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Export Growth and Demographic Changes: Evidence from Vietnam

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Export Growth and Demographic Changes: Evidence from Vietnam

Abstract

This paper evaluates the impacts of trade liberalization on the marital and fertility choices of women in Vietnam. Applying a regional exposure approach, we leverage the U.S.-Vietnam Bilateral Trade Agreement (BTA) as an exogenous and positive shock to the nation's export growth. Our results indicate that young women (aged 18-28) in provinces more exposed to export tariff reductions tend to delay marriage and childbirth. In contrast, we observe no significant impact on the marriage and fertility decisions of older women, nor any changes in sex-selective behavior across the general population. Further analysis reveals that this trade shock does not influence women's participation in the labor force or their employment status, nor does it lead to increased gender segregation in the labor market. The observed delay in marriage and fertility among young women may be attributed to a shift from agriculture to manufacturing and women staying longer at schools.

JEL-Codes: F61, J13, J16

Keywords: Trade liberalization; U.S.-Vietnam BTA; marriage; fertility; sex selection

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1 Introduction

Since its establishment in 1947, the World Trade Organization (WTO) and other international organizations have consistently advocated for trade liberalization - the removal of barriers to the flow of goods and services - as a strategy to promote economic prosperity, especially in developing countries (Siddiqui, 2015; Engel et al., 2021). Most research focuses on the economic impacts of integration, such as growth, poverty reduction, employment, skill premiums, or firms' productivity. However, over the past decade, there has been growing concern regarding the role of trade liberalization in driving social and demographic changes in both developed and emerging economies, primarily through the labor market channel (Chakraborty, 2015; Do et al., 2016; Kis-Katos et al., 2018; Anukriti and Kumler, 2019; Giuntella et al., 2022; Keller and Utar, 2022; Mansour et al., 2023; Luo and Zou, 2024; Feng et al., 2024). The findings of these studies are mixed, depending on the nature of liberalization, how it affects men and women in the labor market, and on other factors such as welfare policies and culture. In developing Asia, the persistence of son preference, combined with declining fertility driven by rapid economic growth and family planning policies, is exacerbating the issue of sex imbalance (Das Gupta and Mari Bhat, 1997; Jayachandran, 2017; Babiarz et al., 2018).

This paper provides an insight into the impacts of trade liberalization on social and demographic changes in Vietnam, a small and developing country with a deeply ingrained preference for sons. To establish causal relationships, this paper leverages an exogenous and positive shock to the export performance of Vietnam in the early 2000s: the implementation of the United States and Vietnam Bilateral Trade Agreement (BTA) in December 2001. The U.S.-Vietnam BTA marked a breakthrough in the relationship between the two countries and opened the door for Vietnam to better integrate into the global economy (Riedel et al., 2003). From virtually no trade relation, the U.S. has become Vietnam's largest export market, accounting for nearly 30% of Vietnam's total exports in 2021.[1] This created a significant and exogenous shock to the labor market of Vietnam (McCaig, 2011; Fukase, 2013; McCaig and Pavcnik, 2018).[2] When the shock occurred, Vietnam's socio-economic conditions had several notable features. First, the country already had a very high level of labor force participation among both men and women.[3] In 1999, nearly 80% of women aged 15-64 were active in the labor market.[4] Second, after a prolonged period implementing family planning policies,

[1] Data compiled by WITS (World Integrated Trade Solution).

[2] More discussion about the U.S.-Vietnam BTA in Section 3.

[3] Banerji et al. (2018) accredit the high rate of female labour force participation to Vietnam's long period under war (during which time the women had to fill in for the shortage of men in the labor market), and socialism, which stresses equality among all individuals.

[4] Authors' calculation from the Vietnam Population Census in 1999 (the 3% sample).

Vietnam's fertility rate had dropped to a low and stable level of just under two children per woman.[5] Third, since the early 2000s, the male-to-female sex ratio at birth in Vietnam began to increase abnormally to more than 110 boys over 100 girls (see Figure 1), placing Vietnam second only to China in terms of sex imbalance at birth.[6] These facts raise the question of to what extent the shock induced by the U.S.-Vietnam BTA has affected Vietnam's demographic structure concerning marriage, fertility, and the sex ratio at birth.

To answer this question, we apply a regional exposure approach following Topalova (2010) and employ data from the Vietnam population census from 1999 to 2019. The indicator of regional exposure to this trade shock is measured by the change in the tariff rate that the U.S. applied on imports from Vietnam in each industry before and after BTA came into effect, interacting with the original share of labor in the corresponding industry in each province. The validity of the approach comes from the exogeneity of the shock (Borusyak et al., 2022), as tariff reduction was implemented immediately and unrelated to the performance of the U.S. or Vietnam economies (McCaig, 2011; McCaig and Pavcnik, 2018). Our results show that provinces more exposed to tariff cuts experienced a reduction in marriage and fertility among young women (aged 18-28) but not among older women (aged 29-49), implying a delay or postponement of marriage and fertility. When distinguishing the trade shock by gender intensity in the initial industry structure of each province, we find that most of the effects are driven by female-intensive shocks. Mediation analysis suggests that these effects are driven by structural change, where women in provinces more exposed to tariff reductions are more likely to move from agriculture to manufacturing, which could raise the opportunity cost of marriage and having children (Erten et al., 2023; Doepke, 2004), and by women staying longer at school. However, we do not find evidence of the BTA's impact on gender allocation in the labor market (i.e., no impacts on the gender intensity of the industry structure at the provincial level or on the indicator of gender segregation in the labor market). This might explain why, unlike the case of India (Chakraborty, 2015) or China (Luo and Zou, 2024), we do not find significant impacts of trade liberalization on the child sex ratio in Vietnam.

Our paper contributes to the growing body of literature on the impacts of economic integration on social and demographic transformations. Most studies in this area have focused on the effects of increasing import competition, either due to China's rising prominence in the global market or domestic trade reforms aimed at reducing protectionist barriers. In the former case, Autor et al. (2019) find that increased import

[5]Starting in the 1960s in the North and since 1975 in the South, the Vietnamese Government promoted a model of small families with two to three children. In 1988, they officially issued a policy limiting the number of children to two per family. As a result, Vietnam's fertility rate declined significantly from 6 to just 2 children per woman from the 1960s to the early 2000s (Ngo, 2020).

[6]Source: https://liveprod.worldbank.org/en/indicator/sp-pop-brth-mf.

competition has adverse effects on both the *absolute* and *relative* employment and earnings of young men in the U.S., which subsequently leads to lower marriage and fertility rates. Keller and Utar (2022) identify parallel negative short-term impacts on men and women in Denmark, but women are more likely to marry or have children. In developing countries, Braga (2018) and Mansour et al. (2023) report that labor market outcomes are more negatively affected for women than for men in Brazil and Chile, respectively. While Braga (2018) observes adverse effects on fertility rates but no significant impact on marriage or cohabitation behaviors, Mansour et al. (2023) finds a decline in marriage rates without a corresponding impact on fertility. Reducing input tariffs has improved labor force participation and employment prospects of low-caste or low-skilled women (relative to men) in India and Indonesia, respectively (Anukriti and Kumler, 2019; Kis-Katos et al., 2018). While Kis-Katos et al. (2018) find lower marriage and fertility rates among young women, Anukriti and Kumler (2019) report a higher fertility rate among low-caste women in rural areas. Studies on the impacts of export growth mainly focus on China, where lower tariffs on Chinese exports are found to improve the economic condition of women relative to men, which contributes to the postponement of marriage and fertility among young women (Luo and Zou, 2024). In the context of low fertility, a worse employment prospect induced by higher import competition with Eastern Europe is associated with lower fertility in Germany (Giuntella et al., 2022). At the same time, structural transformation driven by foreign direct investment in China is found to lower marriage and fertility (on the extensive and intensive margin) of women (Erten et al., 2023). Overall, findings from the literature are mixed, and many of the results are explained by the gender differential impacts of trade liberalization on labor market outcomes. Our paper offers insights into the impacts of export growth in a developing country with an exceptionally high level of female labor force participation *priori* (which was higher than those in the countries mentioned above) and a relatively low fertility rate. Additionally, the effects of the positive trade shock in Vietnam appear to be relatively gender-neutral.

Our paper also contributes to the limited literature on the impacts of trade liberalization on the pre- or post-natal sex selection behavior (Chakraborty, 2015; Anukriti and Kumler, 2019; Luo and Zou, 2024). The phenomenon of sex selection is prevalent in countries with a persistent preference for sons, such as China, India, and Vietnam. Anukriti and Kumler (2019) finds that the positive impacts of trade liberalization in India on employment and fertility of low-caste women are associated with a higher fraction of newborn females and a lower mortality rate for girls within the first year of life. Similarly, the narrower gender gap in the labor market induced by trade shock in China is associated with a higher female-to-male ratio among newborn children, though it only delays the timing of births for women (Luo and Zou, 2024). In Vietnam, an absence of changes in the fertility rate or relative employment of women

might help explain the null effect of trade liberalization on the child sex ratio. Another driving factor is the fact that the fertility rate in Vietnam is higher than in China, and most parents prefer to have mixed-sex children (Vu, 2014; Vu et al., 2021).

Our paper extends the existing empirical research on the impact of the U.S.-Vietnam BTA, which has predominantly focused on economic outcomes. Short-term analyses show the positive impacts of BTA on poverty reduction (McCaig, 2011), skill premiums (Fukase, 2013), labor reallocation from the informal to the formal sector, and firm productivity (McCaig and Pavcnik, 2018). Long-term analyses highlight the role of BTA in facilitating structural transformation (Asghar and McCaig, 2024) and attracting foreign direct investment in sectors experiencing higher tariff cuts (McCaig et al., 2022). Our analysis complements two recent studies, which use different data sets to evaluate the impact of BTA on marriage and fertility (Ngoc et al., 2024) and on the sex ratio (Huynh and Nguyen, 2023). Ngoc et al. (2024) find that BTA reduces marriage rates and fertility among women under 40 but increases marriage rates and the number of children among older women without proper explanation. Huynh and Nguyen (2023) find a lower incidence of childbirth and a higher fraction of boys born to married couples. Our study utilizes more comprehensive data than these studies, specifically the population census, which includes information on the total number of births a woman has had at the time of the survey.[7] In our analysis, we can investigate the impacts of BTA on women across different age groups, providing clearer insights into whether BTA reduces or delays women's marriage and fertility. We also reveal that most of these effects are driven by shocks to female-intensive industries.

The paper is organized as follows: Section 2 synthesizes the channels through which trade liberalization affects marriage, fertility, and sex selection. Section 3 briefly introduces the context and commitments within the U.S-Vietnam Bilateral Trade Agreement (BTA). Section 4 describes the data used in the analysis and presents some general descriptive statistics. Section 5 outlines the empirical approach. Section 6 discusses the main results. Section 7 explores potential mechanisms. Finally, Section 8 concludes the paper.

[7] Ngoc et al. (2024) exploit the Vietnam Multiple Indicator Cluster Surveys (MICS) for their analysis. The MICS sampling was designed to represent national, regional, and rural/urban areas. Despite the authors applying the provincial exposure approach, it does not necessarily assure representativeness at the provincial level. When analyzing the impact of BTA on marriage and fertility among women under 40, the authors use cross-sectional data from the 2013/2014 survey round and create retrospective panel data to analyze the dynamic impacts of the shock. This approach further questions the representativeness of the data at the provincial level and over time while implicitly assuming no migration during the study period. Huynh and Nguyen (2023) use data from the Vietnam Household Living Standard Surveys (VHLSS) to assess the impacts of BTA on fertility and sex selection. While VHLSS data are representative at the provincial level, the authors only consider households where both parents are working. Additionally, VHLSS only provides information about living and co-residing children, which does not always reflect the actual number of births by the mothers.

2 Conceptual framework

Classical trade theory emphasizes the benefit of lowering barriers to the flow of goods and services across countries through improved productivity and reduced consumer prices. David Ricardo's trade theory postulates that trade encourages countries to specialize in the industries in which they have a comparative advantage. Therefore, these industries will expand, while the sectors with comparative disadvantage will contract (Ricardo, 2005). While the Ricardian model explains the comparative advantage by the difference in technologies, the Heckscher-Ohlin model derives such advantage from the difference in factor endowment (capital, labor, land) and factor-intensity of goods (Morrow, 2010).[8] As a consequence, trade liberalization plays an important role in driving the process of structural transformation in both developed and developing countries (i.e., China experiences massive structural change from agriculture to manufacturing and services sectors following its accession to the World Trade Organization (Erten and Leight, 2021)). In a scenario of lowering tariffs between an advanced economy and a developing economy, these models predict that the latter would benefit from the expansion of low-skilled, labor-intensive manufacturing sectors, which would increase income and employment for the general population (as this country is relatively labor-abundant).

The effects of trade liberalization depend on whether it is associated with lowering domestic protection (i.e., reduced import tariffs on final goods) or opening international markets (i.e., reduced export tariffs by trading partners). In the former case, domestic producers would face higher competition from abroad, resulting in job loss or income decline in sectors with weak competitiveness.[9] In the latter case, the country might experience export growth with the overall net impacts on growth and income. In addition, the impacts of trade liberalization depend a lot on the initial structure of the economy. If there are also gender differences in the allocation of labour across sectors, it also affects the gender disparities with respect to income and employment (Brussevich, 2018; Besedeš et al., 2021; Gupta, 2021; Juhn et al., 2013).[10] This, in turn, affects other non-economic outcomes, such as marriage or fertility (Do et al., 2016; Autor et al., 2019).[11] The explanation underlying these non-economic impacts lies in the division of labor within a household: men specialize in market work, and women bear most of

[8] However, these theories are based on a static setting and does not consider dynamic adjustments. It also assumes perfect competition, full employment, and free mobility of labors across sectors (Morrow, 2010; Siddiqui, 2018)

[9] For examples, trade liberalization in Brazil in the late 1980s and early 1990s is found to be associated with lower labour force participation and employment of both men and women, especially in traded sector (Gaddis and Pieters, 2017).

[10] Note that these studies also emphasize other factors associated with trade liberalization that affect gender inequality (such as technological adjustment).

[11] Do et al. (2016) theoretically and empirically prove that countries with comparative advantage in female-intensive goods exhibit lower levels of fertility.

the burden of domestic work and child-rearing (Becker, 1981, 1985). An increase in the earnings of men relative to women would increase marriage and fertility, contrary to the relative increase in the earnings of women (Becker and Lewis, 1973; Stevenson and Wolfers, 2007; Do et al., 2016; Autor et al., 2019).

Even if there are no changes in the relative earnings and employment levels between men and women, the overall improvement in incomes and economic opportunities for the entire population would still influence marriage and fertility patterns. The economic analysis of fertility over the last half of a century, pioneered by the work of Becker (1960), has been centered around the framework of quality-quantity trade-off (Doepke, 2015). According to Becker (1960), the level of fertility is determined by factors such as income, cost of raising children, and tastes. Holding other things constant, an increase in income would be associated with an increase in the desire for both the number and quality of children. However, the income elasticity with respect to the quality of children would be larger than that with respect to the quantity of children (Becker and Lewis, 1973). In another aspect, the rising income and employment conditions of women push up the opportunity cost of raising children, again reducing fertility. Analyzing data on developing countries, Chatterjee and Vogl (2018) find that long-run economic growth is often associated with delay and decline in fertility, with faster fertility decline among the younger cohort (between 20-34 years old).

In poor and developing countries, where a well-functioned welfare system is absent, having children is also considered as an investment in old age security (where the children often take care of their parents in their old ages) (Nugent, 1985; Boldrin and Jones, 2002). Empirical evidence shows that the provision or extension of social pension drives down fertility (Nugent, 1985; Ebenstein and Leung, 2010; Rossi and Godard, 2022). This suggests that the impact of economic shocks on fertility would be systematically different between developed and developing countries, and their effects on fertility in developing countries where fertility is already at a low level would be more limited.

Trade liberalization would have an impact on the sex imbalance, particularly in countries with son preference. First, if trade liberalization improves women's economic empowerment (i.e., through the expansion of female-intensive sectors), there would be relatively more demand for girls as the expected returns to girls increase. Hence, girls would have more chances to be born or survive in their early ages (Qian, 2008). However, if son preference is persistent, fertility decline (due to trade liberalization) would be associated with more sex imbalance as the desired number of boys does not change while the desired number of children goes down (Jayachandran, 2017). In addition, higher income enables parents to afford costly sex-selective technologies (such as the In-Vitro Fertilization (IVF) technology that allows parents to select the child's gender

at conception; or the technologies used for very early detection of the child's gender in utero).

3 The Vietnam - U.S. Bilateral Trade Agreement

After the end of the Vietnam War in 1975, the U.S. imposed a trade embargo on Vietnam, effectively prohibiting any economic relationship with Vietnam. Since the mid-1990s, efforts to normalize the two countries' relationship have proved successful, with the lifting of the embargo in 1994. This went further with the approval of the U.S.-Vietnam Bilateral Trade Agreement in 2001, in which the U.S. granted Vietnam a Normal Trade Relations (NTR) or the Most Favored Nation (MFN) status to enter the U.S. market. This marks a milestone in the relationship between the two countries and paved the way for Vietnam to negotiate with other countries to approve its accession to the World Trade Organization (WTO) in 2007 (Riedel et al., 2003).

The U.S.-Vietnam BTA opened up significant opportunities for Vietnam to expand its exports to the U.S. market. Before the agreement, products originating from Vietnam faced extremely high tariff rates, as outlined in Column 2 in the U.S. Harmonized Tariff Schedule (HTSUS), similar to other countries without a normal trade relationship with the U.S, such as North Korea and Cuba. Following the implementation of the BTA in December 2001, Vietnamese products became subject to considerably lower MFN tariffs. The average tariff rates for Vietnamese products fell dramatically from about 40% to around 3-4%. From the Vietnamese side, even before BTA came into effect, Vietnam had already applied the MFN tariff rates on goods and services from the U.S. Most of the commitments of Vietnam, however, involved institutional and policy reforms necessary to classify Vietnam as a market economy (i.e. market access for trade in services, regulations relating foreign direct investment, intellectual property rights, transparency of laws and regulations, etc.) (Riedel et al., 2003).

Figure A.1 in the Appendix shows that the share of the U.S. exports in the total exports of Vietnam to the world market increased substantially, rising from around 7% to nearly 20% in just five years, from 2001 to 2006. The share of manufacturing exports to the U.S. market saw an even greater increase, jumping from around 4% in 2011 to nearly 30% in 2006. It is important to note that the implementation of the U.S.-Vietnam BTA does not lead to the trade diversion of Vietnamese exports from the other markets to the U.S. market. As illustrated in Figure A.2, after 2001, exports from Vietnam to both the U.S. and other markets increased significantly.

4 Data and Descriptives

4.1 Data

The Population Census: This paper utilizes data from three population censuses of Vietnam, conducted in 1999 (3% of the full population), 2009 (14% sample), and 2019 (8% sample). The censuses provide detailed information regarding the household composition (relationship to the household head, ethnicity, rural/urban area) and individual characteristics (age, gender, education, employment, marital status). Regarding economic activity, respondents were asked whether they were employed, unemployed or inactive in the labor market. For those employed, detailed information is available at the 3-digit level of the industrial sector.

A special module was administered to women aged 15 to 49 years, asking about their reproductive lives, including the total number of children they have ever given birth to, the number of children still alive, and details about their most recent birth (year and month of birth, and the number of boys and girls in the last birth). Using this module, we construct the outcome variables for women, focusing on fertility and the gender of the latest birth. For simplicity, we exclude cases of non-singleton last births, which account for less than 2% of all reported last births. This allows us to assess the impact of trade liberalization on sex selection, which often happens at the last birth. However, not all the latest births in our sample are truly the last births, as many women were still very young at the time of the survey. To complement our analysis of the impact of trade liberalization on sex selection, we also performed an analysis at the provincial level, examining changes in the sex ratio among children under five years old in each province. Throughout the paper, we primarily focus on the marriage and fertility behaviors of women aged 18 to 49, as Vietnamese Family Law sets the minimum legal marriage age for women at 18.[12]

Tariff data: We utilize the tariff cuts matched with the 2-digit industrial classification of Vietnam in 1993, as provided by McCaig (2011).[13] The author calculates the tariff rates applied to Vietnamese products using ad-valorem tariffs weighted by the share of the U.S.'s imports of each industry over its total imports from the world market. A total of 76 industries experienced tariff reductions, with the highest drops in manufacturing sectors, where tariffs declined from an average of 33% to 3.4%.

Table 1 lists the industries with the level of tariff cuts of more than 30% following BTA. These are all manufacturing industries, including garment and textiles,

[12]According to data from the 1999 census, the share of ever-married women among all women aged 10-17 was 0.6%.

[13]The industry codes used the Population Census in 1999 were based on the Vietnam Standard Industrial Classification (VSIC) 1993; The Population Census in 2009 followed the VSIC in 2007; and the Population Census in 2019 followed the VSIC in 2018.

manufacture of tobacco products, furniture, plastics and rubbers, and electric appliances.

Table 1: Industries with highest level of tariff reductions

Industry code	Column 2 tariff rate (%)	MFN tariff rate (%)	Change (%)	Industry Classification
24	35.18	3.19	32.00	Manuf. of chemicals and chemical products
31	35.32	2.81	32.52	Manuf. of electrical machinery and apparatus n.e.c.
29	34.30	1.46	32.84	Manuf. of not-yet-classified machinery and equipment
32	34.88	0.70	34.17	Manuf. of radio, television and communication equipment and apparatus
30	34.99	0.03	34.96	Manuf. of office, accounting and computing machinery
28	39.09	2.93	36.17	Manuf. of fabricated metal products, except machinery and equipment
26	42.25	4.46	37.79	Manuf. of other non-metallic mineral products
33	40.95	1.09	39.86	Manuf. of medical, precision and optical instruments, watches and clocks
25	43.61	3.68	39.93	Manuf. of rubber and plastics products
36	43.16	1.24	41.91	Manuf. of furniture; manufacturing n.e.c.
17	62.67	14.19	48.48	Manuf. of textiles
16	63.83	5.67	58.15	Manuf. of tobacco products
18	74.05	15.53	58.53	Manuf. of wearing apparel; dressing and dyeing of fur

Notes: Data are sorted from McCaig (2011)

4.2 Descriptives

Vietnam stands out from many other countries in the region with a very high level of women's labor force participation (Banerji et al., 2018). Table 2 shows that the share of women who engaged in some economic activities was high at approximately 80% with minor changes from 1999 to 2019. Disaggregating by employment sector, we observe a remarkable fall in the share of women working in agriculture, from 68.3% in 1999 to 51.9% in 2009 and 28.9% in 2019. During the same period, the share of women working in the manufacturing sector increased substantially from 10% in 1999 to 21.8% in 2019. The shares of women aged 18-49 who have never married declined from 25.4% in 1999 to 22.4% and 21.8% in 2009 and 2019, respectively. There was also a slight decrease in the average number of children per woman, from 1.98 to 1.44 children per woman in 1999 and 2019, respectively. The probabilities of having a female in the latest birth were lower than the natural level and declined somewhat from 45% in 1999 to 43.8% in 2019.[14] This partly reflects the son-stopping behavior of parents in Vietnam (indicating a higher likelihood of ceasing childbearing after the birth of a son compared to a daughter).

At the provincial level, the shares of girls among children under 5 years old in 2009 and 2019 are all below the level in 1999, suggesting evidence of sex selection.[15] Compared to the level in 1999, the number of girls per 1,000 children aged 0-5 decreased by an average of 8.3 in 2009 and 5.5 in 2019.. Other figures at the aggregate level also imply the transition out of agriculture in Vietnam (the share of working people (aged 15-64 years old) in agriculture decreased from 72.45% in 1999 to 58.90% in 2009

[14]The normal sex ratios are between 103 to 106 boys over 100 girls, equivalent to the share of female children between 48.3-49.3% (Tafuro and Guilmoto, 2020).

[15]Note that in Vietnam, the male-to-female ratio among deceased children is higher than the world's average (Iqbal et al., 2018).

and 40.5% in 2019), and the urbanization process underway (the share of the total population living in the rural areas fell from 79.5% in 1999 to 71.45% in 2019).

Table 2: Descriptive statistics, Census 1999-2019

	Census 1999	Census 2009	Census 2019
Sample of women aged 18-49			
% single	25.4	22.4	21.8
no. of children	1.98	1.56	1.44
latest birth is female (%)	45	44.3	43.8
% working	79.1	81	78.4
agriculture	68.3	51.9	28.9
manufacturing	9.9	16.9	28.7
Aggregate data at provincial's level			
% girl among children under-5	48.12	47.47	47.75
% rural population	79.50	75.21	71.45
% labor in agriculture	72.45	58.90	40.50
% labor in manufacturing	7.25	11.11	17.66

Notes: Authors' calculation from the Population Census in 1999, 2009, and 2019.

Figure 1 shows the evolution of the total fertility rate[16] and the sex ratio at birth (SRB) of Vietnam, retrieved from World Bank data. The sharp decline in the fertility rate of Vietnam before the 21^{st} century was the result of the relatively stringent implementation of the family planning policy of Vietnam. After that, the fertility rate remains quite stable at just under two children per woman. On the contrary, the SRB of Vietnam was quite stable at around 106 boys over 100 girls, then increased in the early 2000s to a peak of around 112 boys over 100 girls.[17]

5 Approach

We follow the typical regional approach to assess the impact of trade liberalization, pioneered by Topalova (2007, 2010), and later widely used in the literature of trade liberalization (Kovak, 2013; Dix-Carneiro and Kovak, 2015, 2017; Autor et al., 2013, 2014, 2019; McCaig, 2011). This approach asserts that each location experiences varying levels of exposure to tariff reduction based on its initial differences in industrial composition. We first compute a measure indicating the extent of location exposure to tariff cuts. In our paper, we perform the analysis at the provincial level, the second level of the administrative division of Vietnam. The indicator of provincial exposure to tariff reduction, $\Delta\tau_p$, is calculated as follows:

[16]The fertility rate is calculated as the average number of children per woman aged 15-49.

[17]This increase was mainly driven by sex-selective behaviour with the dissemination of ultrasound machines and the approval of safe abortion practices in Vietnam in the early 2000s. Post-natal sex selection in Vietnam was rare because, during the period when Vietnam strictly implemented the two-child policy (i.e., from 1988 until the late 1990s), the child sex ratios (from ages 0 to 10) still lay in the normal range.

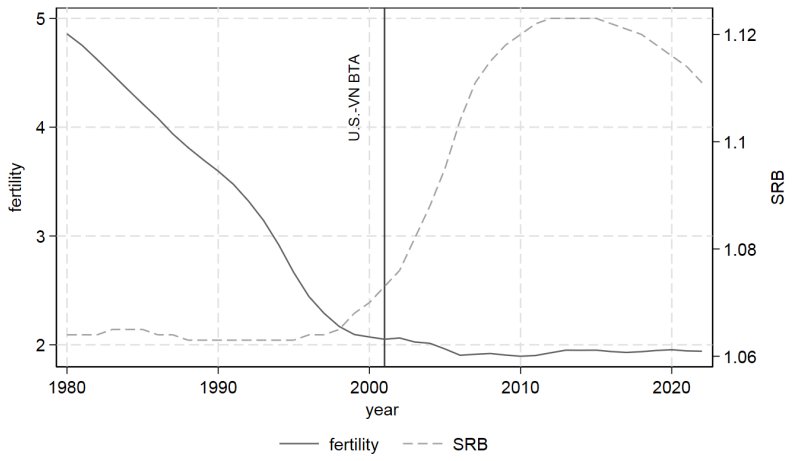

Figure 1: VN's fertility and sex ratio at birth, 1980-2022
Source: World Bank data.

$$\Delta\tau_p = \sum \frac{L_{ip_0}}{L_{p_0}} \Delta\tau_i \tag{1}$$

In equation 1, p denotes province, i denotes industry. $\frac{L_{ip}}{L_p}$ is the share of workers in industry i in the total employment of province p at based-line (year 1999). $\Delta\tau_i$ is the change in the tariff rate imposed on industry i, which is calculated by taking the tariff rate before 2001 (Column 2) minus the tariff rate after 2001 (MFN tariff).[18] This approach assigns null tariff change to the non-traded sector. Kovak (2013) provides a detailed discussion on constructing the measure of regional exposure to trade liberalization. He suggests removing the non-traded sectors and weighing the level of tariff change by the share of employment in the traded sectors only. However, as he points out, this approach is mostly applied to studies on wage-related outcomes, while our focus is more on non-wage outcomes (marriage, fertility, sex selection). Therefore, we also consider the traded sector's size relative to the total employment of the province at the baseline, as the approach in Autor et al. (2019). Figure A.3 illustrates the variation in the level of exposure to tariff reductions across provinces in Vietnam.

In the main analysis, we investigate the changes in the outcomes at the individual level. Our model is as follows:

$$Y_{ipt} = \sum_{s=2009,2019} \beta_t \Delta\tau_p \mathbf{1}(t=s) + \delta X_{ipt} + \eta X_{p_0 t} + \theta_p + \gamma_t + \epsilon_{ipt} \tag{2}$$

In which, Y_{ipt} is the outcome of woman i living in province p at the time of survey t. We interact the level of provincial exposure to tariff cut with dummies indicating whether t equals 2009 or 2019, with 1999 serving as the reference year. We include in

[18] in percentage points, i.e. $\Delta\tau_i = 20$ percentage points if tariff in industry i dropped from 30% to 10%.

the estimation a set of person i's characteristics (X_{ipt}), including age and age-squared. X_{p_0t} is a set of baseline characteristics of the province (in 1999) and interacted with a linear time trend. These include the share of women working in agriculture and manufacturing, the share of women (aged 18-49) who have never married, and the share of the population living in rural areas. We also include province (θ_p) and survey time (γ_t) fixed effects.

Following Autor et al. (2019), we also calculate the measures of provincial exposure to tariff cuts differentiated by gender. As discussed in Section 2, the impacts of trade liberalization also depend on the initial gender allocation across sectors. The locations with more penetration of female workers in industries that experience large tariff cuts would expect larger impacts on women. The composite measure of provincial exposure to tariff cut is apportioned into two additive components: locational female industry shock ($\Delta\tau_p^f$) and male industry shock ($\Delta\tau_p^m$). The formulas are as follows:

$$\Delta\tau_p^f = \sum \frac{f_{ip_0} \times L_{ip_0}}{L_{p_0}} \Delta\tau_i \tag{3}$$

$$\Delta\tau_p^m = \sum \frac{(1 - f_{ip_0}) \times L_{ip_0}}{L_{p_0}} \Delta\tau_i \tag{4}$$

In which f_{ip_0} is the share of female workers in sector i in province p in the baseline year (1999), and $1 - f_{ip_0}$ is the corresponding share of male workers. We then estimate a similar model like equation 2, replacing $\Delta\tau_p$ by $\Delta\tau_p^f$ and $\Delta\tau_p^m$ as follows:

$$Y_{ipt} = \sum_{s=2009,2019} \beta_t^f \Delta\tau_p^f \mathbf{1}(t=s) + \sum_{s=2009,2019} \beta_t^m \Delta\tau_p^m \mathbf{1}(t=s) + \delta X_{ipt} + \eta X_{p_0t} + \theta_p + \gamma_t + \epsilon_{ipt} \tag{5}$$

Table 3 presents the summary statistics of $\Delta\tau_p$, $\Delta\tau_p^f$, and $\Delta\tau_p^m$. The average provincial exposure to export tariff reduction is 7.93 percentage points, with a standard deviation of 1.37 percentage points. The means of provincial male and female trade shock are quite similar and higher for females (4.06 percentage points) than males (3.85 percentage points).

Table 3: Provincial's exposure to tariff reduction

	mean	(std.)	min	max	N
$\Delta\tau_p$	7.93	(1.37)	5.95	14.75	60
$\Delta\tau_p^f$	4.06	(0.85)	2.83	8.37	60
$\Delta\tau_p^m$	3.85	(0.57)	3.00	6.37	60

Notes: Summary statistics of the measures of provincial's exposure to tariff reduction following the formulas in 2, 3, and 4.

Our outcomes of interest include a dummy indicating whether the woman is single or ever-married, the number of children she has ever given birth to, and a dummy equal to one if the gender of the latest birth of the woman is a boy. As the latter outcome is not so informative about sex selection behavior, we complement the analysis at the provincial level. We construct an outcome equal to the share of girls among under-5-year-old children.[19] The estimation at the provincial level is as follows:

$$Y_{pt} = \sum \beta_t \Delta\tau_p \mathbf{1}(t = 2009|t = 2019) + \eta X_{p_0 t} + \theta_p + \gamma_t + \epsilon_{ipt} \tag{6}$$

Where Y_{pt} is the outcome of province p at time t. We only include in the estimation the baseline characteristics of the province as in model 2, and add the share of girls among children under 5 in each province in 1999 (interacted with a linear time trend).

This approach can only yield a consistent estimate of β_t in equation 2, 5, and 6 if the measure of regional exposure to tariff-cut does not correlate with any unobserved factors that also affect outcomes (such as technological changes or any other industrial shocks). Goldsmith-Pinkham et al. (2020) argue that this approach can still yield consistent estimates if the "shares" (the initial structure of labor allocation) are exogenous and examining how different exposure to common shock affects the *changes* in the outcomes (the "share" can still be correlated with the *levels* of the outcomes). Borusyak et al. (2022) instead exploit the exogeneity of the shocks themselves while allowing endogenous exposure to shocks. In our setting, the "shocks" exogeneity condition is more likely to be satisfied than the exogenous "share" condition. McCaig (2011) and McCaig and Pavcnik (2018) have performed exhaustive exercises to prove the exogeneity of the tariff cuts following the implementation of the U.S.-Vietnam BTA (i.e., (a) both the tariff rates in Column (2) or the MFN rates are exogenous to the economic condition of Vietnam; and the tariffs in Column (2) are more politically than economically determined; (b) there are no correlations between tariff cuts and the previous trends in the exports from Vietnam to the United States or from Vietnam to other destinations).

6 Results

6.1 Main results

6.1.1 Marriage and fertility

Table 4, Panel A, presents the results of the main estimations regarding the impact of trade liberalization on marriage and fertility of women aged 18-49 years old. The first four columns examine the probability of being single (never married) across different age groups. For the sample of all women (column (1)), the estimated coefficients are

[19] We will discuss more about this in Section 6.1.2.

positive and statistically significant at the 1% level. A one percentage point increase in the provincial exposure to tariff cuts is associated with an increase of 1.1 and 1.6 percentage points in the probability of being single in 2009 and 2019, respectively. When disaggregating by age groups, the impacts of the U.S-Vietnam BTA are primarily observed among young women aged 18-28 years. An increase of one percentage point in the exposure to tariff cuts is associated with 2.0 and 2.8 percentage points increases in the probability of being single in 2009 and 2019 among these youngest women, respectively. There is only a statistically significant impact of BTA on the likelihood of remaining single among women aged 29-39 in 2019, but not in 2009. The estimates for older women (aged 40-49) are positive but insignificant. These results show evidence of delayed marriage among more exposed provinces over time.

The impacts of BTA on fertility rate are presented in columns (5) to (8). All estimated coefficients are negative but not statistically significant except for the estimates on the sample of women aged 18-28. An increase of 1% in the exposure to tariff cuts reduced the average number of children among the youngest women by 0.032 and 0.044. These results again suggest young women delay having children, which is consistent with the pattern of delaying marriage. However, BTA has no impact on the fertility rate of older women.

Table 4: Impacts of BTA on marriage and fertility

	being single				no. of children			
	18-49	18-28	29-39	40-49	18-49	18-28	29-39	40-49
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A								
$\Delta\tau_p \times 2009$	0.011***	0.020***	0.006	0.005	-0.018	-0.032***	-0.010	-0.010
	(0.004)	(0.003)	(0.005)	(0.004)	(0.033)	(0.011)	(0.047)	(0.065)
$\Delta\tau_p \times 2019$	0.016***	0.028***	0.013**	0.006	-0.015	-0.044***	-0.010	0.024
	(0.005)	(0.004)	(0.006)	(0.004)	(0.037)	(0.011)	(0.050)	(0.074)
Panel B								
$\Delta\tau_p^f \times 2009$	0.030***	0.055***	0.013	0.016**	-0.080	-0.126***	-0.086	0.041
	(0.009)	(0.014)	(0.010)	(0.007)	(0.063)	(0.036)	(0.089)	(0.132)
$\Delta\tau_p^f \times 2019$	0.022**	0.047***	0.016	0.010	-0.034	-0.103***	-0.040	0.119
	(0.009)	(0.013)	(0.011)	(0.008)	(0.081)	(0.034)	(0.116)	(0.160)
$\Delta\tau_p^m \times 2009$	-0.009	-0.017	0.001	-0.009	0.022	0.081	0.042	-0.174
	(0.011)	(0.020)	(0.010)	(0.007)	(0.066)	(0.049)	(0.102)	(0.163)
$\Delta\tau_p^m \times 2019$	0.019	0.021	0.014	0.003	-0.046	0.009	-0.029	-0.206
	(0.013)	(0.022)	(0.013)	(0.010)	(0.109)	(0.048)	(0.160)	(0.231)
Mean Y	0.223	0.469	0.086	0.054	1.636	0.651	1.973	2.601
N	6,070,197	2,261,477	2,157,007	1,651,713	6,070,197	2,261,477	2,157,007	1,651,713

Notes: the estimations also include the women's age, age-squared, ethnicity, provinces' based line characteristics in 1999 interacted with a linear time trend, province and census year fixed effects. Standard errors are clustered at the provincial level and in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Panel B of Table 4 presents the results with gender-specific trade shocks. It appears that most of the effects on women's marriage and fertility are driven by female-industry

shock. A one standard deviation (0.85 percentage points) increase in the province's exposure to female trade shock is associated with 2.6 (0.03×0.85) and 1.9 (0.022×0.85) percentage points increase in the probability of being single for women in 2009 and 2019, respectively. The effects are mainly concentrated among the youngest group. A one standard deviation increase in the province's exposure to female trade shock is associated with a 4.7 and 4.0 percentage points increase in the likelihood of never marrying among women aged 18-28 in 2009 and 2019, respectively. The same pattern was also observed for fertility outcomes. Female-intensive trade shock does not affect the overall level of fertility of all women but reduces the number of children among women aged 18-28. A one standard deviation increase in the province's exposure to female-intensive shock is associated with a reduction in the average number of children among the youngest women by 0.107 in 2009 and by 0.089 in 2019.

6.1.2 Sex selection

Table 5 presents the estimates of the impacts of BTA on sex selection. The analysis at an individual level (Columns (1) to (4)) shows no statistically significant impacts of the trade shocks (and gender-specific shocks) on the probability of having a girl at the latest birth. However, the analysis at the individual level might be only informative for the youngest group of women. The latest birth among this group is more likely to be the first or second birth, while it is more likely to be the last birth among the oldest women. In all periods with and without sex-selective technologies, a large majority of parents still follow son-stopping behaviour: they continue childbearing until they have at least one male child. Therefore, the old mothers (aged 40-49) in 1999 (the period when sex-selective technologies were inaccessible) could still have an equal or higher probability of having a boy in the last birth compared to the old mothers in 2009 or 2019 (the periods in which sex-selective technologies were widely available in Vietnam). In Vietnam, there is evidence of sex selection even from the first birth, as the sex ratio of first-order births is higher than that of the second-order births (UNFPA, 2014, 2019). Therefore, the younger mothers (aged 18-28 and 29-39) in the period with sex-selective technologies (in 2009 and 2019) would have a higher probability of having a boy in the latest birth (due to sex-selection) compared to the mothers of the same ages in 1999. Even so, we do not observe statistically significant impacts of BTA on the sex ratio among the latest births of these younger mothers (though the coefficients are negative in Column (2) Panel (A)).

The results of the estimations at the provincial level (column (5)) corroborate our conclusion from the estimates on individual women. In any specifications, we do not observe statistically significant impacts of the trade shock on the sex ratio among children under 5 years old in each province. However, it should be noted that the coefficients in Panel (A) and the coefficients of the female-intensive shocks in Panel

Table 5: Impacts of BTA on probability of having a female child in the latest birth

	individual level				provincial level
	18-49	18-28	29-39	40-49	
	(1)	(2)	(3)	(4)	(5)
Panel A					
$\Delta\tau_p \times 2009$	-0.0003	-0.0019	0.0014	-0.0015	-0.0008
	(0.0017)	(0.0020)	(0.0012)	(0.0031)	(0.0010)
$\Delta\tau_p \times 2019$	0.0007	-0.0007	0.0014	0.0001	-0.0013
	(0.0020)	(0.0025)	(0.0013)	(0.0033)	(0.0012)
Panel B					
$\Delta\tau_p^f \times 2009$	0.0023	-0.0006	-0.0003	0.0087	-0.0023
	(0.0040)	(0.0055)	(0.0033)	(0.0062)	(0.0023)
$\Delta\tau_p^f \times 2019$	0.0036	0.0056	-0.0020	0.0107	-0.0010
	(0.0050)	(0.0066)	(0.0035)	(0.0079)	(0.0028)
$\Delta\tau_p^m \times 2009$	-0.0045	-0.0041	0.0039	-0.0171*	0.0016
	(0.0058)	(0.0079)	(0.0060)	(0.0087)	(0.0034)
$\Delta\tau_p^m \times 2019$	-0.0039	-0.0109	0.0069	-0.0163	-0.0019
	(0.0076)	(0.0094)	(0.0067)	(0.0120)	(0.0037)
Mean Y	0.444	0.464	0.444	0.429	0.478
N	4,460,953	1,036,322	1,910,293	1,514,338	180

Notes: the estimations also include the women's age, age-squared, ethnicity, province's based line characteristics in 1999 interacted with a linear time trend, province and census year fixed effects. Standard errors are clustered at province level and in parentheses, and with bootstrap procedure in Column (5). $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

(B) are all negative. This aligns with the negative coefficients of trade shock and female-intensive shock on the number of children per woman. Altogether, they might be indicative (though weakly evidenced) of fertility and sex-ratio trade-off: more sex selection among mothers with fewer children.

6.2 Robustness checks

To check for the robustness of our main results, we perform the following exercises:

Placebo tests: First, we run placebo (or permutation) tests. To do so, we randomly re-assign the level of tariff-cut exposure ($\Delta\tau_p$) across provinces and run each of the estimations in the main analysis a thousand times. In any of these exercises, the estimated coefficients have normal distributions with the mean value centered around 0, suggesting no effects of the reshuffled treatments on the outcome variables. We present the graphs of the distribution of these estimates in the Appendix (Figures A.4 and A.5).

Estimations with complete census data: The data used in our main analysis

is only a fraction of the full population of the Vietnamese Census. To check if this sample selection drives our results, we re-run the main analysis using the full population census sample in 1999, 2009, and 2019. The full censuses contain less information than the short censuses: they only provide information about the household composition (age, gender, relation to the household head, years of education, ethnicity, rural/urban, and marital status). We check two main outcomes: (i) the share of girls among children under 5 years old at the provincial level and (ii) the number of children per household. Though there is no information about the fertility of the woman, we substitute by examining the impact of BTA on the average number of children per family (i.e., by counting the number of household members who are children of the household head and restricting the age of the mother to be under 35 or 40 years old). Our results are quite similar to the main results (Table B.4): BTA is not statistically associated with the share of female children under 5 years old and the average number of children per household across provinces.

The role of migration: Migration across provinces constitutes about 2% of the population in Vietnam.[20] We define migrants as individuals whose place of residence five years prior to the survey is different from their current place of residence. As trade shock creates better jobs in the provinces exposed to higher tariff cuts, it might induce more immigrants in these provinces. To assess if the effects are driven by migration, we re-run the analysis on a sample of non-migrants. The estimations on the sample of non-migrants are similar to the results in the main analysis (see Tables B.1 and B.2).

7 Mechanisms

In the previous Section, we find that the U.S.-Vietnam BTA has significantly induced a delay in marriage and fertility of young women, but it did not affect sex selection. In this Section, we explore possible mechanisms behind these effects by examining three channels: (1) the impacts of BTA on employment and sectoral transition of female workers; (2) the influence of BTA on the shift towards more female-intensive industries or increased segregation in the labor market; and (3) the effect of BTA on the educational attainment of women.

7.1 BTA and employment and structural change

We first examine if trade liberalization creates more jobs or alters the nature of women's jobs. In either case, it would affect the opportunity costs of getting married or having children. In this subsection, we estimate similar models as in equation 2 to analyze the following outcomes: women's employment status (whether employed or not) and the probabilities of women working in agriculture, manufacturing, and services.

[20] Own calculation from the population censuses

Table 6: Impacts of BTA on employment and structural transformation, women aged 18-49

	working	agriculture	manufacturing	services
	(1)	(2)	(3)	(4)
$\Delta\tau_p \times 2009$	-0.003	-0.094***	0.071***	0.022*
	(0.008)	(0.009)	(0.013)	(0.013)
$\Delta\tau_p \times 2019$	-0.001	-0.067***	0.053**	0.014
	(0.008)	(0.012)	(0.022)	(0.015)
Mean Y	0.795	0.483	0.192	0.325
N	6,070,753	4,951,395	4,951,395	4,951,395

Notes: the estimations are on sample of women aged 18-49, also include the women's age, age-squared, ethnicity, and the province's based line characteristics in 1999 interacted with a linear time trend, province and census year fixed effects. Standard errors are clustered at province level and in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 6 shows no statistically significant impact of BTA on women's employment status. This may be due to Vietnam's already high rate of women's labor force participation before trade liberalization. However, the coefficients of trade shocks are all negative, which could suggest that women stay in school longer and are, therefore, less likely to work. Columns (2) to (4) indicate a shift of women from agricultural to manufacturing jobs. This pattern of transformation is also observed among male workers (Table B.3). Our results are consistent with those of Asghar and McCaig (2024), which examines the impacts of BTA on sectoral transitions for individuals aged 15 to 29 years. Jobs in the manufacturing sector are more likely to offer higher salaries, be more formal, and have less flexible hours than those in agriculture. McCaig and Pavcnik (2018) find that BTA facilitates the transition from informal to formal sectors in Vietnam. These changes in the nature of jobs likely contribute to changes in gender norms and the empowerment of women, thereby influencing decisions related to marriage and fertility (Li, 2021; Rodríguez-Planas and Tanaka, 2022; Lee et al., 2021). Our results align with findings by Heath and Mobarak (2015) and Kis-Katos et al. (2018), who find that improved employment opportunities in the manufacturing sector lead to delayed marriage among women.

7.2 BTA and gender allocation in the labor market

In this subsection, we examine if BTA affects the relative allocation of males and females across sectors in the labor market. If female-intensive industries expand more rapidly than male-intensive industries, the economic position of women could improve significantly, potentially leading to a reduction or delay in marriage and fertility among women. In another aspect, even if trade creates equal employment opportunities for men and women, it might also trigger gender segregation in the labor market, with men

and women becoming concentrated in different economic sub-sectors. Such segregation could reduce opportunities for matching between men and women, which could have significant consequences for marriage and fertility. Following Kis-Katos et al. (2018) and Ouyang et al. (2023), we construct two measures to assess these dynamics: the Female Intensity Index (FI) and the Gender Concentration Index (GCI).[21] The Female Intensity Index is measured as follows:

$$FI_{pt} = \sum_i \left(\frac{L_{ipt}}{L_{pt}} \times f_{ip_0} \right) \tag{7}$$

In this equation, $\frac{L_{ipt}}{L_{pt}}$ represents the share of labor in sector i in province p relative to the total labor force of province p at time t; f_{ip_0} is the share of female worker in sector i in province p at baseline year (1999). An increase in FI indicates that the industry structure in province p is shifting towards more female-intensive industries at time t, given the initial gender structure of that province at the baseline.

The Gender Concentration Index is defined as:

$$GCI_{pt} = \sum_i \frac{L_{ip_0}}{L_{p_0}} \times \left(f_{ipt}^2 + (1 - f_{ipt})^2 \right) \tag{8}$$

In equation 8, $\frac{L_{ip_0}}{L_{p_0}}$ represents the share of employment of industry i in province p relative to the total employment of province p at the baseline; f_{ipt} denotes the share of female workers in industry i in province p at time t; $1 - f_{ipt}$ is the share of male labors in the same industry and location. A higher value of GCI indicates greater gender segregation across sectors.[22]

We then estimate equation 6 and replace the outcome variables by FI_{pt} and GCI_{pt}. Results of the estimations are presented in Table 7. We do not observe statistically significant impacts of BTA on either FI or GCI. This indicates that trade liberalization does not expand employment for women more relative to men or increase gender segregation across provinces. Therefore, we rule out these channels to explain the impacts of the U.S-Vietnam BTA on women's marriage and fertility in Vietnam.

7.3 BTA and the women's educational attainment

Another potential mechanism by which trade liberalization affects women's marriage and fertility is through its impact on women's educational attainment. More educated women not only spend longer at school but might also face higher opportunity costs of having children (Becker, 1960). Trade liberalization can increase income in

[21] We use the information on the sector of employment detailed at a 3-digit level and harmonize the industry classification in 2007 (Census 2009) and 2018 (Census 2019) to conform with the classification in 1993 (Census 1999).

[22] The addition $f_{ipt}^2 + (1 - f_{ipt})^2$ gets the lowest value if $f_{ipt} = 0.5$

Table 7: BTA and gender allocation in the labor market

	female intensity index	gender concentration index
$\Delta\tau_p \times 2009$	-0.0841	-0.000479
	(-0.23)	(-0.24)
$\Delta\tau_p \times 2019$	0.0225	0.000136
	(0.06)	(0.05)
Mean Y	46.982	0.562

Notes: N=180. The estimations also include province's based line characteristics in 1999 interacted with a linear time trend, province and census year fixed effects. Standard errors are clustered at province level and in parentheses (with bootstrap procedure). $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

regions more exposed to trade, making it more affordable for families in these regions to invest in their children's education. McCaig (2011) finds a higher reduction in the poverty rate in provinces exposed more to tariff reduction within four years after the implementation of BTA. In addition, McCaig and Pavcnik (2018) find that the U.S.-Vietnam BTA promotes the reallocation of labor from the informal to the formal markets, where higher skill levels are often required. Given that women would experience higher returns to investment in education compared to men (Pitt et al., 2012), they are more incentivized to pursue further schooling.

We estimate equation 2, with the dependent variables being the total years of education of the women at the time of the survey. The results are presented in Table 8. Column (1) shows that a one standard deviation (1.37 percentage points) increase in the province's exposure to tariff reduction is associated with an increase in women's average years of schooling by 0.24 years by 2009 and by 0.26 years by 2019. The positive impacts are particularly evident among the younger cohorts of women (aged 18-28 and 29-39 years old) and among the older cohort in 2019. Heath and Mobarak (2015) also find significant effects of exposure to garment jobs to the educational attainment and school enrollment of both boys and girls.

8 Conclusions

In this paper, we study the impacts of a positive trade shock on the marriage, fertility, and sex ratio in Vietnam over the period of nearly 20 years after the shock. We find that the shock significantly reduces marriage and fertility rate among young women (aged 18-28), implying a delay or postponement of marriage and reproductive behaviors. We observe virtually no effect of the shock on sex-selective behavior in Vietnam. Our analysis further shows that the trade shock created by the implementation of the U.S.-Vietnam BTA is relatively gender-neutral, which promotes the transition from agriculture to manufacturing for both men and women without inducing greater gender

Table 8: Impacts of BTA on years of education

	18-49	18-28	29-39	40-49
	(1)	(2)	(3)	(4)
$\Delta\tau_p \times 2009$	0.178***	0.191***	0.226***	0.080
	(0.058)	(0.054)	(0.080)	(0.056)
$\Delta\tau_p \times 2019$	0.191***	0.111*	0.245***	0.226***
	(0.062)	(0.066)	(0.079)	(0.067)
Mean Y	8.83	9.56	8.81	7.78
N	6,070,197	2,261,477	2,157,007	1,651,713

Notes: the estimations also include the women's age, age-squared, ethnicity, and the provinces's based line characteristics in 1999 interacted with a linear time trend, province and census year fixed effects. Standard errors are clustered at province level and in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

segregation or disproportionately expanding female-intensive industries across provinces. This distinguishes Vietnam from other countries examined in the existing literature on trade liberalization, which often find disproportional impacts on females and males in the labor market. Due to the high share of women's participation in the labor market at baseline, this shock does not affect women's employment, at least at the extensive margin. The impacts of this shock on marriage and fertility are driven by changing the nature of women's jobs and improving women's education.

We acknowledge that our analyses have limitations. While our study does not observe the relative expansion of female-intensive industries or effects of the trade shock on gender segregation in the labor market, we are unable to test whether this shock alters the relative earnings of women compared to men - a key channel that could change the opportunity costs of marriage and having children. Unfortunately, the population census data available to us does not provide information on individual income. In addition, our study does not offer a definite explanation for the increasing sex ratio at birth in Vietnam. Many studies have shown that families with better socio-economic status, such as those with more educated mothers and higher wealth quintiles, are more likely to engage in sex-selection practices (Bhalotra and Cochrane, 2010; UNFPA, 2019). In this paper, we show that trade liberalization resulting from the U.S.-Vietnam BTA promotes structural transformation (which often leads to increased income) and women's educational attainment. However, we do not find significant effects of BTA on sex-selective behavior. A possible explanation is that son preference is deeply embedded in the country's culture, and regions with stronger son preference might not coincide with those experiencing greater exposure to the BTA's economic impacts.

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A Figures

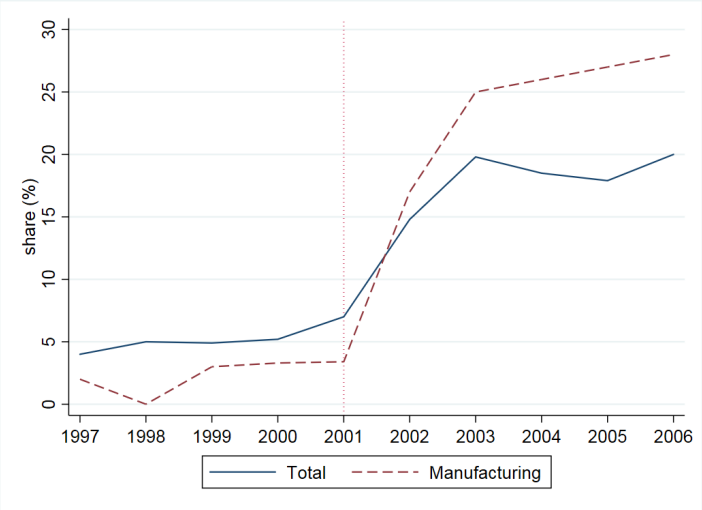


Figure A.1: Share of US in total VN's exports
Source: UNCOMTRADE.

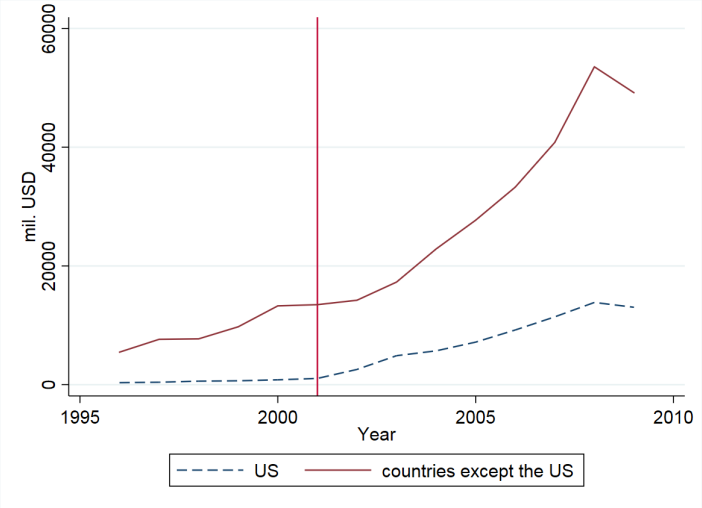
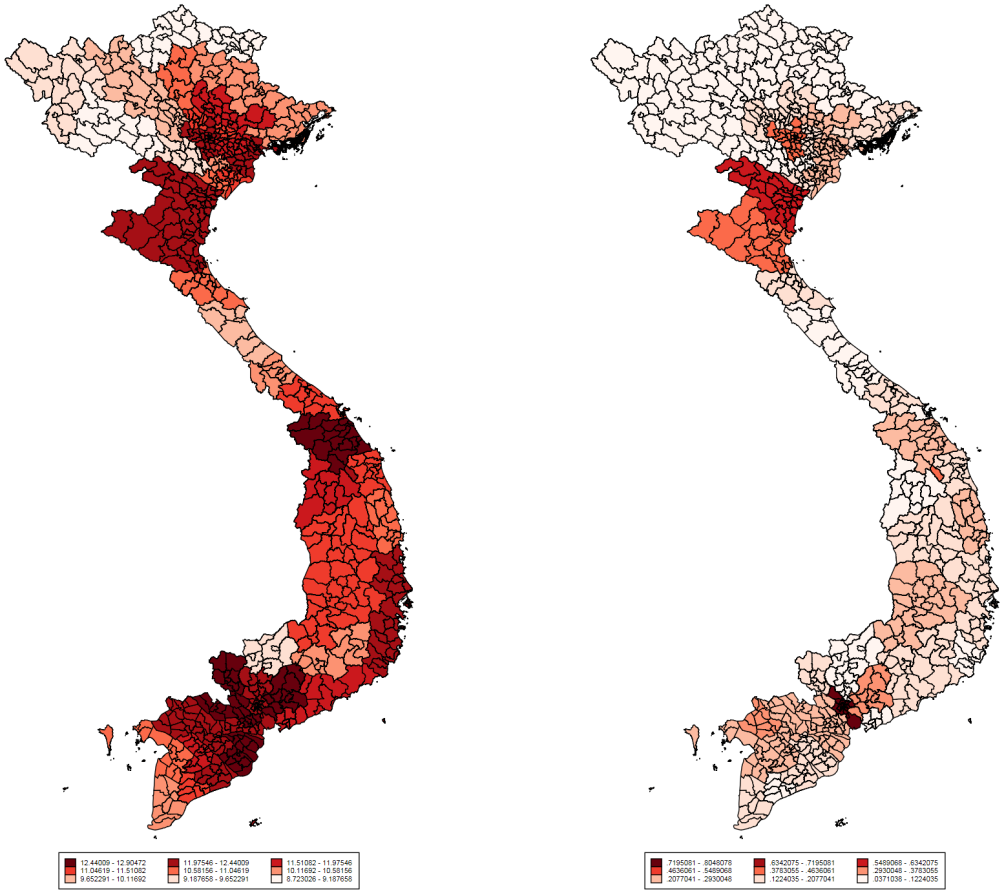


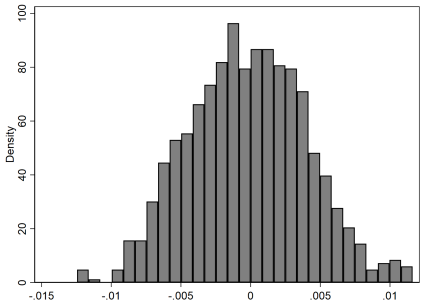
Figure A.2: Exports from Vietnam to the U.S and other markets, 1995-2010
Source: COMTRADE



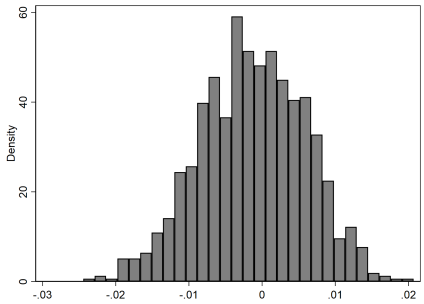
(a) without weights

(b) weighted by population size

Figure A.3: Provincial exposure to tariff cuts by the U.S. - Vietnam BTA

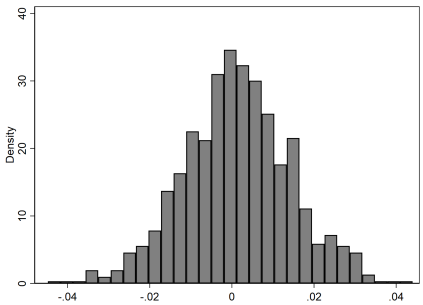


(a) b ($\Delta\tau_p \times 2009$)

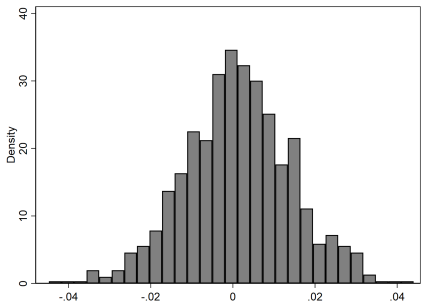


(b) b ($\Delta\tau_p \times 2019$)

Figure A.4: Distribution of the estimates of equation 2 on sample of women aged 18-28, dependent variable is the probability of being single, 1,000 times randomly assign the level of exposure to tariff reduction across provinces



(a) b ($\Delta\tau_p \times 2009$)



(b) b ($\Delta\tau_p \times 2019$)

Figure A.5: Distribution of the estimates of equation 2 on sample of women aged 18-28, dependent variable is the number of children, 1,000 times randomly assign the level of exposure to tariff reduction across provinces

B Tables

Table B.1: Impacts of BTA on marriage and fertility, non-migrants

	being single				no. of children			
	18-49	18-28	29-39	40-49	18-49	18-28	29-39	40-49
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A								
$\Delta\tau \times 2009$	0.012**	0.022***	0.006	0.006	-0.040	-0.040**	-0.029	-0.041
	(0.005)	(0.006)	(0.006)	(0.004)	(0.039)	(0.016)	(0.052)	(0.070)
$\Delta\tau \times 2019$	0.019***	0.035***	0.015**	0.007	-0.035	-0.056***	-0.031	-0.003
	(0.005)	(0.005)	(0.006)	(0.004)	(0.039)	(0.012)	(0.052)	(0.077)
Panel B								
$\Delta\tau^f \times 2009$	0.029***	0.055***	0.012	0.016**	-0.074	-0.122***	-0.077	0.055
	(0.009)	(0.014)	(0.009)	(0.006)	(0.065)	(0.038)	(0.091)	(0.133)
$\Delta\tau^f \times 2019$	0.021**	0.045***	0.015	0.010	-0.018	-0.095**	-0.028	0.137
	(0.009)	(0.013)	(0.011)	(0.008)	(0.084)	(0.037)	(0.119)	(0.160)
$\Delta\tau^m \times 2009$	-0.015	-0.028	-0.002	-0.009	0.015	0.090*	0.049	-0.183
	(0.010)	(0.018)	(0.010)	(0.007)	(0.068)	(0.050)	(0.102)	(0.164)
$\Delta\tau^m \times 2019$	0.017	0.021	0.014	0.003	-0.064	0.001	-0.036	-0.217
	(0.012)	(0.021)	(0.013)	(0.010)	(0.113)	(0.051)	(0.162)	(0.231)
N	5,766,305	2,055,842	2,084,457	1,626,006	5,766,305	2,055,842	2,084,457	1,626,006

Notes: Sample of non migrants. The estimations also include the women's age, age-squared, ethnicity, provinces's based line characteristics in 1999 interacted with a linear time trend, province and census year fixed effects. Standard errors are clustered at province level and in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table B.2: Impacts of BTA on sex selection, non-migrants

	individual level				provincial level
	18-49	18-28	29-39	40-49	
	(1)	(2)	(3)	(4)	(5)
Panel A					
$\Delta\tau_p \times 2009$	-0.0001	-0.0019	0.0017	-0.0013	-0.0008
	(0.0017)	(0.0022)	(0.0012)	(0.0033)	(0.0010)
$\Delta\tau_p \times 2019$	0.0007	-0.0011	0.0016	0.0002	-0.0012
	(0.0019)	(0.0023)	(0.0012)	(0.0035)	(0.0012)
Panel B					
$\Delta\tau_p^f \times 2009$	0.0031	0.0005	0.0003	0.0090	-0.0018
	(0.0039)	(0.0052)	(0.0033)	(0.0064)	(0.0023)
$\Delta\tau_p^f \times 2009$	0.0036	0.0059	-0.0021	0.0107	-0.0001
	(0.0048)	(0.0061)	(0.0035)	(0.0080)	(0.0028)
$\Delta\tau_p^m \times 2009$	-0.0051	-0.0056	0.0037	-0.0170*	0.0006
	(0.0058)	(0.0071)	(0.0060)	(0.0089)	(0.0033)
$\Delta\tau_p^m \times 2019$	-0.0038	-0.0123	0.0074	-0.0158	-0.0031
	(0.0075)	(0.0088)	(0.0066)	(0.0120)	(0.0038)
Mean Y	0.443	0.464	0.444	0.429	0.478
N	4,316,978	968,907	1,855,024	1,493,047	180

Notes: Sample of non-migrants. In Column (5), we only consider children under 5 years old in households whose household heads are non-migrants. The estimations also include the women's age, age-squared, ethnicity, province's based line characteristics in 1999 interacted with a linear time trend, province and census year fixed effects. Standard errors are clustered at province level and in parentheses, and with bootstrap procedure in Column (5). $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table B.3: Impacts of BTA on employment and structural transformation, male aged 18-49

	working	agriculture	manufacturing	services
	(1)	(2)	(3)	(4)
$\Delta\tau_p \times 2009$	-0.006	-0.085***	0.051***	0.034***
	(0.005)	(0.007)	(0.009)	(0.010)
$\Delta\tau_p \times 2019$	-0.007	-0.063***	0.041**	0.022*
	(0.006)	(0.010)	(0.016)	(0.012)
Mean Y	0.882	0.463	0.154	0.382
N	5,979,647	5,336,299	5,336,299	5,336,299

Notes: the estimations are on sample of men aged 18-49, also include the women's age, age-squared, ethnicity, and the provinces's based line characteristics in 1999 interacted with a linear time trend, province and census year fixed effects. Standard errors are clustered at province level and in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table B.4: Impacts of BTA on child sex ratio and fertility, full census 1999-2019

	share of girls children under 5		no. of children mother under 35		no. of children mother under 40	
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta\tau_p \times 2009$	-0.000332		-0.0352*		-0.0341	
	(-0.62)		(-1.66)		(-1.50)	
$\Delta\tau_p \times 2019$	0.000173		-0.0343		-0.0267	
	(0.28)		(-1.27)		(-0.89)	
$\Delta\tau_p^f \times 2009$		-0.00268*		-0.0429		-0.0133
		(-1.95)		(-0.82)		(-0.23)
$\Delta\tau_p^f \times 2019$		-0.00243		-0.00827		0.0351
		(-1.09)		(-0.12)		(0.47)
$\Delta\tau_p^m \times 2009$		0.00323*		-0.0259		-0.0693
		(1.70)		(-0.37)		(-0.91)
$\Delta\tau_p^m \times 2019$		0.00403		-0.0744		-0.122
		(1.22)		(-0.77)		(-1.25)
N	180	180	180	180	180	180

Notes: The estimations are applied on the full population census in 1999, 2009, 2019. The estimations include census year and province fixed effects. Standard errors are clustered at the provincial level with bootstrap procedure. We do not include any other independent variables. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.