substantive way after controlling for female-dominated occupations. We conclude that the differential effects of NAFTA by gender are *not* caused by the different occupational mixes shown by male and female workers.[6]

3.2 Household bargaining

3.2.1 Theory

We now consider the possibility that household bargaining, with asymmetric bargaining power within the household, may be driving the results.

For illustration of the main points in the simplest way possible, consider a model with two periods, two industries, and two towns. Suppose that industry 2 is the numeraire and

[6] In a separate set of regressions, in addition to female-dominated occupations we control for married-women-dominated occupations. We construct a similar binary variable for occupations where the share of married women exceeds 70 percent (in total number of women reporting a given occupation). This share ranges from 40% (Baggage porters) to 87% (Farmers (owners and tenants)). The results reported in Appendix Table A6 are qualitatively similar to those in Table 5, with one exception: net local tariff effect for college graduate married women (with an employed spouse) is negative and statistically significant, and of the same magnitude as that for high school dropouts.

produces an export good, and industry 1 produces an import-competing good, whose world price is P^w, which is taken as given, while the domestic price is $P = P^w + t$, where t is an import tariff. All economic agents have the same homothetic utility function, which produces a consumer price index $\phi(P)$. Denote the *real* price of good 1 by $p_1 \equiv \frac{P}{\phi(P)}$, which is increasing in the tariff; and the real price of good 2 by $p_2 \equiv \frac{1}{\phi(P)}$, which is decreasing in the tariff. Each worker can produce either good $i = 1, 2$ in either town $j = 1, 2$; no other factor than labor is required.[7]

Each worker z has an inherent ability $a^{z,i,j}$ in industry i in town j. The worker's ability in a given industry is allowed to differ from one town to the next, which could occur because the worker has social networks or previous business associates in particular locations that allow him/her to find a more productive business arrangement than in other locations, even within the same industry (there is strong evidence for the importance of local social networks in finding employment; see Topa (2001)). We could think of the $a^{z,i,j}$ as representing worker z's local "opportunities" in industry i in town j. Worker z's real wage is then $w^{z,i,j} = p_i a^{z,i,j}$ if he or she works in industry i in town j.

In addition to the wage, each worker z expects a utility benefit $\epsilon^{z,j}$ from being in city j. This could be due to idiosyncratic tastes for climate, amenities, friends or enemies who happen to live in each town. Both a worker's ability in each industry and town, and that worker's preference for each town, are fixed for that worker's lifetime, and the distribution of these two traits across workers is independent. Suppose that the utility the worker receives is a function v of consumption c^z and amenity preferences $\epsilon^{z,j}$. For now, we assume a linear relationship: $v(c^z, \epsilon^{z,j}) = c^z + \epsilon^{z,j}$.

Now, suppose that during period 1, it is announced that the tariff t will be reduced, lowering real price of output in industry 1, and hence lowering the real wage for every

[7] This structure is of the type known as an 'assignment model' (Costinot and Vogel, 2015). It would be much more realistic to assume that each industry produces with labor and at least one other factor, for example, a specific factor which is in fixed and exogenous supply in each town. Specifically, each industry i in each town $j \in \{1, 2\}$ could have an endowment of a specific factor denoted $K^{i,j}$. This would allow for the two towns to have different employment patterns. Those features create complications that are not germane to the point being made here, however, so we omit them.

worker employed in that industry. Workers in each industry have the option of switching to the other industry and/or town at the end of period 1. If a worker switches, he/she will receive the period-2 wage and idiosyncratic town utility benefit in the new industry/town combination.[8]

Assume that the workers are composed in equal numbers of male and female, and that some fraction are paired up in heterosexual marriages. The distribution of abilities and town preferences is the same for each gender and also for married and single workers. We first discuss the behavior of single workers, then married ones.

(i) Single workers. A worker with no family attachments will simply choose the industry and city combination (i, j) in each period to maximize $v(w^{z,i,j}, \epsilon^{z,j})$, since for such a worker consumption c^z will be equal to the real wage.

When the tariff is reduced, some workers will leave industry 1. The workers who switch industries will be those who, relative to the pool of incumbent industry-1 workers, *ceteris paribus* have a relatively low comparative advantage in industry 1 $(a^{z,1,j} - a^{z,2,j})$ and a taste for a town in which their industry-2 opportunities are good (high $\epsilon^{z,j}$ for a j with $a^{z,2,j}$ big relative to $a^{z,1,j}$). Some workers will change towns in order to switch industries; for example, an industry-1 worker in town 1 might have $a^{z,2,2}$ much bigger than $a^{z,2,1}$, and if $\epsilon^{z,2}$ is not too much lower than $\epsilon^{z,1}$, it will then be optimal to move to town 2 in order to switch industries. We can characterize the adjustment as follows.

Proposition 1. *The drop in the tariff causes a net movement of single workers out of industry* 1*. In addition, the average productivity* $a^{z,i,j}$ *of workers in industry* 1 *will rise.*

As a result of the movements of workers out of industry 1, the drop in wages to industry-1 workers caused by the tariff reduction will be mitigated by a selection effect: The workers who leave the industry are on average those who are less productive in industry 1 than the

[8]The idiosyncratic abilities and town benefits will imply that only a fraction of workers will switch industries or move following the trade shock. In this way, they act like switching costs or moving costs. A full model would need to include direct costs of moving and switching industries, such as retraining and the like. We omit those here for simplicity of exposition.

average worker in the industry. This selection effect means that the average wage for single workers in industry 1 will fall by less than the output price p_1.[9]

(ii) Married workers.

For simplicity, we assume that both partners in a marriage must live and work in the same town; that all workers are employed in equilibrium, regardless of gender or marital status; and that marriages do not either form or break up. Within each marriage, intra-household allocation issues are dealt with by bargaining, as for example in Browning et al (1994). Suppose that at the beginning of Period 1, each couple finds itself exogenously located in one of the two towns,[10] and must bargain to choose the town in which to live and work in Period 1, and again bargain at the beginning of Period 2 after the policy has been revealed.[11] The threat point takes the form of continuing to live in the initial town and each partner in the marriage consuming his/her real wage. Within a marriage where in period 1 the husband worked in industry i_h and the wife in i_w, while both lived in town j, the period-2 industry of employment of each spouse, i'_h for the husband and i'_w for the wife; the consumption, c'_h and c'_w, and the city of residence, j' (which we recall is the same for both partners in the marriage), are chosen to maximize the generalized Nash maximand: $\left(v(c'_h, \epsilon^{h,j'}) - v(w^{h,i_h,j}, \epsilon^{h,j})\right)^{\mu} \left(v(c'_w, \epsilon^{w,j'}) - v(w^{w,i_w,j}, \epsilon^{w,j})\right)^{1-\mu}$, subject to the constraint that $c'_h + c'_w = w^{h,i'_h,j'} + w^{w,i'_w,j'}$. Here, μ is the husband's bargaining power. In an egalitarian marriage, $\mu = \frac{1}{2}$.

Now, recalling that we are focused for the moment on the special case in which $v(c, \epsilon) = c + \epsilon$, the case of linear preferences, maximizing the Nash maximand can be broken into two pieces: Choosing a common value for the town, j, together with an industry for each spouse; and then choosing an allocation of consumption between the two subject to the

[9] If we had a richer model with a fixed factor in each industry, there would be a second mitigating effect: The reduction in the labor supply to industry 1 would push up the marginal physical product of labor in that industry, increasing the price of effective labor there, and so increasing the wage received by any industry-1 worker conditional on ability.

[10] In a fuller model of dynamic adjustment, such as in Artuç and McLaren (2015), this initial allocation would be determined endogenously as the pre-shock steady state.

[11] We assume that the change in tariff at the start of Period 2 is a surprise, so does not factor into Period-1 bargaining.

budget constraint created by that choice. The second choice amounts to choosing a pair of values for the utility of the two spouses, $(c'_h + \epsilon^{h,j'}, c'_w + \epsilon^{w,j'})$, which is a point on a straight line from the endpoint $(\epsilon^{h,j'}, w^{h,i'_h,j'} + w^{w,i'_w,j'} + \epsilon^{w,j'})$, which gives all of the consumption to the husband, to the endpoint $(w^{h,i'_h,j'} + w^{w,i'_w,j'} + \epsilon^{h,j'}, \epsilon^{w,j'})$, which gives it all to the wife. Any increase in $w^{h,i'_h,j'} + w^{w,i'_w,j'} + \epsilon^{h,j'} + \epsilon^{w,j'}$ will shift this line upward, allowing for higher values for the two spouses' utilities. Therefore, we have:

Proposition 2. *In each period, bargaining within a marriage results in a common value of j' and an industry pair i'_h and i'_w that maximizes:*

$$w^{h,i'_h,j'} + w^{w,i'_w,j'} + \epsilon^{h,j'} + \epsilon^{w,j'}. \tag{3.6}$$

It is worth pointing out that we can see here why it matters that the idiosyncratic abilities $a^{z,i,j}$ in general vary by town and not only by industry. In the special case in which a worker's productivity in a given industry does not depend on the town in which he/she is employed, so that $a^{z,i,j} \equiv a^{z,i}$, maximization of (3.6) is separable in the town and industry decisions. The couple can choose the town that maximizes the sum of their $\epsilon^{z,j'}$ preference terms, and within that town choose the industries that maximize their incomes. Since this choice of industry is no different from what a single worker would do, we conclude that there would be no difference in the response of industry employment shares or in the behavior of average productivities in either industry, or therefore, in wages, as a result of the trade shock, between married and single workers, or between workers of either gender. Our data reject that possibility, so we proceed with the assumption that workers' abilities across industries are not perfectly correlated across towns.

A full analysis of the equilibrium response to a reduction in the tariff is beyond our scope, but it is easy to see how marriage can make a worker less responsive to trade shocks that affect her industry. Consider a single worker who is initially in industry-town cell $(1, 1)$ and who following the tariff reduction would switch to $(2, 2)$. If that same worker had been married to a worker with a strong enough preference for town 1, the couple would remain in that location and the worker in question would choose between industry 1 and 2 in that town. If her ability in industry 2 in town 1 happens to be weak, it will be optimal to remain in $(1, 1)$. Put differently, a single worker will choose industry and town to maximize $w^{z,i',j'} + \epsilon^{z,j'}$ but a married couple will maximize $\bar{w}^{i',j'} + \bar{\epsilon}^{j'}$, where $\bar{w}^{i',j'} \equiv \frac{1}{2}\left[w^{h,i'_h,j'} + w^{w,i'_w,j'}\right]$ and $\bar{\epsilon}^{ij'} \equiv \frac{1}{2}\left[\epsilon^{h,j'} + \epsilon^{w,j'}\right]$. A change in a worker's wage matters half as much at the margin for the decision in a marriage compared to the decision for a single worker.

Consider the implications for equilibrium wages, as determined by the labor-supply effect and the selection effect discussed above. If it is true that fewer married women leave industry 1 following the trade shock than single women do, the selection effect analyzed in Proposition 1 will be weaker for married women than for single one. In that case, the industry-1 wage will fall more for married women than for single women in industry 1.

However, because the criterion for moving is simply the sum of the two spouses' payoffs, the selection effect will be exactly the same for husbands as for wives. Consequently, this specification for the bargaining model is rejected by the data: It can rationalize a larger wage effect of the tariff reduction for married industry-2 workers than for unmarried workers, but it cannot rationalize the much larger effect for married women than for married men. We should also note that in this special case, the bargaining parameter μ has no effect on worker mobility or on wages at all. It affects the within-household allocation of consumption, but it does not affect decisions on switching industries or moving from one town to another.

We now investigate whether or not this theory is consistent with the data.

3.2.2 Empirical test

A key point to note is that in our simple model, no matter how strong the asymmetry in bargaining power within a marriage, the effect of tariff changes on wages of married men and women should be symmetric. Because the criterion (3.6) for moving is simply the sum of the two spouses' payoffs, the selection effect will be exactly the same for husbands as for wives. Thus, the theory can rationalize a larger wage effect of the tariff reduction for married industry-1 workers than for unmarried workers, but it cannot rationalize a larger effect for married women than for married men. We should also note that in this special case, the bargaining parameter μ has no effect on worker mobility or on wages at all. It affects the within-household allocation of consumption, but it does not affect decisions on switching industries or moving from one town to another.

However, as seen in Tables 3 and 5 the wage responses of married men and women to the NAFTA shock are not symmetric. This asymmetry is not restricted to wages only but is extended to the migration behavior of married men and women as well, as reported in Table 6. We run a set of regressions for each worker group where the dependent variable is the change in the log labor force of educational class k, either employed or unemployed, in conspuma c between 1990 and 2000. We regress this on the initial local tariff and change in local tariff to see if movements in workers of various groups are driven to a significant degree by the NAFTA shock.

Focusing on high-school dropouts, the main message is that a conspuma with a high level of protection that lost it by 2000 tended to lose more high-school dropout women than men over the 1990s relative to other conspumas. In particular, for married women with an employed spouse this loss amounted to $-27.91 + 17.96 = -9.95$ percent, significant at the 1% level, as opposed to married men with an employed spouse for which the loss was -8.27 percent. For single high school dropout women, this loss amounts to -8.97, whereas the share of similar single men increased by 1.1 percent, although not significantly different from zero.[12]

[12] These effects are to some extent the result of high-school dropout married women leaving the labor force which we explore further below in Section 3.4. Repeating the regression with the log change in working-age population for each educational class and group of workers instead of the labor force provides similar effects with smaller magnitudes (Appendix Table A7). However, the difference between initial tariff and change in tariff is now -7.15 and -4.98 for married high school dropout men and women with an employed spouse, respectively, also significant at the 1% level.

Table 6: Labor Force Growth Regressions

Dependent Variable:	Employed spouse		Unemployed/NILF spouse		Single	
$\triangle$ in Log Labor Force	Male	Female	Male	Female	Male	Female
Less than High School						
Initial tariff, $loc\tau^c_{1990}$	-9.349	-27.91**	-44.52***	-56.94***	-29.37***	-27.73**
	(9.207)	(11.21)	(15.06)	(19.15)	(10.27)	(13.82)
Change in tariff, $loc\triangle\tau^c$	-1.083	-17.96	-46.30***	-54.56***	-30.47***	-18.76
	(10.01)	(12.24)	(16.01)	(20.86)	(11.16)	(14.77)
F-statistic	23.96***	25.63***	0.48	0.57	0.34	19.35***
High School Graduates						
Initial tariff, $loc\tau^c_{1990}$	8.252	18.22***	-12.43	8.707	17.66*	4.804
	(6.018)	(6.141)	(10.58)	(13.57)	(9.227)	(6.378)
Change in tariff, $loc\triangle\tau^c$	8.241	19.41***	-21.13*	6.323	16.85*	5.231
	(6.461)	(6.625)	(11.33)	(14.39)	(9.988)	(6.907)
F-statistic	0.00	1.26	27.17***	1.00	0.31	0.15
Some College						
Initial tariff, $loc\tau^c_{1990}$	20.06***	27.38***	-0.995	15.53	14.97	33.73***
	(7.109)	(7.248)	(11.94)	(14.45)	(9.814)	(8.657)
Change in tariff, $loc\triangle\tau^c$	20.78***	26.35***	-6.763	8.686	12.19	33.37***
	(7.630)	(7.710)	(13.01)	(15.38)	(10.44)	(9.140)
F-statistic	0.39	0.80	8.90***	8.62***	4.06**	0.07
College Graduates						
Initial tariff, $loc\tau^c_{1990}$	7.890	5.366	-22.68*	3.121	12.26	-12.90
	(10.03)	(10.09)	(11.88)	(22.56)	(8.168)	(12.22)
Change in tariff, $loc\triangle\tau^c$	6.266	4.047	-26.92**	2.522	10.72	-14.56
	(10.61)	(10.99)	(12.70)	(24.80)	(9.127)	(13.09)
F-statistic	1.41	0.62	5.97**	0.02	0.88	0.88

Notes: N=543 conspumas. Robust standard errors in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively. The table also reports F-statistics for testing whether the difference between initial local tariff and change in local tariff is different from zero.

3.3 Household bargaining with non-linear preferences

3.3.1 Theory

The previous section showed that household bargaining with asymmetric bargaining power is not sufficient to match the findings in the data, because in the model with linear utility asymmetric bargaining power does not lead to asymmetric industry-switching behavior. However, this changes if we allow for non-linear preferences.

For a simple example, let $v(c, \epsilon) = c\epsilon$. In this specification, a member of the household will enjoy consumption spending more while located in a town that he or she enjoys.

To see how bargaining-power asymmetry can create asymmetries in mobility in this model, it is helpful to consider the limiting case in which the husband has all of the bargaining power (that is, the limit as $\mu \to 0$). In this case, the outcome will keep the wife at her threat-point utility, which is $v(w^{w,i_w,j}, \epsilon^{w,j}) = w^{w,i_w,j}\epsilon^{w,j}$. If the outcome of the bargaining leads the couple to settle in town j', this level of utility will require the wife's consumption to be $\left(\frac{\epsilon^{w,j}}{\epsilon^{w,j'}}\right) w^{w,i_w,j}$. Subtracting this from the total wages available, $w^{h,i'_h,j'} + w^{w,i'_w,j'}$ gives the amount of consumption left over for the husband, and so the utility the husband obtains is:

$$\left([w^{h,i'_h,j'} + w^{w,i'_w,j'}] - \left(\frac{w^{w,i_w,j}\epsilon^{w,j}}{\epsilon^{w,j'}} \right) \right) \epsilon^{h,j'}. \tag{3.7}$$

Bargaining, then, results in the locational outcome that maximizes (3.7).

Clearly the husband's and wife's wages do not enter symmetrically, as was the case in Section (ii) above. The wife's initial-industry wage $w^{w,i_w,j}$ has a unique role, in determining the strength of the wife's threat point. For a couple in which the wife is initially in industry 1, a reduction in the tariff lowers $w^{w,i_w,j}$; aside from the direct effect that the changes in real wages have for the two spouses in the different work options, this effect indirectly increases the payoff to the husband in all options, because it lowers the amount of consumption he has to give up to the wife. However, the effect is the largest for choices in a town j' which the husband likes more than the wife (that is, has a high value of $\frac{\epsilon^{h,j'}}{\epsilon^{w,j'}}$). As a result, the way the bargaining power works, a tariff reduction is more likely to result in a selection of town that the husband enjoys, relative to the status quo with no tariff reduction. Importantly, there is no corresponding role for the husband's initial-industry wage, $w^{h,i,j}$, in the allocation decision.

Of course, in the limit as μ approaches 0, the roles will reverse, and there will be husbands trapped by wives' town preferences. The point is that with non-linear preferences, town-dependent opportunities, and asymmetric bargaining power from treating μ as a free parameter, we can rationalize both different switching behavior between married and unmarried workers in response to a common trade shock, and different moving behavior for married male and female workers in response to a common trade shock. Further, this can rationalize different wage responses for married women, since different switching behavior implies different degrees of strength for the selection effect that was formalized in Proposition 1. Now we turn to the question of whether this richer story fits the data or not.

3.3.2 Empirical test

To test this theory, we run a set of regressions where the dependent variable is the share of employed married (or single) women (or men) of educational class k in each industry j and conspuma c in total labor force or working age population of conspuma c between 1990 and 2000. Our regressors include industry- and location-specific initial tariffs and change in tariffs. According to this version of the household-bargaining theory, the employed married women's share in each industry/conspuma should *rise* when hit by a trade shock since other groups are leaving the industry/conspuma but at least a fraction of the married women cannot leave. However, as reported in Table 7, we find exactly the opposite.

Focusing on high-school dropouts, a conspuma with a high level of protection that lost it by 2000 tended to lose both more married women and men employed in an average industry than single workers over the 1990s relative to other conspumas. In particular, for married women this loss amounted to $-0.611 + 0.382 = -0.229$ percentage points, and for married

Table 7: Change in share of employed married/single women in working age population and labor force

	Married women				Single women			
	Less than high school	High School	Some College	College Graduate	Less than high school	High School	Some College	College Graduate
Working age population								
Initial local tariff	-0.00489***	0.00430	0.0106***	-0.00120	-0.000122	0.00247	0.00411***	-0.00328***
	(0.00162)	(0.00291)	(0.00182)	(0.00163)	(0.000865)	(0.00154)	(0.00137)	(0.000868)
Change in local tariff	-0.00270	0.00510	0.0104***	-0.00107	0.000961	0.00252	0.00382***	-0.00307***
	(0.00179)	(0.00315)	(0.00196)	(0.00177)	(0.000957)	(0.00167)	(0.00147)	(0.000942)
Initial industry tariff	0.00173***	0.00131	-9.25e-05	-0.000762***	0.00102***	-3.20e-07	-0.000518***	-0.000437***
	(0.000601)	(0.000988)	(0.000272)	(0.000137)	(0.000305)	(0.000492)	(0.000199)	(9.87e-05)
Change in industry tariff	0.00300***	0.00218*	0.00138***	0.000811***	0.00171***	0.00103*	0.000639**	0.000380***
	(0.000739)	(0.00116)	(0.000343)	(0.000185)	(0.000388)	(0.000590)	(0.000264)	(0.000133)
N of Observations	116,750	116,750	116,750	116,750	116,750	116,750	116,750	116,750
Labor force								
Initial local tariff	-0.00611***	0.00439	0.0113***	-0.00225	-0.000349	0.00252	0.00406**	-0.00449***
	(0.00188)	(0.00337)	(0.00213)	(0.00191)	(0.001000)	(0.00178)	(0.00164)	(0.00100)
Change in local tariff	-0.00382*	0.00478	0.0108***	-0.00230	0.000761	0.00231	0.00351**	-0.00432***
	(0.00206)	(0.00364)	(0.00230)	(0.00208)	(0.00110)	(0.00193)	(0.00174)	(0.00109)
Initial industry tariff	0.00183***	0.00127	-0.000201	-0.000911***	0.00109***	-0.000138	-0.000666***	-0.000532***
	(0.000694)	(0.00114)	(0.000314)	(0.000157)	(0.000350)	(0.000567)	(0.000230)	(0.000113)
Change in industry tariff	0.00325***	0.00234*	0.00162***	0.00102***	0.00187***	0.00109	0.000755**	0.000494***
	(0.000848)	(0.00134)	(0.000395)	(0.000212)	(0.000445)	(0.000678)	(0.000305)	(0.000153)
N of Observations	116,750	116,750	116,750	116,750	116,750	116,750	116,750	116,750

Notes: The number of observations is not equal to the number of conspumas (543) times the number of industries (239) because we only include industries for which we observe at least one of these groups (single/married men/women) to have positive employment. Robust standard errors in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.

Table 8: Change in share of employed married/single men in working age population and labor force

	Married men				Single men			
	Less than high school	High School	Some College	College Graduate	Less than high school	High School	Some College	College Graduate
Working age population								
Initial local tariff	-0.0112***	-0.00380	0.00886***	0.000537	-0.000991	0.00770***	-0.000197	-0.000215
	(0.00221)	(0.00319)	(0.00205)	(0.00180)	(0.000887)	(0.00162)	(0.00105)	(0.000867)
Change in local tariff	-0.00867***	-0.00515	0.00870***	-0.000176	-0.000815	0.00750***	-0.000688	-0.000264
	(0.00244)	(0.00343)	(0.00225)	(0.00199)	(0.000973)	(0.00176)	(0.00114)	(0.000944)
Initial industry tariff	0.00191***	0.000983	0.000491	-0.00116***	0.000317*	-0.000577*	-0.000554***	-0.000540***
	(0.000476)	(0.000781)	(0.000433)	(0.000385)	(0.000180)	(0.000328)	(0.000181)	(0.000146)
Change in industry tariff	0.00324***	0.00322***	0.00200***	-3.64e-05	0.000699***	0.000372	0.000136	-0.000107
	(0.000626)	(0.000963)	(0.000560)	(0.000508)	(0.000236)	(0.000407)	(0.000239)	(0.000191)
N of Observations	116,750	116,750	116,750	116,750	116,750	116,750	116,750	116,750
Labor force								
Initial local tariff	-0.0136***	-0.00467	0.00909***	-0.00103	-0.00146	0.00868***	-0.000791	-0.00101
	(0.00253)	(0.00367)	(0.00237)	(0.00207)	(0.00103)	(0.00189)	(0.00122)	(0.00100)
Change in local tariff	-0.0111***	-0.00685*	0.00848***	-0.00212	-0.00140	0.00820***	-0.00151	-0.00113
	(0.00278)	(0.00395)	(0.00260)	(0.00230)	(0.00113)	(0.00204)	(0.00133)	(0.00109)
Initial industry tariff	0.00209***	0.000914	0.000393	-0.00148***	0.000335	-0.000737**	-0.000691***	-0.000665***
	(0.000540)	(0.000900)	(0.000499)	(0.000441)	(0.000206)	(0.000376)	(0.000208)	(0.000167)
Change in industry tariff	0.00360***	0.00351***	0.00218***	-0.000100	0.000784***	0.000392	0.000150	-0.000107
	(0.000708)	(0.00111)	(0.000644)	(0.000584)	(0.000269)	(0.000466)	(0.000276)	(0.000219)
N of Observations	116,750	116,750	116,750	116,750	116,750	116,750	116,750	116,750

Notes: The number of observations is not equal to the number of conspumas (543) times the number of industries (239) because we only include industries for which we observe at least one of these groups (single/married men/women) to have positive employment. Robust standard errors in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.

men -0.25 percentage points. For single high school dropout women and men, this loss amounted to -0.111 and -0.006 percentage points, respectively.

We conclude that household bargaining with asymmetric bargaining power and non-linear preferences cannot explain our findings any more than the linear model could.

3.4 Selective non-participation

3.4.1 Theory

Some studies, such as Autor et al (2013) and Sauré and Zoabi (2014), have found evidence of workers withdrawing from the labor force in response to a loss of tariff protection. We argue here that under some conditions selection decisions by some women to withdraw from the labor market in response to a trade shock hitting their industry could produce magnified wage responses for married women compared to other workers. The way this could happen is as follows.

Suppose that single workers have no option to stay out of the labor market, and suppose that cultural norms prevent a married man from doing so except in case of disability or retirement age (this will of course depend on the time and place and local culture, but is probably a reasonable assumption to impose for our data period). Under these assumptions, the only group of workers with an option to leave the labor market is married women. Suppose that a married woman will choose to remain in the labor market if her wage is high enough or her husband's wage is low enough; then if an import-competing industry is hit with a trade shock that lowers wages for all workers in the industry, a certain fraction of the married women will respond by leaving the labor market. Now, if those women are the most productive women in that industry, their departure will lead to a selection effect that will magnify the effect on average wages of married women still in the industry. This is exactly what will happen if two conditions are satisfied: (i) The departing women have higher-income spouses – as they will tend to do because only a worker with a sufficiently highly-paid spouse can afford to leave the labor market. (ii) Partners in marriage with highly-paid spouses tend to be highly-paid themselves, since the marriage market features positive assortative matching. These two features together tend to lead to the departing women being higher-wage workers than the ones they leave behind, pushing average wages down beyond the effect of the initial trade shock.[13]

We can formalize a simple model as follows. Suppose that unmarried workers simply consume their own wages, but married workers share their earnings. Suppose that all married couples have the same utility function, an increasing, concave, twice-differentiable function $U(\cdot)$, which is a function of the couple's combined real wage. If a married couple have a wife whose real wage is w^w and the husband's real wage is w^h, and if they both work, their utility is $U(w^w + w^h)$. On the other hand, if the wife chooses not to work, their utility is $U(w^h) + F$, where $F > 0$ is extra utility they share from the wife's extra time for non-market activities, a parameter that is the same for all households. If $U(w^w + w^h) - U(w^h) \geq F$, the wife will work, and otherwise she will leave the labor market. (For all workers, for the moment assume that there is no other alternative employment; there is only one choice, and that is to be in or out of the labor force for married women.)

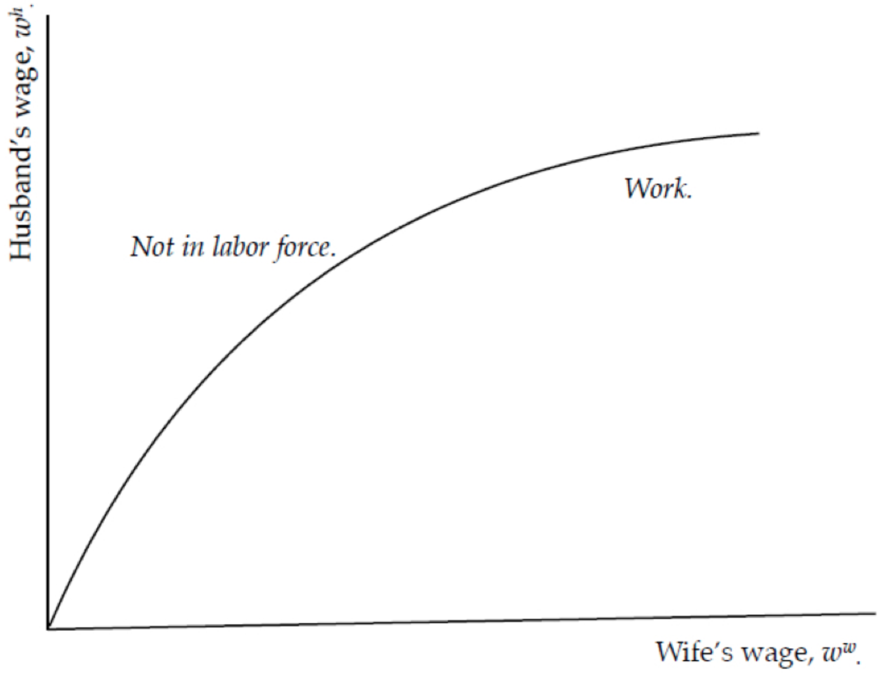
Clearly, for a given w^h, a married woman worker will remain in the labor market if and only if w^w is above a given threshold. Denoting that threshold as $\tilde{w}^w(w^h)$, and taking the derivative of $U(\tilde{w}^w(w^h) + w^h) - U(w^h) = F$ with respect to w^h, we obtain:

$$\frac{d\tilde{w}^w}{dw^h} = \frac{U'(w^h) - U'(\tilde{w}^w(w^h) + w^h)}{U'(\tilde{w}^w(w^h) + w^h)} > 0. \tag{3.8}$$

Therefore, we can draw a figure with w^w on the horizontal axis and w^h on the vertical axis, with an upward-sloping curve representing the threshold between the region in which the woman worker stays in and leaves the labor force. This curve is represented in Figure 3.1, which measures the wife's real wage on the horizontal axis and the husband's on the vertical axis. Any point in the figure to the right of the curve represents a couple for whom

[13]Note that the effects we find empirically are all within an educational class, since we control for education. Consequently, the theory should be interpreted as one in which higher-wage women *within their educational class* withdraw from the labor market in response to a trade shock.

Figure 3.1:



the wife's wage is high enough and the husband's wage is low enough that the wife remains in the labor market. Any point to the left of the curve represents a couple for whom the wife will leave the labor market. An assumption on the curvature of U allows us to characterize the shape of the curve:

Proposition 3. *If the coefficient of relative risk aversion associated with U is everywhere greater than 1, then the curve defined by $U(\tilde{w}^w(w^h) + w^h) - U(w^h) = F$ goes through the origin. Further, any ray through the origin that intersects the curve will intersect it from below, and only once.*

The implication of Proposition 3 is that, if relative risk aversion exceeds 1, other things equal, a woman will be more likely to work, the higher is her wage (the farther to the right is the couple in the diagram), and the *lower* is her husband's wage (the farther down is the couple in the diagram).

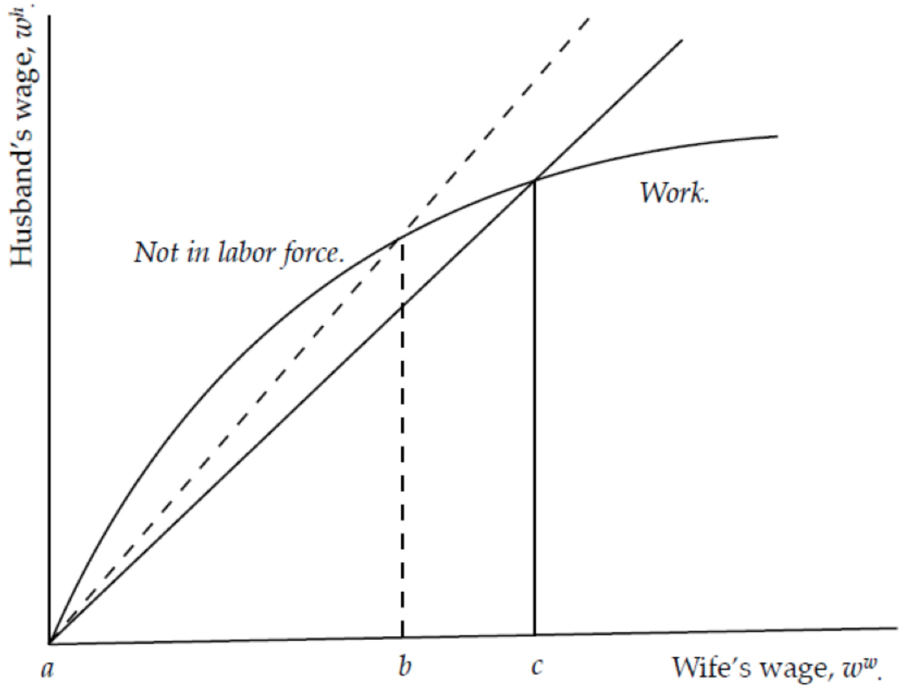
To fill in the rest of the model, suppose that there are many industries, one of which is the import-competing industry 1, initially protected by a tariff. The price of industry-1 output is denoted p. We wish to compare outcomes before and after a trade shock. To make the analysis as simple as possible, consider a two-period model, and suppose that in Period 1 workers select their industries, and a fraction λ of male and female workers choose a spouse and marry, expecting the same trade policy to prevail in Period 2. In Period 2, all agents are surprised by a change in trade policy that lowers the value of p. Workers are unable to change their choice of industry or spouse in Period 2. Denote the initial-equilibrium value for the industry-i output price by p^i and the Period-2 value by $\tilde{p}^i$.

Each worker z has ability level $a^{z,i}$ in industry i, which is a constant for each worker. The distribution of $a^{z,i}$ values is the same for male and female, married and unmarried workers. The wage received by worker z in industry i is $w^z = a^{z,i}p^i$, so each worker z will have a wage given by $w^z = \max_i\{a^{z,i}p^i\}$.

Now, suppose that a randomly selected fraction λ of male and female workers marry in Period 1, sorting according to positive assortative matching. Given the symmetry of the model, this implies that within each marriage the male wage and the female wage are equal. As a result, every married couple will occupy a point along the 45^o line, portrayed as the solid ray, in Figure 3.2. Some fraction will have the husband and the wife both in industry 1; some will have husband in 1 and wife in 2, and so on; and some fraction will be located above the curve so that the wife leaves the labor market. The range of wages for this subset of married woman workers in industry 1 is given by *ac*.

Now, consider a married couple with the wife in industry 1 and the husband in some other industry. When the Period 2 shock arrives, since p^1 will fall to $\tilde{p}^1$, the ray showing the wage pairs for this subset of married couples will rotate as shown in the broken ray in Figure 3.2. Consequently, a fraction of the women in this set will leave the labor market, and only *ab* will remain. Since the portion of workers who remain in industry 1 will see a wage reduction of $\frac{p^1-\tilde{p}^1}{p^1}$, and the portion who leave the labor market, *bc*, are at the higher end of the wage distribution, the average wage for married women workers in this industry will fall by *more* than $\frac{p^1-\tilde{p}^1}{p^1}$.

Figure 3.2:



On the other hand, a couple with both members in industry 1 will see both wages fall proportionally, a move down and to the left along the solid ray in Figure 3.2. If both spouses were initially in the labor market, they will continue to be so after the shock. Consequently, average wages for married women in this category will fall by $\frac{p^1-\tilde{p}^1}{p^1}$, the same as unmarried workers or married male workers.

This can all be summarized as follows.

Proposition 4. *Assume that the coefficient of relative risk aversion associated with* U *is everywhere greater than* 1*. Then as a result of the trade shock, the wages of all workers in industry* 1 *fall in the same proportion, except for married women whose husband is in a different industry. Their average wage in industry* 1 *falls by more than the other groups, and their share of employment in industry* 1 *falls.*

3.4.2 Empirical test

To see if this theory is consistent with the data, we first look at some basic correlations implied by the model. Specifically, we ask (i) whether our data exhibit positive assortative matching, and (ii) whether, as implied by Proposition 3 (combined with relative risk aversion greater than unity), a higher husband's wage lowers the probability that a married woman will stay in the labor force. To test these hypotheses we need a model that deals with the sample-selection issue raised by the fact that the wage of a worker who has left the labor force is not observed.[14]

Suppose that each woman worker i has a latent wage w_i^*. This is a function of the worker's personal, industry, geographic, and occupational characteristics X_i including potentially the husband's wage because of positive assortative matching:

$$w_i^* = X_i\beta + \epsilon_i. \tag{3.9}$$

The wage is observed if and only if the worker chooses to be in the labor force. This occurs if:

$$w_i^* \geq Z_i\beta + \eta_i. \tag{3.10}$$

The Z_i should in principle could contain all of the variables in X_i plus some variables that plausibly affect the decision to be in the workforce but not the wage conditional on being in the labor force, such as cultural factors, family information and home ownership. Assume that η_i is distributed as $N(0,1)$ and ϵ_i is distributed as $N(0,\sigma)$, with a correlation of ρ between the two. We restrict the sample to married woman workers whose husbands work at least 35 hours per week and report positive wages, and estimate these two equations together using the Heckman two-step procedure.

[14] We have last year's wages for workers who are not currently in the labor force but who were employed last year. We do not use those wages here.

Table 9: Selection model

Dependent variable:	"In Labor Force" Dummy	Wife's Logwage
Spouse's logwage	-0.164***	0.114***
	(0.00140)	(0.00321)
Age	0.150***	-0.0766***
	(0.000920)	(0.00325)
Age squared	-0.00175***	0.000957***
	(1.08e-05)	(3.77e-05)
White	-0.158***	0.0600***
	(0.00339)	(0.00499)
Speak English	-0.0121***	0.00450*
	(0.00196)	(0.00271)
Less than high school	-0.520***	-0.0421***
	(0.00418)	(0.0129)
High school graduate	-0.222***	-0.150***
	(0.00288)	(0.00603)
Some college	-0.131***	-0.156***
	(0.00287)	(0.00477)
Own house	0.133***	
	(0.00281)	
School-aged child	-0.0322***	
	(0.00233)	
Immigrant	-0.133***	
	(0.00418)	
Year 2000 dummy	0.0137***	0.424***
	(0.00216)	(0.00303)
Lambda	-2.234***	
	(0.0640)	
N of Observations	2,919,674	2,919,674

The results are reported in Table 9. The first column shows the results for equation (3.10). This equation contains standard demographic and educational variables, plus a dummy for home ownership (as a proxy for wealth), for presence of a school-aged child (which can raise the opportunity cost of going into the workforce), and for immigrant status, which may be correlated with cultural views on female labor-force participation. These last three are omitted from the second column, which shows the results for equation (3.9). The second-to-last row of the table shows the estimate of $\lambda \equiv \sigma\rho$. One important note to make is that, as in all of our wage regressions, the specification of equation (3.9) includes conspuma dummies, which are (as always) suppressed in the table, but equation (3.10) does not have conspuma dummies since a probit is inconsistent as the number of fixed effects becomes large, and the estimation does not converge in our case.

Controlling for all other observables, a woman worker in our data is less likely to be in the labor force if she has less than a college education, if she has a school-age child at home, and if she is an immigrant. A small surprise is the positive coefficient on home ownership; one might have expected this to have a negative sign, if it proxies for higher household wealth. Other things equal, the probability of being in the labor force peaks at age 45, while the wage takes a minimum at that age.

The main coefficients for our purposes are in the first row. *Ceteris paribus*, a higher husband's wage implies a higher wage for the woman worker, which is evidence of positive assortative matching (item (i) above). In addition, *ceteris paribus*, a higher husband's wage is correlated with a lower probability of being in the labor force, which is in line with Proposition 3 (item (ii) above). Both of these findings hold with a high degree of statistical significance.

Having checked for the basic correlations implied by the model, we turn now to testing the main predictions of the theory. First, we test the prediction of Proposition 4, that some fraction of married women choose not to participate in the labor force in response to a trade shock, in two ways. The first is to estimate a linear probability model of labor force participation where the dependent variable is a dummy that takes a value of 1 if the individual is in the labor force and zero otherwise. The second test examines a subsample of married men and women where both spouses are employed in the same or different industries. According to our theory, for those couples that work in the same industry there would be no effect on labor force participation, and the effect of the trade shock on wife's and husband's wages would be the same, because if the husband is hit with the same wage shock as the wife, the couple cannot afford to lose her income.

Table 10 reports the results from a linear probability model of labor force participation

Table 10: Labor force participation: Difference between initial tariff and impact effects

	Employed spouse		Unemployed/NILF spouse		Single	
	Male	Female	Male	Female	Male	Female
Location effect						
Less than high school	-0.389**	-1.998***	-0.41	-1.09	-0.158	-2.024***
High school graduate	-0.278***	-1.291***	-1.33***	-2.397***	-0.84***	-1.583***
Some college	-0.391***	-1.175***	-0.778***	-1.743***	-0.554***	-1.171***
College graduate	-0.174	-0.533***	-0.561***	-1.08**	-0.463**	-0.763***
Industry effect						
Less than high school	-0.209	-0.8487*	0.113	-0.326	-0.081	-0.347
High school graduate	-0.271**	-0.4711	-0.347	-0.3418	-0.107	-0.244
Some college	-0.205**	-0.524	-0.655***	-0.563	0.025	0.255
College graduate	-0.152	0.007	0.049	0.103	-0.353***	-0.309
N of Observations	2,800,323	3,178,574	1,439,309	534,960	1,925,952	2,076,050

for each of six groups of workers. The right-hand-side variables are the same as in the wage regression, and the results are arranged in the same way as in Table 3. The coefficients for location effects are negative for all groups of workers at almost all educational levels, with the effects being larger for both married and single women and decreasing in the level of educational attainment. This implies that, for example, high-school dropout female workers in a location that had high protection and lost it by 2000 are less likely to be in the labor force by 2000. The industry effects are less strong and imprecisely measured, but the overall story is the same in that women are more likely to drop out of labor force than men in highly-protected industries that lost their protection by 2000. The overall message of Table 10 is that NAFTA-driven tariff reductions did disproportionately push female workers, both married and single, out of the labor force in the hardest-hit communities.

Another implication of the marriage market/selection model is that among married couples, controlling for all other factors, wages should fall for women workers when their own industry tariff falls but should *rise* when their husband's industry tariff falls, since if the husband's tariff falls, the woman worker is more likely to remain in the labor force, and under

Table 11: Own and Spouse's Industry Tariffs: Difference between initial tariff and impact effects

Dependent variable:	Wife's logwage
Location effect	
Less educated	-1.132**
Highly educated	-1.55**
Industry effect	
Less educated	-4.708***
Highly educated	-2.054**
Less educated (husband)	2.111***
Highly educated (husband)	2.79***
N of Observations	3,052,775

conditions of Proposition 3 this will raise the average productivity of working women in her industry. Table 11 examines this prediction. This is a wage regression for the married women in the sample with employed husbands, with all of the controls of earlier regressions and the same format, except that we control not only for the woman worker's industry tariff but also for her husband's industry tariff. (The locational tariffs are the same for both spouses.) Recalling our basic estimating equation (2.2), this creates a large number of interactions, which prove to be too many to estimate, so we collapse the four educational categories to two, 'Less educated' (high-school or below) and 'Highly educated' (some college or college graduate).

The first four rows of Table 11 show results in line with the main specification as in Table 3; a married woman worker's wage falls when her town's average tariff or her industry's tariff falls. The last two lines show the effect of the husband's industry tariff, and these are in line with the prediction of the selection model: A drop in the husband's industry tariff increases the wife's expected wage, with high statistical significance. It is difficult to imagine a mechanism by which this finding could be rationalized except through the sort of selection mechanism we have sketched here.

Finally, recall that according to the labor-force-participation model, if both spouses are in the same industry, a drop in the tariff should have no effect on the wife's participation decision, while if they are in different industries, a drop in the wife's industry tariff will make

Table 12: Difference between initial tariff and impact effects

	Wage growth				Labor Force Participation			
	Same industry		Different industries		Same industry		Different industries	
	Male	Female	Male	Female	Male	Female	Male	Female
Location effect								
Less than high school	2.827**	-1.876	-0.8	-3.91***	0.408	0.483	-0.508***	-2.171***
High school graduate	-0.601	1.146	-0.268	-0.454	0.029	-0.208	-0.321***	-1.194***
Some college	1.802	-1.022	-1.586***	-1.518**	-0.17	-0.956***	-0.44***	-0.975***
College graduate	1.177	-1.192	-0.533	-2.193*	-0.252**	0.14	-0.172*	-0.539***
Industry effect								
Less than high school	0.207	-4.326*	-1.028*	-3.503**	0.08	-0.526	-0.325**	-1.304**
High school graduate	-1.357**	-3.28**	-0.315	-2.689***	-0.631***	-0.222	-0.242*	-0.994**
Some college	-0.268	-1.263	-0.001	-1.502	-0.13	-0.169	-0.205**	-1.177**
College graduate	1.132	1.12	-0.253	2.17	0.415*	-0.092	-0.165	-0.251
N of Observations	279,714	294,311	2,204,347	2,348,297	326,036	360,951	2,474,287	2,817,623

her more likely to leave the labor force. To test this hypothesis, we next limit our sample to married individuals with both spouses being employed, and run separate wage and labor force participation regressions for spouses employed in the same and different industries. Although the sample size for the former type of couples (employed in the same industry) is small and the estimates are imprecisely measured, we do find support for our theory (Table 12). In particular, there is no distinguishable difference in labor force participation response of men and women when both spouses are employed in the same industry (columns 5 and 6); for this group, the labor-force participation effects are mostly small and insignificant. The earlier differential results across men and women are completely driven by women that are employed in a different industry then their spouse.

The main elements of the selective non-participation story are therefore consistent with the data. However, we should note that this theory does not provide a full explanation. Table 12 shows that even for couples with both spouses employed in the same industry, the effect of industry tariff reductions on the wife's wage (-4.326) is negative, statistically significant, and much larger than the statistically insignificant effect on the husband's wage

(0.207). This would not be the case if our selective non-participation story was the sole force driving the results.

4 Conclusion

We have documented a sharp difference in labor-market response to NAFTA across gender and marital status: The largest effects of NAFTA, by far, are shown in the wages of married women workers whose industry of employment lost its tariff. We have shown that this cannot be explained by the different occupation mix of male and female workers, or by household bargaining in which husbands with disproportionate bargaining power within the household prevent their wives from adjusting to shocks as they otherwise would wish to do. We do find some support for an interpretation based on selective non-participation, in which some married women workers adjust to a trade shock by leaving the labor market; under this interpretation, because of positive assortative matching in the marriage market, the ones who do so tend to be the women with higher wages. However, this does not account for all of the features of the data, so we are left with a puzzle.

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Appendix

Proof of Proposition 1.

Proof. For a given worker z, fix $\epsilon^{z,j}, j = 1, 2$, and $a^{z,i,j}$ for $i \neq 1$. The optimal choice will be industry 1 in town 1 if and only if $p_1 a^{z,1,1} + \epsilon^{z,1} \geq \max\{p_1 a^{z,1,2} + \epsilon^{z,2}, p_2 a^{z,2,1} + \epsilon^{z,1}, p_2 a^{z,2,2} + \epsilon^{z,2}\}$. Consider the case in which $p_2 a^{z,2,1} + \epsilon^{z,1} \geq p_2 a^{z,2,2} + \epsilon^{z,2}$. Then the condition for choosing $(1, 1)$ reduces to:

$$a^{z,1,1} \geq a^{z,1,2} + \frac{\epsilon^{z,2} - \epsilon^{z,1}}{p_1} \text{ and} \tag{4.1}$$

$$a^{z,1,1} \geq \frac{p_2}{p_1} a^{z,2,1}. \tag{4.2}$$

The condition for choosing $(1, 2)$ analogously becomes:

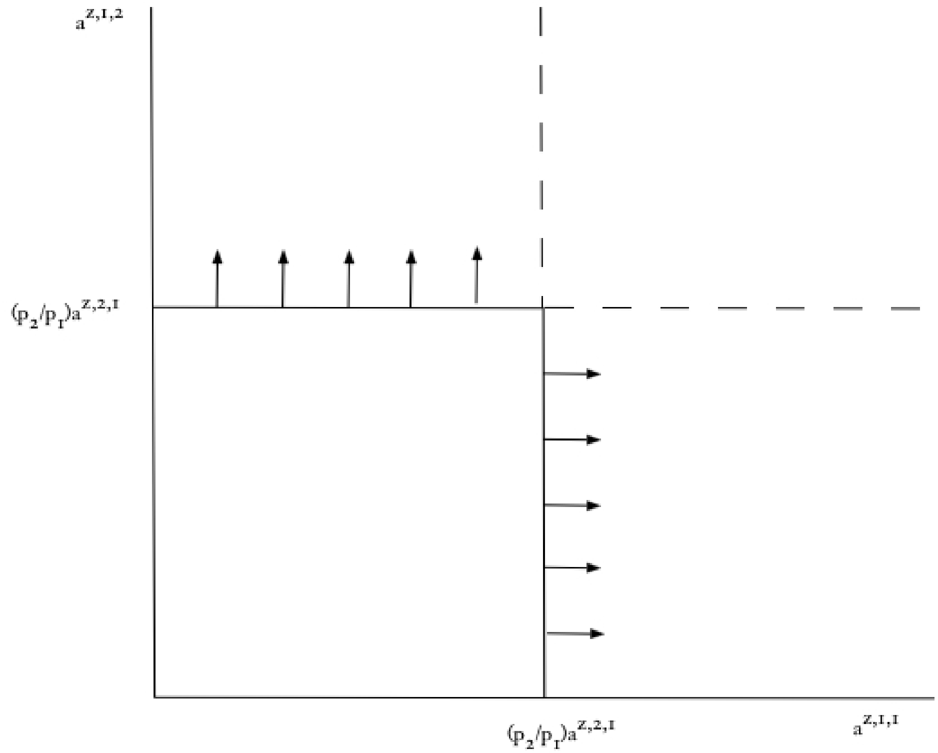
$$a^{z,1,1} \leq a^{z,1,2} + \frac{\epsilon^{z,2} - \epsilon^{z,1}}{p_1} \text{ and} \tag{4.3}$$

$$a^{z,1,2} \geq \frac{p_2}{p_1} a^{z,2,1}. \tag{4.4}$$

The condition for choosing industry 1 is then the condition that (4.1) and (4.2) or (4.3) and (4.4) hold. This reduces to (4.2) or (4.4). These together create a region of the form of Figure 1A. The integral of the density for $a^{z,1,1}$ and $a^{z,1,2}$ above that boundary gives the fraction of single workers who choose industry 1, conditional on those values of $\epsilon^{z,j}, j = 1, 2$, and $a^{z,i,j}$ for $i \neq 1$.

Now, note that a reduction in the tariff, by reducing p_1 and increasing p_2, shifts the boundary up and to the right, reducing the fraction of these workers who choose industry 1. For these workers as well, since the bottom boundary of the region is being trimmed away, the average productivities for workers who remain above the boundary has risen. All of this was conditional on the case $p_2 a^{z,2,1} + \epsilon^{z,1} \geq p_2 a^{z,2,2} + \epsilon^{z,2}$, but a parallel argument

Figure 1A



constructed for the contrary case produces the same conclusions. Therefore, conditional on $\epsilon^{z,j}, j = 1, 2$, and $a^{z,i,j}$ for $i \neq 1$, a reduction in the tariff reduces the fraction of single workers who choose industry 1, and increases the average productivity of those who remain in industry 1. Integrating of all values of $\epsilon^{z,j}, j = 1, 2$, and $a^{z,i,j}$ for $i \neq 1$ then establishes the proposition. □

Proof of Proposition 3.

Proof. For values of w^w and w^h along a ray through the origin, $U(w^w + w^h) - U(w^h)$ can be written as $U(y) - U(\kappa y)$, with $\kappa \in (0, 1)$ a constant. For the proposition, it is sufficient to show that this function is a decreasing function of y. First:

$$\frac{d}{dy}\left[U(y) - U(\kappa y)\right] = U'(y) - \kappa U'(\kappa y). \tag{4.5}$$

This derivative is negative if and only if $U'(y) < \kappa U'(\kappa y)$. For this, it is sufficient that

$\kappa U'(\kappa y)$ be a decreasing function of κ (since $\kappa < 1$). Note:

$$\frac{d}{d\kappa}\left[\kappa U'(\kappa y)\right] = U'(\kappa y) + U''(\kappa y)\kappa y. \tag{4.6}$$

This is negative if and only if

$$\frac{U''(\kappa y)\kappa y}{U'(\kappa y)} < -1, \tag{4.7}$$

which is the stated condition. □

Table A1: Income growth (includes positive business and farm income for zero-wage earners): Difference between initial tariff and impact effects

	Employed spouse		Unemployed/NILF spouse		Single	
	Male	Female	Male	Female	Male	Female
Location effect						
Less than high school	-0.4	-3.61***	-1.42	-1.84	-1.149	-1.82
High school graduate	-0.224	-0.472	-1.752**	-1.51*	-0.372	-0.97
Some college	-1.152*	-1.33*	-1.122**	-1.71*	-0.831*	-0.8138
College graduate	-0.018	-2.252*	-1.362	-2.038	-0.161	-0.291
Industry effect						
Less than high school	-0.97	-3.93***	-1.033**	-4.139**	-1.903***	-2.031*
High school graduate	-0.43**	-3.164***	0.736**	-3.05***	-0.639	-0.51
Some college	0.091	-1.662	-0.127	-2.34**	0.229	0.41
College graduate	-0.243	2.83**	0.411	1.698	-0.8	0.856
N of Observations	2,695,858	2,801,866	1,335,379	431,088	1,769,819	1,877,418

Table A2: Weekly wage growth: Difference between initial tariff and impact effects

	Employed spouse		Unemployed/NILF spouse		Single	
	Male	Female	Male	Female	Male	Female
Location effect						
Less than high school	0.758	-0.6	0.02	-0.982	1.263*	-0.39
High school graduate	0.4251	1.058*	-0.935*	0.783	0.876*	0.65
Some college	-0.249	0.068	-1.364**	-0.895	-0.38	-0.217
College graduate	0.083	-0.83	-0.235	-1.223	0.407	0.19
Industry effect						
Less than high school	-0.137	-2.334***	-0.216	-3.11***	-0.769	-1.282*
High school graduate	-0.148	-1.903***	0.556	-1.988**	0.125	0.281
Some college	0.213	-0.405	0.073	-0.533	0.648*	0.951**
College graduate	0.279	2.94***	1.071*	1.8898	0.421	1.226**
N of Observations	2,484,061	2,642,608	1,225,713	410,167	1,656,555	1,809,235

Table A3: Wage growth: Difference between initial tariff and impact effects (excluding individuals over 55)

	Employed spouse		Unemployed/NILF spouse		Single	
	Male	Female	Male	Female	Male	Female
Location effect						
Less than high school	-0.49	-3.82***	-3.26**	-4.19	-1.794**	-2.31
High school graduate	-0.215	-0.592	-1.78***	-2.39**	-0.137	-0.57
Some college	-0.994*	-1.371*	-1.157*	-1.704	-0.817*	-0.465
College graduate	-0.293	-1.749	-0.2	-3.117***	0.079	-0.449
Industry effect						
Less than high school	-0.91*	-3.922**	-1.093**	-3.818**	-2.048***	-2.803***
High school graduate	-0.53*	-2.975***	0.251	-3.475**	-0.783	-0.418
Some college	-0.1488	-1.603*	-0.047	-0.998	-0.058	0.873
College graduate	0.243	2.046	0.431	2.433	-0.53	0.335
N of Observations	2,197,807	2,440,960	991,668	281,180	1,543,163	1,598,206

Table A4: Wage growth: Difference between initial tariff and impact effects (limiting to workers with spouses between ages 25 and 64)

	Employed spouse		Unemployed/NILF spouse	
	Male	Female	Male	Female
Location effect				
Less than high school	-0.19	-3.87***	-1.94	-3.52*
High school graduate	-0.374	-0.473	-2.077***	-1.16
Some college	-1.22*	-1.35	-1.054*	-1.235
College graduate	-0.212	-1.941*	-0.938	-1.63
Industry effect				
Less than high school	-0.796	-3.8057**	-0.66	-3.673**
High school graduate	-0.471**	-2.948***	0.76**	-3.752***
Some college	-0.007	-1.541*	-0.199	-1.268
College graduate	-0.104	2.05	0.617	-1.409
N of Observations	2,402,200	2,580,460	1,153,077	334,415

Table A5: Fertility effect: Wage regressions for women

	Employed spouse			Unemployed/NILF spouse			Single		
	Female	Under 35	Over 35	Female	Under 35	Over 35	Female	Under 35	Over 35
Location effect									
Less than high school	-3.8***	-3.661**	-3.75***	-2.71*	-2.589	-2.52	-1.86	-5.37***	-0.17
High school graduate	-0.358	0.347	-0.756	-1.99**	0.74	-2.55***	-0.87	-1.56*	-0.591
Some college	-1.357*	-1.31**	-1.221	-1.262	-3.47**	-0.77	-0.727	-0.267	-1.1472
College graduate	-1.944*	-0.73	-2.654**	-2.423	-3.6	-2.25	-0.133	0.97	-0.905*
Industry effect									
Less than high school	-3.797**	-4.318***	-3.733**	-3.897**	-2.947	-4.166***	-1.874*	-1.684***	-1.908
High school graduate	-2.913***	-2.117***	-3.145***	-2.704***	-3.175*	-2.678***	-0.452	1.099***	-1.233**
Some college	-1.491	-1.241	-1.509**	-1.597	-4.653**	-0.83	0.536	1.34	-0.004
College graduate	2.041	0.27	3.73***	0.585	2.69	-0.48	0.665	-0.223	2.608***
N of Observations	2,642,608	889,065	1,753,543	410,167	76,435	333,732	1,809,235	708,079	1,101,156

Table A6: Wage growth: Difference between initial tariff and impact effects (controlling for share of married women-dominated occupations)

	Employed spouse		Unemployed/NILF spouse		Single	
	Male	Female	Male	Female	Male	Female
Location effect						
Less than high school	-0.34	-3.53***	-2.08	-2.72	-1.181	-2.09
High school graduate	-0.25	-0.335	-1.789**	-2.13**	-0.541	-1.18
Some college	-1.196*	-1.343	-1.202*	-1.482	-0.992*	-1.161
College graduate	-0.162	-3.03**	-1.138	-2.894	0.266	-0.965
Industry effect						
Less than high school	-0.854**	-3.038**	-0.735	-3.294**	-1.695***	-1.199
High school graduate	-0.402	-2.001**	0.68	-1.986*	-0.588	0.293
Some college	0.024	-0.532	-0.162	-0.792	0.156	1.334*
College graduate	-0.097	2.89**	0.7	1.194	-0.905	1.11
N of Observations	2,484,061	2,642,608	1,225,713	410,167	1,656,555	1,809,235

Table A7: Working Age Population Growth Regressions

Dependent Variable: $\triangle$ in Log Working Age Population	Employed spouse		Unemployed/NILF spouse		Single	
	Male	Female	Male	Female	Male	Female
Less than High School						
Initial tariff, $loc\tau^c_{1990}$	-11.47	-27.32***	-63.35***	-72.40***	-36.27***	-38.46***
	(8.451)	(8.821)	(14.59)	(19.05)	(9.993)	(12.81)
Change in tariff, $loc\triangle\tau^c$	-4.324	-22.34**	-66.43***	-68.74***	-38.33***	-32.09**
	(9.175)	(9.703)	(15.74)	(20.35)	(10.72)	(13.86)
F-statistic	21.60***	8.60***	1.33	1.74	1.50	10.97***
High School Graduates						
Initial tariff, $loc\tau^c_{1990}$	9.115	14.91**	-19.05*	3.390	18.07**	4.902
	(5.632)	(5.819)	(10.35)	(11.15)	(8.493)	(6.482)
Change in tariff, $loc\triangle\tau^c$	9.064	14.55**	-28.51**	-2.153	16.45*	3.571
	(6.088)	(6.268)	(11.15)	(11.87)	(9.200)	(6.945)
F-statistic	0.00	0.13	31.60***	8.01***	1.42	1.76
Some College						
Initial tariff, $loc\tau^c_{1990}$	18.06***	26.59***	-1.714	12.50	15.19*	34.90***
	(6.915)	(7.295)	(10.61)	(12.03)	(8.203)	(7.654)
Change in tariff, $loc\triangle\tau^c$	18.44**	24.90***	-7.675	3.552	12.08	33.17***
	(7.438)	(7.800)	(11.60)	(12.91)	(8.815)	(8.138)
F-statistic	0.11	2.12	11.47***	21.14***	5.87**	1.98
College Graduates						
Initial tariff, $loc\tau^c_{1990}$	6.638	4.509	-17.88	13.79	11.99	-12.78
	(9.795)	(9.310)	(12.29)	(21.17)	(8.162)	(12.72)
Change in tariff, $loc\triangle\tau^c$	4.808	2.466	-22.37*	12.45	10.50	-14.99
	(10.26)	(10.20)	(13.07)	(22.55)	(9.051)	(13.61)
F-statistic	2.02	1.59	6.99***	0.19	0.91	1.64

Notes: N=543 conspumas. Robust standard errors in parentheses. *** indicates significance at the 1% level. The table also reports F-statistics for testing whether the difference between initial local tariff and change in local tariff is different from zero.