Explorations Into the Fertility Transition and Female Labor Force Participation in Bangladesh

by

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DISSERTATION ABSTRACT

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This dissertation is comprised of three papers. Together, they investigate aspects of the fertility and female labor force transition in Bangladesh that started in the 1960s and continuing today. The dissertation is organized as follows:

Chapter 1 summarizes the context, and provides an overview of the three research chapters. Chapter 2 analyzes the effect of increased industrial work opportunity on women's employment, reproductive behavior, and human capital accumulation. Using shift-share instrument, I find that increased industrial work opportunity increased women's employment significantly and reduced human capital accumulation very modestly among teenage girls. However, there was no effect on reproductive behavior.

Chapter 3 provides the first comprehensive construction, to the best of my knowledge, of completed birth estimates of Bangladeshi women who were born all the way back in 1920. This exercise shows that the rural fertility transition begun with the 1945-50 cohort, within five years of the fertility transition in urban areas. I then present suggestive evidence that agrarian economic conditions, mediated by land availability, was a driver of the transition.

Chapter 4 (co-authored with Shankha Chakraborty) utilizes Oaxaca-Blinder decompositions to examine why the female labor force participation rate has increased more in Bangladesh compared to contiguous Indian states since 1990s. We find that while women's education is positively associated with employment in Bangladesh, the reverse is true in the selected Indian states. We also find some evidence that women's relative education compared to men's has been an important factor in explaining this. Chapter 5 concludes the dissertation.

This dissertation includes previously unpublished co-authored material.

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To my family, who have always been by my side.

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CHAPTER 1

INTRODUCTION

Two of the most important developments of the last 200 years is a sharp decline in number of children that women have on an average (fertility), and increased participation of women in the formal labor force. One mechanism suggested by the literature is that urbanization and industrialization initially shifted occupations that made child rearing costly and increased returns to labor and human capital accumulation. The decline in fertility and increase in women's employment outside the household were then consequences of these changes. Similar dynamics are likely under way in developing countries since the 1960s.

Bangladesh has been undergoing a rapid fertility transition since the 1970s. The total fertility rate declined from a high of 6.9 to less than two in a span of five decades,[1] marking it as one of the fastest fertility transition. Over the same period, the GDP per capita grew from 2015 USD equivalent of 385 to 1,593;[2] whereas the share of industry went from six percent to 33 percent. The industrialization went hand in hand with an increase in urbanization by 32 percentage points, reaching 40 percent in 2020. Additionally, the female labor force participation rate (FLFP) rate increased by 11 percentage points between 1990-2020. This dissertation, across three chapters, aims to add to our understanding of the changes in fertility and women's employment through the lens of structural change and gendered industrialization, and evolving rural economic conditions.

In chapter two, I begin with an analysis of the effect of female labor demand in the Ready-Made Garment (RMG) industry on FLFP, fertility, and human capital accumulation decisions of Bangladeshi women. Using a shift-share instrument, I find that increased industrial work opportunity increased women's employment significantly across all age group and reduced human capital accumulation very modestly among teenage girls. However, there was no effect on reproductive behavior.

Motivated by the inability of women-employing industrialization and the general lack of explanations of most of the fertility transition in Bangladesh, in Chapter three I use descriptive analysis to date the fertility transition in rural and urban

[1] All data in this paragraph are from The World Bank (2021)

[2] PPP GDP data is not available for Bangladesh prior to 1991. For reference, the 2020 PPP GDP per capita was 5,905.

Bangladesh, and examine typical correlates of fertility. Then I examine the role that rural economic conditions may have played in initiating rural fertility transition in Bangladesh. I find that the rural fertility transition begun with the 1945-50 cohort, within five years of the fertility transition in urban areas; and present suggestive evidence that agrarian economic conditions, mediated by land availability, was a driver of the transition.

Chapter four, co-authored with Prof. Shankha Chakraborty, co-chair of this dissertation, examines the divergence in women's employment trajectory in Bangladesh and contiguous neighboring Indian states that are likely to share common initial conditions. We find that women's education is positively associated with employment in Bangladesh, but the reverse is true in the contiguous Indian states. We also present some evidence that women's relative education compared to men's has been an important factor in explaining the divergence in FLFP trajectory.

CHAPTER 2

GARMENT MANUFACTURING AND WOMEN'S WORK, REPRODUCTION, AND HUMAN CAPITAL ACCUMULATION

2.1 Introduction

There has been dramatic changes to fertility and women's educational attainment in developing countries since the 1960s. One potential source of these changes is industrialization associated with increased employment opportunities for women. By increasing opportunity costs of child-bearing and child-rearing, and by increasing returns to human capital accumulation in agrarian economies, industrialization may reduce fertility and increase educational attainment of women through increased female labor force participation (FLFP) (Morgan and Hagewen (2005); Aaronson et al. (2014)). Additionally, it can encourage women's schooling if returns to education increases (Heath & Mobarak, 2015).

Since its inception in the late 1970s, the Ready Made Garments (RMG) industry has provided millions of Bangladeshi women their first opportunity for employment outside of agriculture in a high fertility, low FLFP, and low human capital accumulation context. The gradual expansion of the RMG industry allows me to examine the salience of low-skilled employment opportunity in the industrial sector in explaining long-term fertility reduction and increases in educational attainment of women.

The RMG industry dominates the manufacturing landscape and export earnings of Bangladesh. In Fiscal Year 2016-2017, the RMG industry accounted for 81 percent of Bangladeshi exports – employing about 4 million people, and contributing 6.6 percent and 33 percent to overall and industrial labor force participation in Bangladesh respectively (Bangladesh Burea of Statistics, 2020). Matsuura and Teng (2020) estimates that about 60 percent of the workers in RMG sector are women.[1] It is perhaps not surprising that the growth of the RMG industry has coincided with a steady increase in FLFP in Bangladesh from 24.6 percent in 1990 to 36 percent in 2019. This contrasts South Asia's overall experience (see Figure 2.1) where FLFP dropped from 29 percent in 1990 to 23.6 percent in 2019 (The World Bank, 2021).

[1]Matsuura and Teng (2020) also notes that estimates from different sources range from 58-80 percent.

Between 1990 and 2016, the total fertility rate in Bangladesh decreased from 4.49 to about 2.20.[2] This change occurred concurrently with an increase in women's youth literacy rates by more than 60 percentage point.[3] Using available census subsamples, and a novel RMG factory dataset obtained by combining multiple datasets from Bangladesh Garments Manufacturers and Exporters Association (BGMEA), I first estimate the extent to which the expansion of the exporting RMG industry contributed to the increase in FLFP in Bangladesh between 1991-2011. Second, I estimate the long-term effect of the increased employment opportunities on reproductive and human capital accumulation choices of Bangladeshi women.

The spatiotemporal expansion of the RMG industry is correlated with the spatiotemporal development pattern in Bangladesh. I overcome this endogeneity by using a Bartik-style instrument. Specifically, the identifying variation in exposure to employment opportunity is generated by spatial differences in knit- and woven-based product specialization within areas with RMG factories. My estimates indicate that FLFP increased substantially – in regions exposed to the garment industry, 31 percent of the increase in FLFP between 1991-2011 is due to the garment industry. I also find that school enrollment of working age teenage girls decreased due to increased exposure to employment opportunities in the RMG industry. However, I find no changes in the reproductive choices that I examine (age specific marriage and fertility rates) and in other aspects of human capital accumulation (school enrollment at younger ages, and literacy and years of schooling of working age teenage girls).

The findings in this paper add to three important discussions. First, it informs us about how important export-oriented manufacturing has been to Bangladesh's ongoing development process, adding to the literature discussing the mechanisms of manufacturing- and export-led development. It shows that industrialization associated with increased FLFP does not explain the remarkable fertility reduction and increased education of Bangladeshi women between 1991-2011. This is particularly relevant given concerns about structural transformation bypassing the manufacturing sector in many of the currently developing countries as discussed in Rodrik

[2]See Figure 2.2 for a comparison of Bangladeshi fertility transition with other countries.

[3]The corresponding increase for men was less dramatic, from 52 percent to 91 percent (The World Bank, 2021).

(2016). Second, this paper adds to the literature examining the impact of exposure to international trade on various economic and non-economic aspects of the lives of workers (Atkin, 2016; Autor et al., 2013, 2019; Li, 2018).

Third, it documents the role of the RMG industry in fostering overall development and gender equality in Bangladesh over 1991-2011. In a work with a similar focus, Heath and Mobarak (2015) investigated how greater access to RMG factory jobs changed Bangladeshi women's marriage, childbearing, school enrollment, and employment decisions. Their outcome and control data comes from a 2009 survey of 1395 households in sixty villages in four sub-districts of Bangladesh. Their factory data comes from a 2014 survey of local individuals knowledgeable about the timing of RMG industry expansion in their own localities. Using 1991, 2001, and 2011 census sub-samples, I am able to investigate the effects of the expansion of the RMG industry across Bangladesh over a longer period. Moreover, factory level data on location, size, and product type allows me to use differences in product specialization within areas with RMG factories as my identifying variation, ameliorating concerns related to endogeneity coming from unobserved location characteristics. Additionally, the prevalence of women in RMG industry in Bangladesh has been declining since 2010 (Matsuura & Teng, 2020), and this fact is in line with what can be expected as technology improves in a manufacturing sector (Tejani & Kucera, 2021).[4] The RMG industry was particularly hit by Covid-19 as well (Kabir et al., 2020). The findings of this study also informs debate about the immediate future path of Bangladeshi development.

The FLFP in industrial sector in Bangladesh was quite low at the inception of the RMG industry. In 1991, only 0.5 percent percent of working aged women was employed in industrial sectors in Bangladesh whereas the corresponding figure for men was 2.7 percent.[5] Over the next decades, the RMG industry expanded and became the largest industrial and export sector of Bangladesh. Expansion of the RMG industry in different regions increased demand for labor in those regions. The increase in labor demand for women may be more salient as the relative importance of female employment in textile and clothing related industries has been observed across time and space. Field-Hendrey (1998) and Burnette (2008) docu-

[4]There has been a reduction in number of RMG factories despite continued growth in export value since 2013 (Reihan & Bidisha, 2018).

[5]Based on my own calculations using Census 1991 data.

ment that women made up large portions of the labor force in textile and related industries in USA and in England in 1800s, well before their respective rapid FLFP transition. Kucera and Tejani (2014) find that textiles and related industries were the strongest drivers of women's share of employment among a broad swath of countries at different levels of development during 1981-2008. Women make up the majority of labor force in the Bangladeshi RMG industry as well (Matsuura & Teng, 2020). In addition to the direct employment effects of the RMG industry, widespread employment in one industrial sector has the potential to increase overall FLFP by fostering pro-FLFP cultural norms, or by generating and spreading knowledge about the lack of impact of FLFP on children, as in Fogli and Veldkamp (2011) and Fernández (2013). These channels could be especially important in the historically low FLFP and pro-natal context of Bangladesh.

From a theoretical point of view, FLFP and fertility are endogenous. Employment opportunities for female workers increase the opportunity cost of having children, and decreases fertility and desired fertility (Aaronson et al., 2014). FLFP could also lead to changes in marriage and divorce by altering the cost and benefit of marriage for both men and women (Autor et al., 2019; Greenwood et al., 2017). Additionally, industrial employment may change norms regarding women's reproductive decisions, a key driver of fertility (S. Amin et al., 1998; Baudin, 2010; Bhattacharya & Chakraborty, 2012). Interestingly, Bangladesh was undergoing a rapid fertility transition since the 1970s, decades before the emergence of the RMG industry. One feature of the Bangladeshi fertility transition is that it started in rural areas shortly after the transition started in urban areas, where factories are mostly located (see 3.4.1). Thus the effect of RMG industry expansion on fertility is an empirical question.[6]

Opportunities to work in manufacturing sector could increase returns to education, as argued in (S. Amin et al., 1998; Heath & Mobarak, 2015). Export demand from contextually higher skilled sectors has been found to increase schooling in India (Oster & Steinberg, 2013; Shastry, 2012) and in China (Li, 2018). On the other hand, Atkin (2016) finds that opportunities in export-oriented manufactur-

[6]Given the prevalence of younger workers in the RMG industry, it is also possible that RMG expansion led to delayed child bearing without changing fertility overall. About 90 percent of the women working in RMG factories are younger than 40 years old, gaining first experience of paid employment in the RMG sector (Matsuura & Teng, 2020).

ing increases school drop-out rate. Since the returns to skills learned in school in the RMG industry in Bangladesh is not well established, whether expansion of the RMG industry increased or decreased human capital accumulation of Bangladeshi women remains unclear.

The methodology of this inspired by Autor et al. (2013) who derive a measure of US local labor market exposure per worker to Chinese import competition based on standard trade models. Their measure starts with industry specific measures of exposure, obtained by apportioning observed changes in import in an industry j to each local labor market by that local labor market's share of total US employment in industry j. The sum of industry specific exposures in a local labor market is divided by local employment numbers to obtain per worker measures. Autor et al. (2013) instrument their share measures with 10 year lags and import measures with Chinese imports to other countries.

In my case, there are two key challenges in employing a similar measure of export exposure coming from the RMG industry. First, the placement of RMG factories are correlated with development patterns in Bangladesh.[7] Second, the RMG industry has an overwhelming importance in Bangladeshi industrial and manufacturing employment. Thus, patterns of industrial and manufacturing employment will also be correlated with development pattern. I get around these challenges by focusing my analysis only to areas that had export-oriented RMG factories. I exploit spatial differences in knit- and woven-based product specialization within areas with RMG factories to obtain identifying variation in exposure to the export-oriented RMG industry in Bangladesh.

My estimates indicate that the average export exposure during 1991-2011 in areas with RMG factories increased overall FLFP rate by 3.4 percentage points and industrial FLFP by 4.5 percentage points.[8]. For comparison, during 1991-2011, overall FLFP in Bangladesh increased by 2.45 percentage points and industrial FLFP increased by 2.04 percentage points. I also find that school enrollment of working age (14-19) teenage girls decreased by 2.7 percentage points. However, I find no impact on other aspects of human capital accumulation, and reproductive choices. My FLFP findings are consistent with previous findings in the literature that the RMG industry increased FLFP in Bangladesh (Heath & Mobarak, 2015)

[7]See section 2.2 and section 2.5.1

[8]854 USD per working age (15-64) person

and that increased import competition reduced employment in the United States (Autor et al., 2013, 2019). Decreased school enrollment of working age teenagers due to opportunities in export-oriented manufacturing was also observed in the case of Mexico (Atkin, 2016). However, my finding related to schooling and reproductive choices differs from the literature focusing on Bangladesh (Heath & Mobarak, 2015).

The rest of the paper is organized as follows - section 2.2 provides a brief introduction to the RMG industry in Bangladesh, section 2.3 describes the empirical approach, section 2.4 discusses the data, section 2.5 presents and discusses the results and section 2.6 concludes the paper.

2.2 The RMG industry in Bangladesh

The textile and clothing sector is one of most traded sector in the world. It accounted for about 4 percent of the total global trade in 2018 (World Integrated Trade Solution, 2022). As of 2015, Bangladesh was the second largest exporter in the textile and clothing sector, behind China (World Integrated Trade Solution, 2022). Within the textile and clothing sector in Bangladesh, the export-oriented RMG industry is overwhelmingly important, accounting for about 93 percent of Bangladesh's textile and clothing exports in 2015 (UN Comtrade, 2022). The defining feature of the RMG industry is that it mass-produces finished textile products to generalized measurements, as opposed to tailoring textiles to an individual's measurement.

Exporting RMG industry started its journey in independent Bangladesh in 1978 with *Desh Garments*. The factory started with 130 workers trained in South Korea (BGMEA, 2022a). Since then, the industry expanded rapidly. Figure 2.3 shows the increase in number of export-oriented RMG industry factories between 1978 and 2006. The industry took off in late 1980s, and its expansion accelerated in the 1990s. About 779 factories were likely established between 1978-1991, whereas about 2075 factories were likely established between 1992-2001.[9] By 1991, the

[9]The numbers are obtained by matching factory information in BGMEA Directory 2000-01, and 2009-10 to two other BGMEA datasets. Few factories could not be matched, and date of establishment had to be estimated for some factories. Both non-match incidence and error rates in estimating date of establishment are relatively low. Hence, these numbers are best interpreted as lower bounds on the

RMG industry accounted for more than 50 percent of Bangladeshi exports. Europe and North America emerged as the key importers of RMG products, possibly buoyed by the Multifiber Agreement, and those areas remain the largest markets (BGMEA, 2022b).[10]

Figure 2.4 shows the spatial spread of export-oriented RMG factories in Bangladesh between 1991 - 2006. In 1991, 37 sub-districts (admin level 3) of 9 districts (admin level 2) had RMG factories in them.[11] Most of these sub-districts are located in or near the two economically important districts containing the capital city (Dhaka) and the port city (Chittagong). These sub-districts contained about 11 million people in 1991, roughly about 10 percent of Bangladesh's population. By 2006, RMG factories had spread to 63 sub-districts in 18 districts, containing roughly 14 percent of Bangladesh's population. [12] In my analysis below, I find that relative to availability of workers, quality of infrastructure at the sub-district level is much more correlated with the existence of RMG factory in a sub-district in 1991 and 2001 (see section 2.5.1 for details). Similarly, Kagy (2014) also find that the quality of infrastructure and utilities are the key drivers of RMG factory location choice, whereas access to educated workforce is not a concern for most factory owners. In a survey of RMG factory owners, 96 percent of owners considered good quality roads and access to buildings with gas and electricity to be "very important" for choosing location of RMG factories, while 70 percent of them considered access to educated workforce as being "not important" (Kagy, 2014) .

The RMG industry produces two broad categories of products – knit (HS code 61) and woven (HS code 62). Knit fabric is comprised of a single yarn looped repeatedly to produce cloth whereas woven fabric is made with multiple strains of yarn criss-crossed over and under each other. Some of the common knit products include cotton T-shirts and sweater, while jackets, shirts and pants are examples of common woven products. Most factories in Bangladesh specialize working with

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number of RMG factories established in the respective time periods. See section 2.4 for details.

[10]Multifiber Agreement ended in 2004, but does not seem to have impacted factory formation or export growth. See Reihan and Bidisha (2018) and Figure 2.3.

[11]For comparison, there were 485 sub-districts and 64 districts in 1991.

[12]There has been administrative boundary restructuring at the sub-district level within our study period of 1991-2011. All population numbers are estimated based on the 1991 census boundaries.

either knit fabric or woven fabric, although several factories are able to work with both types of fabrics. Producing woven fabric is more energy and capital intensive, and woven products command about 10 percent higher per unit price. However, the value-added in knit export in Bangladesh is higher (Sytsma, 2022) and woven factories tend to employ more women relative to knit factories (Matsuura & Teng, 2020).

Figure 2.5 shows the changing importance of knit manufacturing relative to woven manufacturing within the Bangladeshi RMG industry. Most of the RMG factories established by 1991 engaged in production of woven garments. Over time, more knit factories have opened and, by 2006, Bangladesh was exporting comparable value of knitted and woven products.

2.3 Empirical Strategy

The goal of this paper is to estimate the long-run effect of increased employment opportunities stemming from the exporting RMG industry on FLFP, fertility and marriage rates, and on several aspects of human capital accumulation choices of Bangladeshi women. Ideally, the value of RMG exports from a sub-district will be entirely driven by export shocks that are orthogonal to other channels that affect outcome in that sub-district. In that ideal case, I could simply regress sub-district outcomes on value of RMG exports from a sub-district as follows:

$$Y_{s,t} = \beta \text{ Orthogonal Export}_{s,t} + \eta_t + Z_{s,t}\beta_z + \gamma_{s,t} \tag{2.1}$$

where $Y_{s,t}$ are the outcome variables in sub-district s at a period t. $\text{Orthogonal Export}_{s,t}$ measures export from a sub-district s in time t that is orthogonal to the other channels affecting outcomes, η_t are time fixed-effects, and $Z_{s,t}$ is a vector of sub-district specific controls.

However, this simple analysis cannot be performed for two reasons. First is that the spatiotemporal expansion of the RMG industry is correlated with the spatiotemporal pattern of overall development in Bangladesh. The second is that due to data limitations, I do not observe exports from a sub-district. The primary concern for identification in this context is that RMG factories are likely to be located in more developed sub-districts. Differences in these development characteristics will influence the size of the RMG industry as well as FLFP, reproductive, and human capital accumulation choices of women. This concern is accentuated since the sample period of 1991-2011 is a period of rapid change in Bangladesh.[13]

I overcome the challenge of omitted and unobserved development characteristics in two steps. First, I restrict my analysis to sub-districts that had factories in them by the end of 2006. The end of year 2006 was chosen as the mid-point between 2001 and 2011 censuses. This restriction of sample to only sub-districts with factories avoids comparing outcomes of sub-districts with RMG factories to sub-districts that do not have RMG factory, ameliorating bias from unobserved development characteristics. I then estimate a first difference regression equation of the following form:

$$\Delta Y_{s,t} = \beta \Delta \text{Export}_{s,t} + \delta_t + Z_{s,t-10}\beta_z + X_{s,t-10}\beta_x + \epsilon_{s,t} \tag{2.2}$$

where $\Delta Y_{s,t}$ is the change in outcome variables in sub-district s over a period ending at t. The outcome variables in this paper are estimated from 1991, 2001 and 2011 census sub-samples. The decadal changes over 1991-2001 and 2001-2011 in each sub-district are stacked. $\Delta \text{Export}_{s,t}$ measures change in export from a sub-district s in the decade ending at t and δ_t are period fixed-effects. $Z_{s,t-10}$ is a vector of sub-district specific controls common to all regressions. $Z_{s,t-10}$ includes two proxies of infrastructure quality at a sub-district (beginning of the decade electrification rate and urbanization rate) and three measures of sub-district demographics (beginning of the decade education levels of men and women between the ages 15-64, and population density). $X_{s,t-10}$ are beginning of the decade controls that vary depending on the outcome variable. They are discussed in relevant sub-sections below. This sample restriction and working with first difference of outcomes and exports ameliorates concerns regarding unobserved location characteristics driving the outcomes.

The second problem is that I do not observe the value of exports originating from sub-districts. So, I construct proxy for exports that is orthogonal to local development using available data: number of knit and woven producing machines in

[13]For example, the economy grew at an average rate of 5.8 percent per year over 1991-2011. In addition to improvements in FLFP and women's education, and reductions in fertility discussed in the introduction; this period saw a doubling of available workforce, rapid urbanization, and improvements in infrastructure. The electrification rates increased from 14 percent in 1991 to 60 percent in 2011 (The World Bank, 2021).

a sub-district. Specifically, I construct and use a Bartik-style instrument of decadal changes in export exposure per potential worker in a sub-district following Autor et al. (2013).[14] The RMG industry produces two broad categories of products – knit products and woven products.[15] I first create a measure of total export exposure in a sub-district by apportioning values of knit and woven exports originating in Bangladesh to each sub-district in proportion to that sub-district's share of knit and woven machines relative to total knit and total woven machines in Bangladesh respectively. This measure of total export exposure in a sub-district is divided by the working age population in that sub-district to derive the export exposure per potential worker, or simply - Export Exposure. Thus, in a sub-district s ending at decade t, the Export Exposure is:

$$\text{Export Exposure}_{s,t} = \sum_{i=0}^{9} \alpha^{K}_{s,t-i} * \frac{\text{Export}^{K}_{BD,t-i}}{L_{s,t-i}} + \sum_{i=1}^{9} \alpha^{W}_{s,t-i} * \frac{\text{Export}^{W}_{BD,t-i}}{L_{s,t-i}} \tag{2.3}$$

$$\text{Where } \alpha^{K}_{s,t-i} = \frac{Machines^{K}_{s,t-i}}{Machines^{K}_{BD,t-i}}, \text{ and } \alpha^{W}_{s,t-i} = \frac{Machines^{W}_{s,t-i}}{Machines^{W}_{BD,t-i}} \tag{2.4}$$

K and W denotes knit and woven respectively, BD denotes the total for Bangladesh, $Machines$ is the number of machines, and L is the 15-64 year old population.

Changes in value of knit or woven exports in a decade could be related to both changes in outcome Y and changes in knit or woven shares in sub-districts. Additionally, location-time specific shocks could change the outcome, as well as change the export exposure measures in a sub-district. I account for this by setting the knit shares, woven shares, and working age population to the beginning of the decade knit shares, woven share, and working age population respectively. With this modifications, the decadal change in export exposure per potential worker in

[14] Autor et al. (2013) use standard trade models to derive a measure of Chinese import exposure per worker at the different US commuting zones (CZs), their unit of local labor markets. Industry specific measures of import exposure at the CZs can be obtained by apportioning observed changes in import in an industry j to each CZ by that CZ's share of total US employment in industry j. The sum of industry specific exposures in a CZ is divided by CZ employment numbers to obtain per worker measure of import competition in a CZ.

[15] See Section 2.2 for details.

sub-district s and in the decade ending in t is as follows:

$$\Delta \text{ Export Exposure}_{s,t} = \alpha^{K}_{s,t-10} * \frac{\Delta \text{Export}^{K}_{BD,t}}{L_{t-10}} + \alpha^{W}_{s,t-10} * \frac{\Delta \text{Export}^{W}_{BD,t}}{L_{t-10}} \tag{2.5}$$

Replacing $\Delta\text{Export}_{s,t}$ in equation 2.2 with Δ Export Exposure$_{s,t}$ in equation 2.5, the first difference regression equation that I estimate takes the following form:

$$\Delta Y_{s,t} = \beta \Delta \text{ Export Exposure}_{s,t} + \delta_t + Z_{s,t-10}\beta_z + X_{s,t-10}\beta_x + \epsilon_{s,t} \tag{2.6}$$

Thus, the identifying variation in my regressions stem from spatial variation in knit- and woven-based product specialization within areas with RMG factories. The increase in total knit and woven exports from Bangladesh over decades *(see Figure 2.5)* were likely driven by changing comparative advantage as Chinese wages were increasing (BBC, 2012; Zhang et al., 2016) and unlikely to be correlated with the changes in outcomes in different sub-districts of Bangladesh. Additionally, all of Bangladesh did experience the phase-out of Multi-Fiber Agreement in 2005. However, the identification do not rely on the independent or as-if independent "shifters" assumption highlighted in Borusyak et al. (2022) since I only have the two sub-sectors - knit and woven, and two periods of change. Rather, the identification in this paper comes from exploiting the variation in exposure generated by differences in knit and woven shares across sub-districts exposed to the RMG industry. These shares are then scaled by temporal differences in changes in knit and woven exports from Bangladesh.

Following Goldsmith-Pinkham et al. (2020), the identifying assumption in this paper's context is that the relative specialization into knit versus woven products in a sub-district is unrelated to the $\epsilon_{s,t}$ in equation 2.6. This implies that the differences in shares should not influence the outcome through any other confounding channel. The assumption would be violated in the following scenario. Say, for instance woven factories employ relatively more women. This may relatively increase the number of potential mothers in a sub-district with relatively higher intensity of woven factories. In turn, governments or non-governmental organizations may be encouraged to channel relatively more resources to schooling in areas with relatively more woven production. This will improve schooling for females in those sub-districts without a corresponding improvement in demand for women's labor, violating our identifying assumption.

2.3.1 Female Labor Force Participation

I first investigate the impact of increased export exposure on FLFP by estimating equations of the following form:

$$\Delta Y_{s,t} = \beta \Delta \text{Export Exposure}_{s,t} + \delta_t + Z_{s,t-10}\beta_z + \beta_{x1} Y^{Male}_{s,t-10} + \beta_{x2} Pop^{15-64}_{s,t-10} + \epsilon_{s,t} \quad (2.7)$$

Changes in overall and industrial FLFP rate for working age women (ages 15-64) are investigated first.[16] In two surveys separated by 9 years, Heath and Mobarak (2015) and Matsuura and Teng (2020) found that roughly 70 percent of the women working in the RMG industry are 29 years old and younger. In addition, both surveys found that about 20 percent were teenagers. These age groups are also more involved in reproductive and schooling choices. Hence, I also investigate the changes in overall and industrial FLFP for 15-29 year old women and for 15-20 year old women.[17]

In addition to common controls mentioned in Section 2.3 equation 2.7 adds two more controls to equation 2.6. Beginning of the period labor force participation rate for men in corresponding age groups for all or industrial sectors, as relevant, is added to each of the regression to capture changes in local industry structures unrelated to the expansion of the RMG industry. While it is likely that men's labor force participation is influenced by the RMG industry and its supporting industries, it makes up a small portion of men's employment.[18] In addition, start of the period population of 15-64 year old is included as a control of labor supply conditions.

2.3.2 Reproductive Behavior

Figure 2.6 shows how rates of being ever married and the number of own children in household varies for females 10-40 year old in sub-districts with factories by 2006. Opportunities in the RMG industry changes the economic options of women. And given the age profile of RMG industry workers discussed above, it also

[16]None of the census asks whether a respondent worked in garment industry. 2011 census does break occupation down to manufacturing, hence I am using industrial FLFP instead of manufacturing FLFP.

[17]Labor force participation data is only available for 15+ ages.

[18]Even if half the RMG industry employees were men, less than 5 percent of the working men would be working in the RMG industry.

changes costs and benefits of marriage and of bearing and raising children during ages that are very important for marriage and fertility in Bangladesh. I investigate how changes in export exposure influences two key components of reproductive choices of women – marriage rates and fertility rates at different ages. Marriage rate is investigated by estimating equations of the following form:

$$\Delta Y_{s,t} = \beta \Delta \text{Export Exposure}_{s,t} + \delta_t + Z_{s,t-10}\beta_z + \epsilon_{s,t} \tag{2.8}$$

where $\Delta Y_{s,t}$ includes changes in rates of ever being married among 15-20 and 21-30 year old women. Influence on women 30 years and above are not investigated since almost all women of that age have had married at least once by that age among Bangladeshi women in our sample. No additional controls are included in regressions investigating marriage rates at different age groups. Next, I investigate how fertility changes by estimating regressions as follows:

$$\Delta Y_{s,t} = \beta \Delta \text{Export Exposure}_{s,t} + \delta_t + Z_{s,t-10}\beta_z + \epsilon_{s,t} \tag{2.9}$$

where $\Delta Y_{s,t}$ are measures of changes in fertility rates among 15-20, 21-30, and 31-40 year old women. Since I do not observe realized fertility or birth histories, I use number of own child in household as a proxy measures of fertility.

2.3.3 Human Capital Accumulation

Exposure to exports from RMG industry could encourage increased educational attainment by increasing returns to basic education. However, it could also reduce educational attainments by encouraging drop-outs among working age teenage girls. Additionally, efforts to learn while in school may also increase if returns to human capital increases. These hypotheses are tested using regressions of the following form:

$$\Delta Y_{s,t} = \beta \Delta \text{Export Exposure}_{s,t} + \delta_t + Z_{s,t-10}\beta_z + \beta_x Y^M_{s,t-10} + \epsilon_{s,t} \tag{2.10}$$

where $\Delta Y_{s,t}$ include changes in enrollment rates for girls aged 5-9, girls aged 10-13, 14-19; and changes in years of schooling and literacy among working age teenage girls (ages 14-19). These regressions include beginning of the period outcomes for males of the corresponding age group as a control for changes in quality of educational institutions in these regions.

2.4 Data

2.4.1 Factory and Export Data

Data on location, product type and number of machines of all factories in 1991 and 2001 is needed to estimate the share α_s^K and α_s^W in 1991 and 2001. To that end, four datasets from the Bangladesh Garments Manufacturers and Exporters Association (BGMEA) are combined to obtain the factory dataset. Two of the four datasets provide year of establishment data, needed to identify factories in different sub-districts that existed in 1991 and 2001. The other two datasets provide data on number of machines in each factory in 1991 and 2001. BGMEA membership application and annual fees are inexpensive,[19] and provides a way for factories to establish their legitimacy with foreign buyers. The reported number of machines can be a good proxy for factory capacity and easily verifiable by prospective buyers. Hence, the data on factories and their numbers of machines are likely to be of good quality.

BGMEA Members Directory contains data on name, BGMEA membership number, addresses associated with the entry (often separated into address of the factory, and address of the office), number of machines, capacity, and the type of products produced by the factory. I have directory entries for the years 2000/01 and 2009/10, which means that I observe firm-level characteristics at these two points in time. For ease of exposition, I call these two datasets *directory-based datasets* from hereon. Next, I also obtained a separate 2015 factory list from BGMEA and a factory list that I scraped from the current members list section of BGMEA website on March of 2021. I call the latter two datasets *list-based datasets* from hereon. In addition to the data in directory-based datasets, list-based datasets also include the year of establishment of the firm.[20] However, I cannot solely rely

[19]Currently, the application and annual fees are approximately USD 400 and USD 100

[20]Specifically, for each entry, the 2015 list contains data on name, name of corporate owner, email, telephone, cellphone, and fax numbers; contact person and their designation, primary banker, factory address, product types, whether the unit specializes in knit or woven, number of machines; and employees. The list scraped from BGMEA on 2021 contains data on name, BGMEA membership number, office address, factory address, number of machines, capacity, and year of establishment of each entry.

on the list-based datasets for two reasons. First, the lists do not include factories that were operational in 1991 and/or 2001, but that have left the industry before the lists were compiled.[21]. This can be a serious source of bias. Second, factories may have changed their number of machines in the 2-4 decades between the observation dates in the list-based datasets and 1991 and 2001.

These four datasets are combined to crate a panel of factory level data. The first step in constructing the factory dataset is matching entries in the directory-based dataset with entries in the list-based datasets by their name or unique BGMEA membership number. This yielded 71 percent and 80 percent matches for entries in the 2000-01 and 2009-10 BGMEA directory respectively, providing their factory address and year of establishment. Sub-districts for these matches are assigned by geo-coding the factory addresses using Awesome Table. For the remainder of entries in the BGMEA directory 2000-01, sub-districts are determined manually by obtaining their factory address and using Google Maps to assign sub-districts. In many instances, the BGMEA directories do not explicitly classify an address associated with an entry as a factory address or an office address. In those instances, the address is classified as a factory address if the phone number of the factory and the phone number of the office for that entry is the same. When both addresses and phone numbers of an entry are not classified in the directories, I am unable to assign a sub-district as I cannot infer whether the address associated with the entry is of the factory, or of the office space. Consequently, locations of 13 percent of entries in the BGMEA directory 2000-01 remains undetermined and are not included in my factory dataset.

The years of establishment for BGMEA entries that could not be matched with the list-based datasets are unavailable. Since its inception in 1983, BGMEA assigned membership number in a sequence starting with one, and with increments of one.[22] I impute the missing year of establishment using an OLS regression capturing the relationship between year of establishment and BGMEA number within the BGMEA directory entries that could be matched with the list-based datasets.

[21]A substantial bout of factory exits occurred in the aftermath of 2013 Rana Plaza tragedy (Reihan & Bidisha, 2018). Events like these high-light the challenges of relying only on current list-based datasets

[22]This fact, and the number of entries in the 2000-01 directory can be used to infer that at most 19 of the 3026 factories exited the industry between 1983 and 2000-01.

Whether a factory existed in 1991 or 2001 is then determined by the year of establishment, or its estimate if needed. In the final factory dataset used to estimate 1991 and 2001 α_s^K and α_s^W, 16 percent of the year of establishment is estimated, yielding an error rate of 1.14 percent in assigning whether a factory existed in 1991 or 2001.[23] Additionally, missing number of machines is assigned the mean value of machine and constitutes 5 percent of the sample.

Table 2.1 shows the summary statistics of factories in my sample. There are 2853 factories, the average factory had 198 machines with a standard deviation of 259.

Figure 2.7 shows the empirical cumulative distribution of machine size of knit and woven factories established on or before 1991, and between 1991-2001. No evidence of in changes in factory size is evident, implying similar factory level technology at work in the export oriented RMG industry at least till early 2000s.

30 percent of the factories in my sample existed in 1991. 30 percent of them specialized in knit production, 60 percent on woven production and the remaining factories produced both.

Bangladesh imports a large portion of the knit and woven textile used in the RMG industry. Workers in Bangladesh add value to the textile by various production activities such as cutting and sewing. As a measure of labor demand, estimated values of export originating from Bangladesh is used. For knit (woven) products, export originating in Bangladesh at year t is estimated by subtracting value of total knit (woven) textile imports from total value of knit (woven) product exports. The data of these values are obtained from (UN Comtrade, 2022).[24]

2.4.2 Population Census

The outcome and control data comes from Bangladesh Census 1991, 2001 and 2011 sub-samples, obtained from Minnesota Population Center (2020). Individual

[23]When applied to factories whose year of establishment is known, this procedure yields a 7 percent error rate. The procedure is applied to 16 percent of the factories in the final dataset.

[24]Sytsma (2022) reports that Textiles fall under the HS2 heading HS60 (knit), and HS4 headings (woven): 5007, 5111, 5112, 5113, 5208, 5209, 5210, 5211, 5212, 5309, 5310, 5311, 5407, 5408, 5512, 5513, 5514, 5515, 5516, 5602, 5603, 5801, 5802, 5809, 5903, 5906, and 5907. Knit-based products have an HS code of 61 and woven-based products have an HS code of 62.

data are aggregated to the sub-district level. The spread of RMG industry across different sub-districts in Bangladesh is correlated with infrastructure quality[25]. Infrastructure quality could change the outcome variables differentially on its own. Hence analysis in the main specifications is restricted to sub-districts that already had RMG industry factories in them by the end of 2006, the mid point of the last sample period. Table 2.2 shows the difference in key demographic and infrastructure measures in 1991 census between sub-districts that are included in the sample, i.e. had factories by 2006, and sub-districts that are excluded from sample, i.e. did not have factories by 2006. Whereas Table 2.3 shows the correlation between specialization on woven production and the same demographic and infrastructure measures in the sub-district in 1991.[26] There are clear differences in density, urbanization, electrification, average age, gender distribution and average years of schooling in areas with RMG industry factories by 2006, and areas without. However, within factory exposed areas, specialization is uncorrelated with the same measures.

2.5 Results

2.5.1 Factory Locations and Shares

I first confirm that quality of infrastructure, rather than availability of workers, is the main determinant of RMG factory location in Bangladesh. Table 2.4 presents results of linear probability models (LPM) of factory locations in 1991 and 2001. In each case, the dependent variable is an indicator of whether a sub-district had RMG factories by 1991 and 2001 respectively. All explanatory variables are in standardized units. Measures of infrastructure variables – the electrification rate and the urbanization rate (i.e. share of population in urban areas), are both statistically significant and meaningful in explaining factory location. One standard deviation increase in electrification rate is associated with a 13-16 percentage point increase

[25]see section 2.2 and section 2.5.1

[26]Measured as ratio of woven-producing machines to total RMG industry machines in a sub-district. Since the RMG industry is classified into knit and woven in our analysis, specialization in knit = 1-specialization in woven.

in probability of a sub-district having a factory by 1991 or 2001.[27] The impact corresponding to one standard deviation increase in urbanization rate is 5-7 percentage point. On the other hand, measures of demographic variables – density of working age (15-64) population and average years of schooling in a sub-district are less systematically associated with a a sub-district having a factory by a given year. Years of schooling do not have a statistically significant impact. Whereas one standard deviation increase in density of working age population is associated with a 3-6 percentage point increase in probability of having a factory, much weaker than the combined impact of infrastructure measures. Additionally, dropping density of working age population barely changes the variation explained by the models, with electrification rate absorbing the effect.

While the above confirms factory locations are endogenous in the unrestricted sample, I next provide evidence that the knit and woven shares are not correlated with evolution of development in the restricted sample. One concern for identification in this paper's context is that knit share ($\alpha^k_{s,t}$) and woven share ($\alpha^W_{s,t}$) in one period may change characteristics of a location which in turn can change the outcome variables. I regress $\alpha^k_{s,t}$ and $\alpha^W_{s,t}$ in 1991 and in 2001 on changes in observed sub-district characteristics between 1991-2001, and 2001-2011 respectively. Table 2.5 presents the results of the regressions. I find no evidence of correlation between the start of the period knit and woven shares in a sub-district, and the subsequent decade's changes in electrification and urbanization rate, population (15-64 year old) and male's labor force participation in that sub-district. There is a very weak correlation with reduced schooling of males less than 15 years old, however. The adjusted R^2 is close to zero in all specifications.

2.5.2 Female Labor Force Participation

Table 2.6 presents estimates of regressions of the form of equation 2.7. The dependent variables are FLFP rates of various age groups expressed in percentage

[27]Fujii and Shonchoy (2020) argues that spatial differences in electrification in Bangladesh in the sample period is dependent on infrastructure, number of households, state of industrial and commercial development and existing social and community institutions. Hence a more accurate interpretation is that electrification and the unobserved development patterns associated with electrification is associated with a 13-16 percentage point increase in probability of having a factory.

and the export exposure measure is in one thousand dollar per working age population. Column 1-2 presents estimates for ages 15-64, column 3-4 presents estimates for ages 15-29 and column 5-6 presents estimates for ages 15-20. Odd numbered columns correspond to overall FLFP and even numbered columns correspond to industrial FLFP. The results indicate that exposure to export-oriented RMG industry increases overall and industrial FLFP across all age groups.Table 2.7 reports that the estimates in specification in column 1 are stable to inclusion of controls. The coefficient estimates are between 4.06 and 7.56, and are all statistically significant at the 1 percent level. The increase in industrial FLFP is stronger than the increase in overall FLFP, as expected when demand for female labor increases in the industrial sub-sector. Additionally, the effect on FLFP is stronger for younger age groups. This is consistent with findings that younger women are more prevalent in the RMG industry of Bangladesh (Heath & Mobarak, 2015; Matsuura & Teng, 2020).

The point estimates imply the effect of export exposure on FLFP is large. To see why, consider that the average value of export exposure in my sample is 854 dollars over two decades, roughly 6 months - 12 months of income in the time period. The average exposure changes overall FLFP by 3.47 percentage points. In sub-districts included in my sample, overall FLFP increased by 10.8 percentage point over 1991-2011. [28] Thus, about 31 percent of the change in overall FLFP over 1991-2011 in my sample areas can be attributed to the expansion of the RMG industry in Bangladesh. Additionally, the point estimate for increase in industrial-FLFP is 5.36. Thus, about 55 percent of the 8.13 percentage point increase in industrial-FLFP can be explained by exposure to the RMG industry. With similar calculations, the results indicate that for ages 15-29, 32 percent of the increase in overall FLFP, and 51 percent of the increase in industrial FLFP can be attributed to the expansion of the RMG industry. The numbers for 15-20 year old are 36 percent for overall FLFP and 49 percent for industrial FLFP. It can be seen that even though the coefficient is largest for the youngest age group, the economic significance is actually lower for them, reflecting a broader trend of increasing FLFP among younger cohorts in Bangladesh.

My findings of positive long-term effect of increases in exposure to the RMG

[28] For context, the FLFP in Bangladesh increased by 3.59 percentage points over the same time period.

industry on FLFP in Bangladesh is expected and is in-line with previous literature (S. Amin et al., 1998; Heath & Mobarak, 2015; Kabeer & Mahmud, 2004). However, the magnitude of effect that I find is smaller. My estimates indicate that at the average value of exposure, overall and industrial FLFP increases by about 3.47 and 5.36 percentage points respectively. Using a difference-in-difference estimator, Heath and Mobarak (2015) found that women in villages within commuting zones of RMG factories were about 15 percentage point more likely to have worked outside of home. Moreover, the effect was stronger among women exposed to RMG factories during critical exposure period (ages 10 - 23) by an additional 12 percentage points.[29] When examining the effect of exposure to the RMG industry by using variation in product specialization within garment exposed sub-districts, I find a smaller effect, possibly pointing to differences between areas close to garments and further with limited spillovers in female employment between them.

Examining impact of import competition using a similar methodology, Autor et al. (2013) found that import competition reduced US manufacturing employment by about a quarter over 1990-2007. Autor et al. (2019) found that one unit of import exposure, roughly equivalent to the average decade level exposure between 1990-2014, reduced manufacturing employment as a share of the population for both sexes by 1.06 pp. My estimates also suggest a large impact of the RMG industry on Bangladesh FLFP. I also find that the impact is larger among younger women. However, my magnitudes of impact of exposure to trade are larger than what Autor et al. (2019) and Autor et al. (2013) finds in the case of US, perhaps reflective of the relatively more important role of RMG industry in the Bangladeshi FLFP context.

2.5.3 Reproductive Choices

I assess the impact of expansion of the RMG industry on marriage rates of 15-20, and 21-30 year old women; and on fertility rates of 15-20 year old women, 21-30 years old women, and 30-40 year old women by estimating regressions of the form in equation 2.8 and 2.9. Table 2.8 presents the results. The results indicate that expansion of the export-oriented RMG industry in Bangladesh did not have a measurable impact on marriage rates or on fertility rates in Bangladesh. My findings

[29]Heath and Mobarak (2015) determined whether villages were in commuting zones of factories in consultation with officials from BGMEA.

are in contrast to both the existing literature in the Bangladeshi RMG industry context, and in the trade exposure literature context. Using total years of exposure to capture the overall impact of RMG factories on marriage and child-bearing decision, Heath and Mobarak (2015) found that 6.4 years of RMG exposure (mean in their sample) reduced the probability of getting married and having first children by about 0.3 and 0.23 percentage point. In the trade exposure literature, Autor et al. (2019) found that negative shocks to female-dominated industries tend to increase family formation and fertility. Thus, positive shocks to female-dominated industry can be expected to reduce family formation and fertility.

The high R^2 in the regressions, and apparent lack of strong evidence of statistical significance of any of the controls other than the time trend suggest a very important role of time trend in analysis of reproductive behavior among Bangladeshi women over 1991-2011. One interesting feature of the employment in the RMG industry is the strong encouragement from husbands to partake in the employment (Matsuura & Teng, 2020), reducing potential trade-offs between marriage and working outside that can exist in a low FLFP context.

Figure 2.2 shows that between 1970-1990, the TFR in Bangladesh dropped by about 2.5. The RMG industry emerged and expanded during a period with momentum in favor of declining fertility. This, combined with the estimates of Heath and Mobarak (2015) suggests that in the backdrop of a rapid fertility transition, the relative importance of the expansion of the RMG industry to Bangladeshi fertility transition is minor at best.

2.5.4 Human Capital Accumulation

Table 2.9 presents estimates of regressions of the form of equation 2.10. Columns 1, 2 and 3 presents results for school enrollment, expressed in percentages, for ages 5-9, 10-13 and 14-19 year old girls respectively. Column 4 and 5 presents the results for literacy rate and years of schooling for working age teenage girls. The results indicate that exposure to the export-oriented RMG industry did not influence school enrollment of younger girls (ages 5-9 and ages 10-13). However, school enrollment for working-age girls (ages 14-19) is reduced. Despite this, exposure to the RMG industry did not have a statistically significant impact on literacy rate and years of schooling of working age girls. At the mean export exposure value, enrollment for 14-19 year old girls reduces by 2.71 percentage point. The average school enrollment rate for that age group was 40.6 in 2001 and 2011. Thus, exposure to the RMG industry has reduced school enrollment by 6.6 percentage. The point estimate on years of schooling is negative, and almost statistically significant. Using a similar interpretation, mean export exposure led to a decline in 0.11 years of schooling. Taken together, my estimates suggest that the expansion of the garment industry is associated with a small decline in women's education. In contrast, Heath and Mobarak (2015) found positive impact of exposure to RMG industries on human capital accumulation in Bangladesh. They found that increased exposure increased educational attainment for women and men by 0.22 and 0.26 years respectively. A positive effect of 0.22 years on women's education is outside my 95 percent confidence interval. However, they did not find evidence suggesting increases in enrollment.

The negative impact of opportunities in export-oriented manufacturing on school enrollment for working-age students is also observed in case of Mexico. Atkin (2016) finds that opportunities in low-skilled manufacturing export industry reduces enrollment between grades 9-12 in Mexico. In the case of China, Li (2018) finds that high skill export shock increased high school and college enrollment in between 1990 to 2005. The RMG industry is a low-skilled manufacturing industry. Additionally, results of my FLFP regressions (2.6) show that years of schooling and FLFP are negatively related. Taken together, it is likely that working age girls who drop out due to opportunities in the RMG industry may not have continued in much further in schools anyway. Thus the opportunities in the RMG industry may have reduced school enrollment of 14-19 year olds without a statistically significant impact on years of schooling .

2.6 Conclusion

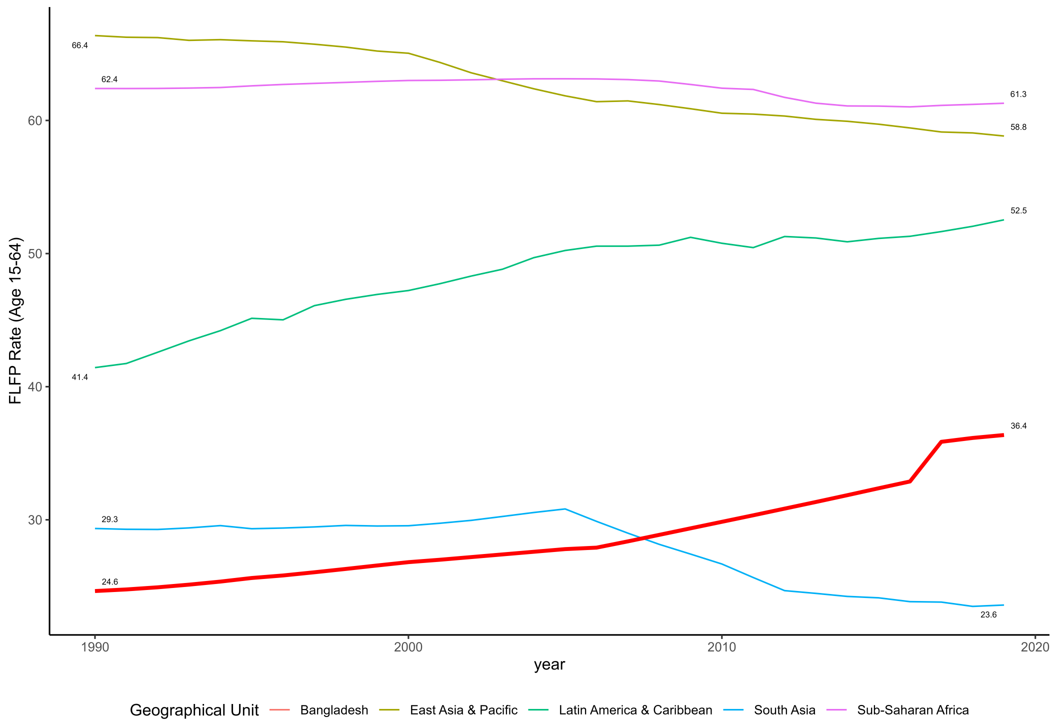
In this paper, I analyze the effect of the rapid expansion of the RMG industry in Bangladesh on labor force participation, reproductive and human capital accumulation choices of Bangladeshi women. RMG exports from Bangladesh grew at a rate of 16 percent a year between 1991-2011, with the industry expanding from 37 sub-districts in 1991 to 63 sub-districts by 2006. Both historically and in present, employment in textile and closely related industries are often female dominated even in low female labor force participation contexts. Most workers in the export oriented Bangladeshi RMG industry are women as well. The expansion of the RMG industry presented opportunities in industrial employment for millions of Bangladeshi women for the first time. My analysis indicates that the expansion of the RMG industry has contributed extensively on the overall and industrial FLFP in Bangladesh, perhaps at the expense of small reductions in schooling for working age teenage girls. However, I find no impact on marriage rates and fertility rates among different ages group amid an ongoing fertility transition. Taken together, the analysis presented here confirms the direct effect of increased engagement of women in the labor market due to labor demand in the RMG industry. However, there is no evidence to indicate that the industry contributed to the remarkable changes in reproductive choices and human capital accumulation of Bangladeshi women over 1991-2011.

So, what explains the change fertility transition in Bangladesh and what explains the rural FLFPR in Bangladesh? The next chapter tackles the fertility question by first documenting the transition in a finer detail, conducting exploratory analysis, and examining the role of land constraint in the rural fertility transition of Bangladesh.

The fourth chapter examines the issue of FLFPR in rural Bangladesh.

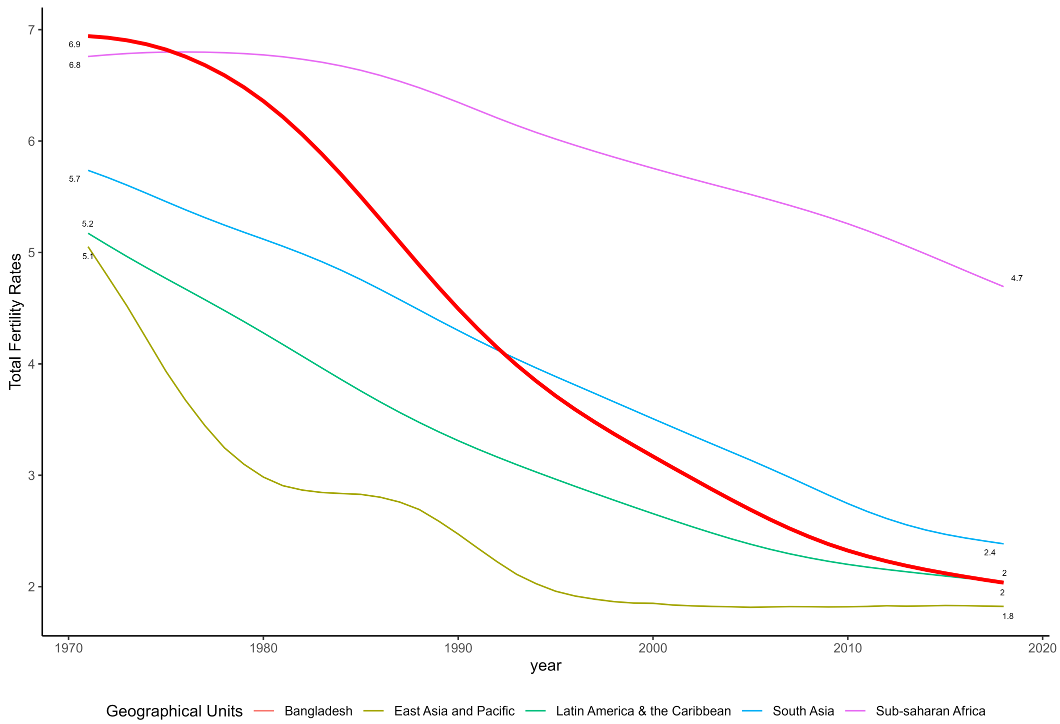
2.7 Figures

Figure 2.1. Female Labor Force Participation in Bangladesh and Elsewhere (1990:2019)



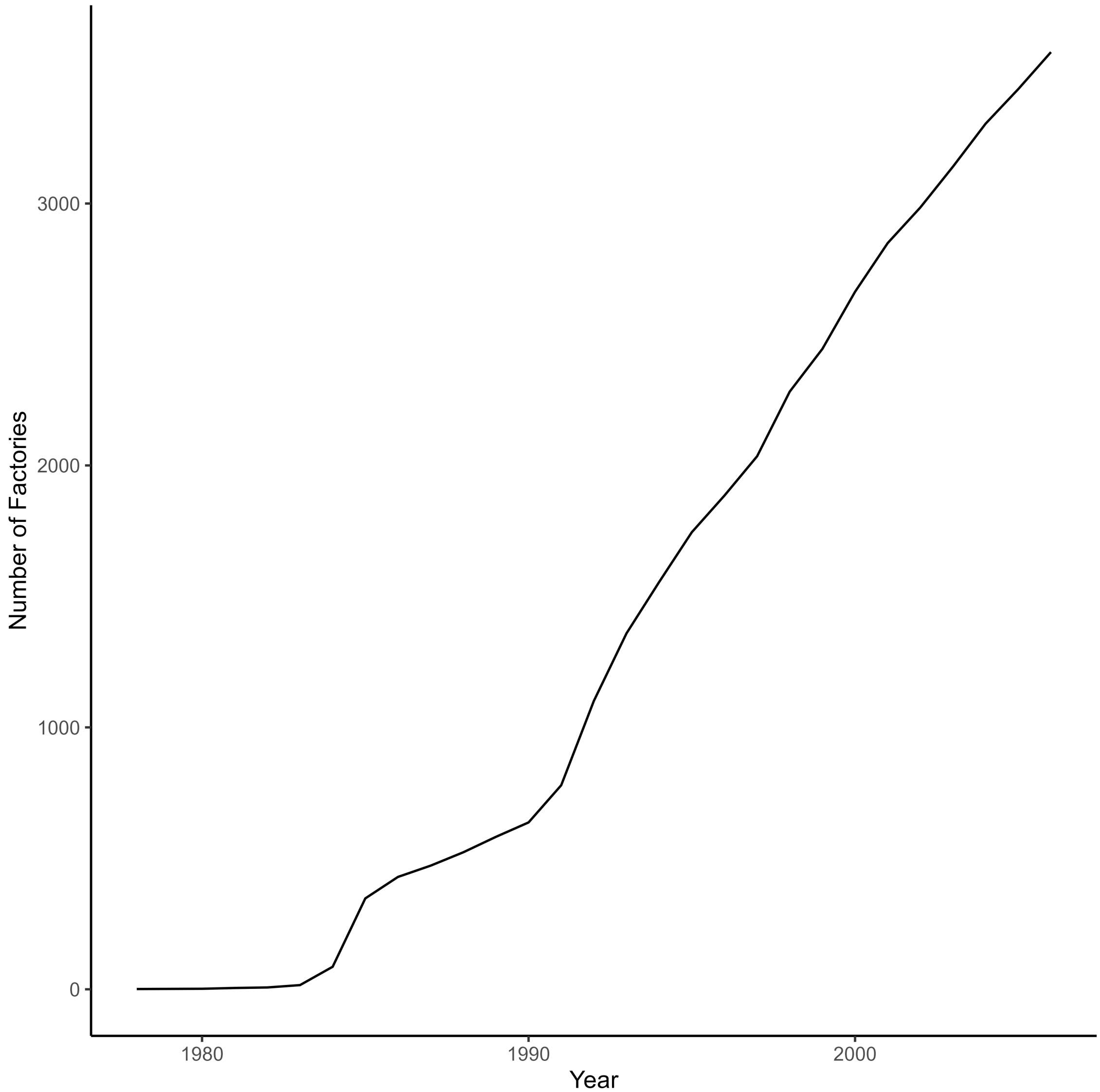
Bangladesh had one of the lowest FLFP rate in 1990 among developing regions. While most other developing regions saw its FLFP decline over 1990-2019, Bangladesh's FLFP increased. Notably, FLFP of Bangladesh's neighbors in South Asia decreased overall. *Data source: (The World Bank, 2021)* .

Figure 2.2. Fertility Transition in Bangladesh and Elsewhere (1970:2019)



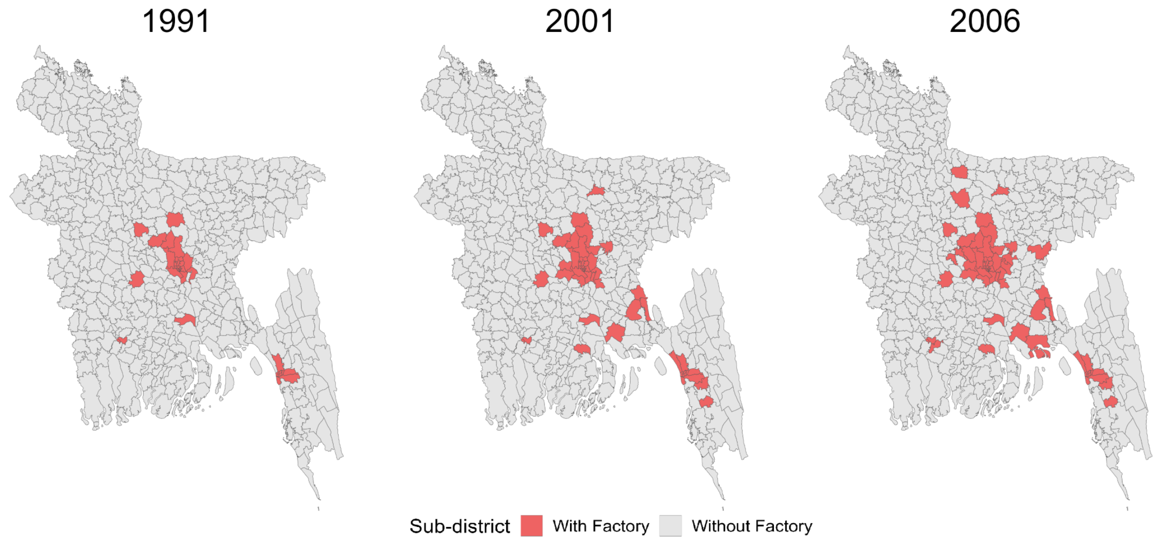
In 1970, Bangladesh had one of the highest fertility rate in the world. Since 1970s, it experienced a rapid fertility transition, bringing its TFR to near replacement rate towards the end of late 2020s. *Data source: (The World Bank, 2021)*

Figure 2.3. Expansion of the Ready-Made Garment (RMG) Industry in Bangladesh (1978:2006)



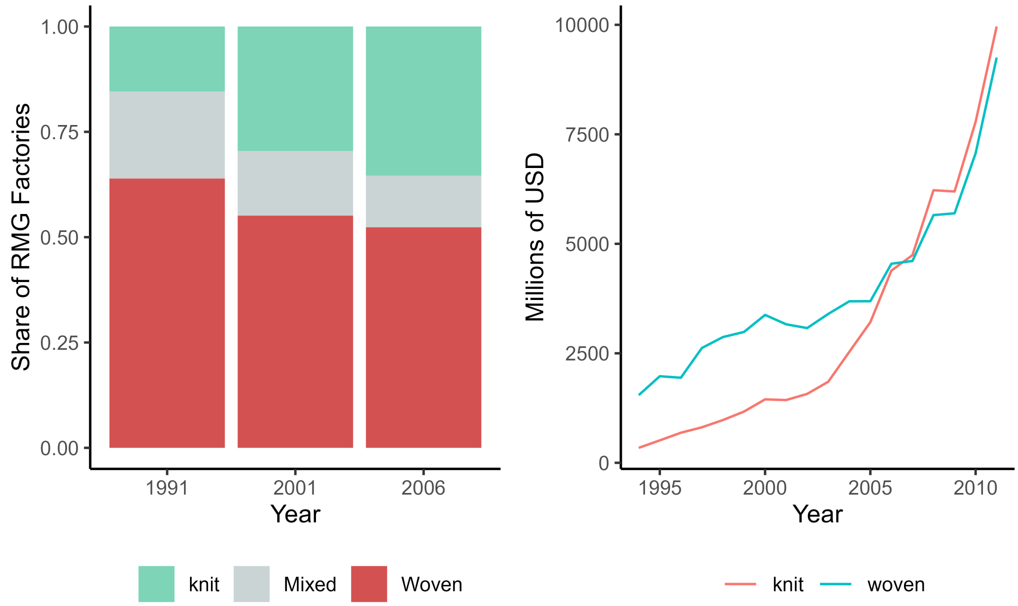
The number of RMG factories have been increasing steadily over 1991-2006. *Data source: My own compilation from various BGMEA sources, See section 2.4.*

Figure 2.4. Spread of the RMG industry in Bangladesh (1991-2006)



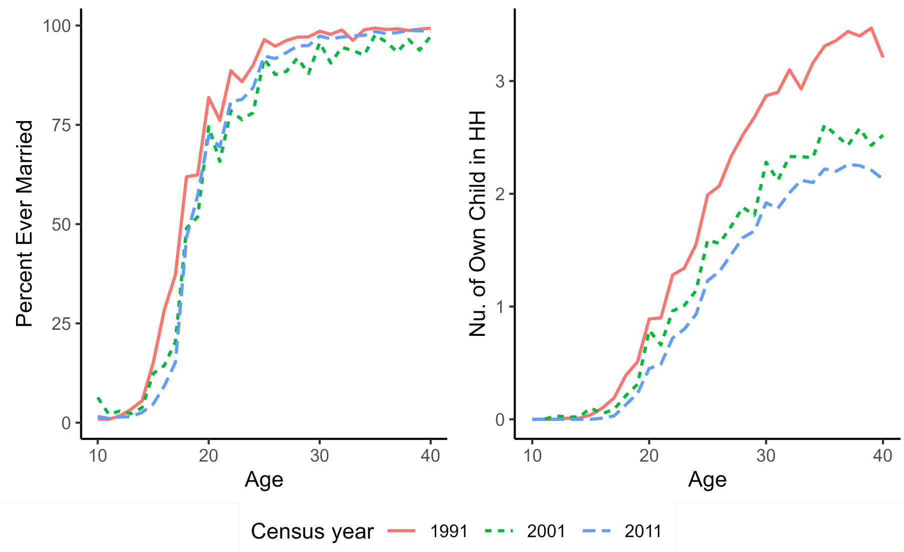
The RMG industry emerged in Bangladesh in the 1980s. By 1991, 37 of the 485 sub-districts had RMG factories in them. By 2001, there were 54 sub-districts with factories and by 2006, 63 sub-districts had factories. *Data source: My own compilation from various BGMEA sources, See section 2.4.*

Figure 2.5. Importance of knit Versus Woven in the Bangladeshi RMG Industry (1991:2006)



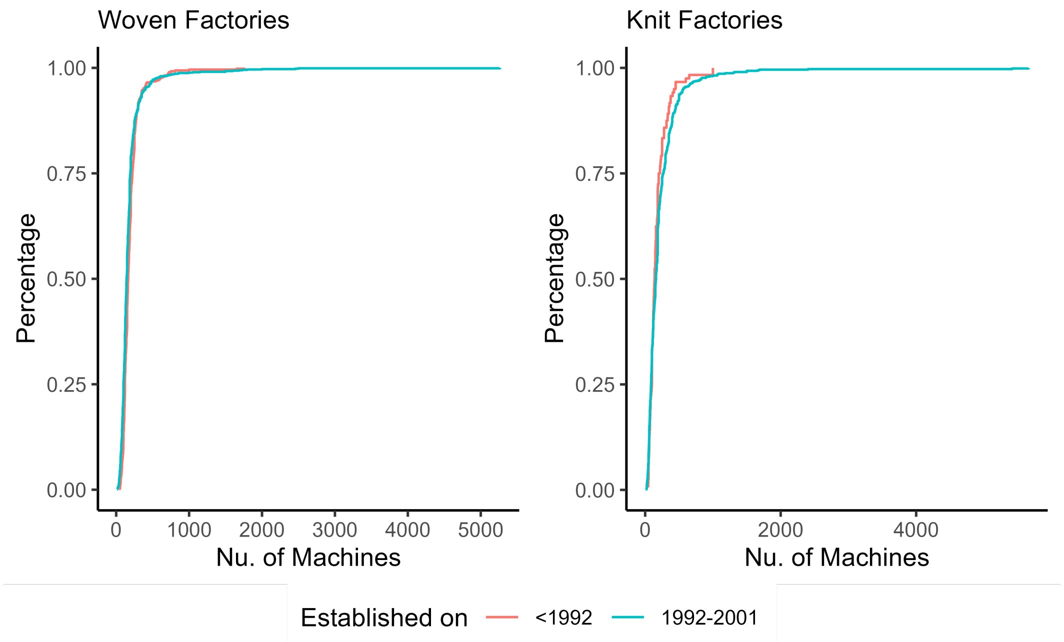
At the beginning of 1991, most of the RMG factories specialized in woven-based products. Since then, more knit factories opened up relative to woven factories. Exports of knit increased as well. By late 2000s, Knit and woven exports were comparable in value. *Data source: Export values are from BGMEA (2022b). Factory data is my own compilation from various BGMEA sources, See section 2.4.*

Figure 2.6. Age Specific Marriage and Own Children in Household in the Sample Areas



The left-hand panel shows age-specific rates of ever being married for Bangladeshi females of ages 10-40. It shows that a large portion of Bangladeshi teenage girls do in fact get married. Additionally, rates of ever being married flattens from ages 30 and onward. The right hand side shows number of own children in household, my measure of fertility in this study. It can be seen that the number of own children in household starts declining for women in their late 30s, perhaps due to family formation of their own children. These facts motivated my choice of analyzing the effect of exposure to RMG factories on marriage rates for females of ages 15-20 and 20-30 year old; and on fertility rates for 15-20, 20-30, and 30-40 year old Bangladeshi females. *Data Source: Bangladesh Census 1991, 2001, 2011.*

Figure 2.7. Empirical Cumulative Distribution of RMG factory Size in 1991 and 2001



The woven and knit shares are measured in 1991 and 2001. I examine whether technology of factories that were formed between 1991-2001 were similar to technology of factories formed before 1991. Both knit producing and woven producing factories have very similar empirical cumulative distribution function for factories established before 1991 and factories established between 1991-2001. Thus, technology likely remained the same even though a few new entrants in 1991-2011 were much larger than existing factories. *Data source: Export values are from BGMEA (2022b). Factory data is my own compilation from various BGMEA sources, See section 2.4.*

2.8 Tables

Table 2.1. Summary Statistics of RMG Factories in the Sample

Statistic	N	Mean	St. Dev.
Num. of Machines	2,849	197.9	259.1
Existed in 1991	2,849	0.3	0.4
Knit Factory	2,849	0.3	0.5
Woven Factory	2,849	0.6	0.5

There are 2849 factories in the factory dataset. factories had 198 machines on an average. 30 percent of the factories existed in 1991. 30 percent of them specialized in knit production, 60 percent specialized in woven production and the remain produced both.

Table 2.2. Differences between Sub-districts With or Without Factory, Census 1991

Variable	**N**	**Factory by 2006**[1] **N** = 64	**No Factory by 2006**[1] **N** = 421	**p-value**[2]
Density	485	12,580 (27,765)	865 (965)	<0.001
Access to electricity	485	0.42 (0.35)	0.08 (0.11)	<0.001
Urban	485	0.52 (0.45)	0.13 (0.16)	<0.001
Age	485	22.19 (0.92)	21.65 (0.95)	<0.001
Female	485	.465 (0.033)	1.488 (0.012)	<0.001
Schooling (Yrs)	485	3.17 (1.32)	2.02 (0.63)	<0.001

[1] Mean (SD)

[2] Wilcoxon rank sum test

Sub-districts that had a RMG factory in them by 2006 were clearly more developed even by 1991. Factory-exposed sub-districts were much more educated, dense, urbanized, and had better access to electricity by 1991. They also contained slightly older individuals and more males by 1991. This correlation between having RMG factory and development level informed the decision to restrict analysis only to regions with factories by 2006.

Table 2.3. Correlation Between Intensity of Woven Specialization and Measures of Infrastructure and Demographic Conditions in 1991 Within Sub-districts with RMG Factories

	Density	Electrification	Urbanization	Age	Sex	Yrs. of School
Density						
Electrification	0.54***					
Urbanization	0.35*	0.88***				
Age	0.30	0.35*	0.25			
Female	-0.42**	-0.83***	-0.67***	-0.49**		
Yrs. of School	0.44**	0.86***	0.70***	0.51**	-0.71***	
Intensity of Woven[1]	0.16	0.22	0.13	-0.31	-0.17	0.26

*p<0.1; **p<0.05; ***p<0.01

[1] Measured as ratio of woven-producing machines to total RMG industry machines in a sub-district

This table shows that intensity of woven and knit production within sub-districts with RMG factories is not correlated with sub-district level measures of density, electrification, urbanization, average age, sex distribution, and years of schooling in 1991.

Table 2.4. LPM Estimating Whether a Sub-district Has Factory by 1991 and 2001

	Dependent variable:			
	Has Factory by 1991 = 1		Has Factory by 2001 = 1	
	(1)	(2)	(3)	(4)
Electrification Rate	0.13***	0.16***	0.14***	0.15***
	(0.03)	(0.03)	(0.02)	(0.02)
Urbanization Rate	0.06***	0.05**	0.05***	0.07***
	(0.02)	(0.02)	(0.02)	(0.02)
Density (Age 15-64)	0.06***		0.03***	
	(0.02)		(0.01)	
Yrs. of Schooling	0.01	0.01	−0.01	0.001
	(0.02)	(0.02)	(0.02)	(0.02)
Constant	0.13***	0.14***	0.06***	0.06***
	(0.01)	(0.01)	(0.01)	(0.01)
Observations	485	485	485	485
R^2	0.52	0.51	0.43	0.42
Adjusted R^2	0.51	0.50	0.43	0.42

*p<0.1; **p<0.05; ***p<0.01

The dependent variables are whether a sub-district had RMG factory by 1991 and 2001 respectively. All explanatory variables are standardized. The results indicate that RMG factory location choice is primarily driven by infrastructure considerations (as measured by electrification and urbanization rate). Labor market conditions, as measured by density of working age population and years of schooling seem less important.

Table 2.5. 1991 and 2001 α_k and α_W and Sub-sequent Changes in Sub-district Characteristics

	Dependent variable:			
	α_k 91	α_W 91	α_k 01	α_W 01
	(1)	(2)	(3)	(4)
Δ Electrification Rate	0.05	−0.004	0.05	−0.002
	(0.03)	(0.03)	(0.03)	(0.03)
Δ Urbanization Rate	0.27	0.20	0.09	0.06
	(0.27)	(0.24)	(0.21)	(0.18)
Δ Pop (Age 15-64)	−0.00	0.00	−0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Δ Male Ind. LFP	0.10	0.09	0.08	0.08
	(0.12)	(0.11)	(0.12)	(0.11)
Δ Male Schooling (<15)	−0.13	−0.14*	−0.14	−0.15*
	(0.09)	(0.08)	(0.09)	(0.08)
Constant	0.01	0.02*	0.01	0.02*
	(0.01)	(0.01)	(0.01)	(0.01)
Observations	53	53	53	53
R^2	0.10	0.13	0.08	0.12
Adjusted R^2	0.002	0.03	−0.01	0.02

*p<0.1; **p<0.05; ***p<0.01

α_k and α_W at the beginning of 1991 and 2001 is uncorrelated with changes in electrification rate, urbanization rate, population, industrial labor force participation of men, and men‘s schooling in subsequent decade.

Table 2.6. Export Exposure and Female Labor Force Participation

	Dependent variable:					
	Ages 15-64		Ages 15-29		Ages 15-20	
	Δ FLFPR$_{s,t}$	Δ FLFPR-Ind$_{s,t}$	Δ FLFPR$_{s,t}$	Δ FLFPR-Ind$_{s,t}$	Δ FLFPR$_{s,t}$	Δ FLFPR-Ind$_{s,t}$
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Export Exposure$_{s,t}$	4.06***	5.36***	5.23***	6.88***	6.34***	7.56***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Electrification Rate$_{s,t-1}$	0.03	0.02	0.04	0.02	0.05	0.04
	(0.03)	(0.02)	(0.04)	(0.03)	(0.04)	(0.04)
Urbanization Rate$_{s,t-1}$	0.01	0.01	−0.01	0.005	0.01	0.005
	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
Yrs. School (15-64,M)$_{s,t-1}$	0.04***	0.01	0.04***	0.01	0.04*	0.01
	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
Yrs. School (15-64,F)$_{s,t-1}$	−0.05***	−0.03**	−0.05***	−0.03***	−0.05***	−0.04***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
Density$_{s,t-1}$	−0.00	0.00	−0.00	0.00	−0.00	−0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Pop (15-64)$_{s,t-1}$	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$Y^M_{s,t-1}$	0.19	−0.001	0.15	0.03	0.06	−0.04
	(0.13)	(0.07)	(0.11)	(0.09)	(0.11)	(0.13)
Period Fixed Effects	✓	✓	✓	✓	✓	✓
Observations	126	126	126	126	126	126
R^2	0.73	0.73	0.70	0.74	0.65	0.74
Adjusted R^2	0.70	0.71	0.67	0.72	0.62	0.71

*p<0.1; **p<0.05; ***p<0.01

Female Labor Force Participation (FLFP) is measured in percentages. Export exposure is measured in thousands of dollars per working age (16-64 year old) person. The results show that increases in export exposure led to increases in FLFP. As expected, the effect is stronger for younger women, and for industrial FLFP.

Table 2.7. Stability of Estimated Coefficients

	Dependent variable:				
	FLFP (Ages 15-64)				
	(1)	(2)	(3)	(4)	(5)
Δ Export Exposure	4.52***	5.00***	4.82***	4.53***	4.06***
	(0.60)	(0.52)	(0.62)	(0.63)	(0.70)
Electrification Rate			−1.39	4.23	3.42
			(2.45)	(2.76)	(2.82)
Urbanization Rate			1.49	0.89	0.60
			(1.71)	(1.60)	(1.62)
Yrs. School (15-64, M)				3.30***	3.68***
				(1.14)	(1.17)
Yrs. School (15-64, F)				−4.78***	−4.64***
				(1.18)	(1.18)
Density				0.00	−0.00
				(0.00)	(0.00)
Pop (15-64)					0.00
					(0.00)
$Y^M_{s,t-1}$					18.80
					(12.90)
Period Fixed Effects	No	✓	✓	✓	✓
Observations	126	126	126	126	126
R^2	0.32	0.66	0.67	0.72	0.73
Adjusted R^2	0.31	0.66	0.65	0.70	0.70

*p<0.1; **p<0.05; ***p<0.01

FLFP is measured in percentages. Export exposure is measured in thousands of dollars per working age (16-64 year old) person. The results provide evidence of stability of estimated coefficient on export exposure under different nested specifications.

Table 2.8. Effect of Export Exposure on Marriage and Age-specific Fertility Rates

	Dependent variable:				
	Δ Marriage $\text{Rate}_{s,t}$		ΔFertility $\text{Rate}_{s,t}$		
	Ages 15-20	Ages 21-30	Ages 15-20	Ages 21-30	Ages 30-40
	(1)	(2)	(3)	(4)	(5)
Δ Export Exposure_t	-0.22	0.38	0.22	-0.16	3.98
	(0.53)	(0.43)	(0.47)	(1.63)	(2.44)
Electrification $\text{Rate}_{s,t-1}$	5.08^{**}	-1.82	2.37	-7.81	-2.54
	(2.31)	(1.89)	(2.08)	(7.12)	(10.69)
Urbanization $\text{Rate}_{s,t-1}$	-0.29	2.02^{*}	-0.74	6.00	4.90
	(1.34)	(1.09)	(1.20)	(4.13)	(6.20)
Yrs. School $(15\text{-}64,\text{M})_{s,t-1}$	-1.70^{*}	-1.45^{*}	-1.40	-3.18	-8.47^{*}
	(0.96)	(0.78)	(0.86)	(2.95)	(4.42)
Yrs. School $(15\text{-}64,\text{F})_{s,t-1}$	1.75^{*}	1.32	1.93^{**}	5.41^{*}	11.80^{**}
	(0.99)	(0.81)	(0.89)	(3.04)	(4.57)
$\text{Density}_{s,t-1}$	-0.00^{**}	-0.00	-0.00	0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Period Fixed Effects	✓	✓	✓	✓	✓
Observations	126	126	126	126	126
R^2	0.60	0.74	0.87	0.86	0.89
Adjusted R^2	0.58	0.72	0.86	0.85	0.88

$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Marriage rates are in percentages. Number of own children in household is used as estimates of fertility rates. Export exposure is measured in thousands of dollars per working age (16-64 year old) person. The results indicate that increases in export exposure did not have any effect on marriage and fertility rates of Bangladeshi women.

Table 2.9. Export Exposure and Human Capital Accumulation of Bangladeshi Girls (Ages 5-19)

	Dependent variable:				
	Δ Enrollment $\text{Rate}_{s,t}$			Δ Literacy $\text{Rate}_{s,t}$	Yrs. $\text{School}_{s,t}$
	Ages 05-09	Ages 10-13	Ages 14-19	Ages 14-19	Ages 14-19
	(1)	(2)	(3)	(4)	(5)
Δ Export $\text{Exposure}_{s,t}$	0.56	−1.19	-3.17^{***}	−0.96	−0.13
	(0.90)	(0.88)	(1.20)	(0.83)	(0.08)
Electrification $\text{Rate}_{s,t-1}$	-9.15^{**}	-17.84^{***}	-26.78^{***}	-12.15^{***}	-1.36^{***}
	(3.91)	(3.66)	(5.04)	(3.57)	(0.34)
Urbanization $\text{Rate}_{s,t-1}$	1.04	−0.12	−0.30	−0.42	0.07
	(2.31)	(2.21)	(3.06)	(2.11)	(0.20)
Yrs. School $(15\text{-}64,M)_{s,t-1}$	−0.43	5.28^{***}	7.91^{***}	6.81^{***}	0.71^{***}
	(1.60)	(1.61)	(2.55)	(2.55)	(0.18)
Yrs. School $(15\text{-}64,F)_{s,t-1}$	1.49	-4.92^{***}	-5.29^{**}	-6.96^{***}	-0.68^{***}
	(1.67)	(1.58)	(2.18)	(1.53)	(0.15)
$\text{Density}_{s,t-1}$	0.00	0.00	0.00	0.0000	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$Y^{M}_{s,t-1}$	-0.58^{***}	-0.54^{***}	-0.52^{***}	-0.50^{***}	-0.45^{***}
	(7.72)	(6.83)	(12.87)	(8.79)	(0.12)
Period Fixed Effects	✓	✓	✓	✓	✓
Observations	126	126	126	126	126
R^2	0.89	0.92	0.67	0.93	0.93
Adjusted R^2	0.88	0.91	0.64	0.93	0.93

$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Enrollment rate and literacy rates are in percentages. Export exposure is measured in thousands of dollars per working age (16-64 year old) person. The results indicate that increases in export exposure led to decreases in enrollment for working age teenage girls. However, export exposure did not have an effect on other dimensions of human capital accumulation of Bangladeshi girls.

CHAPTER 3

RURAL FERTILITY TRANSITIONS: THE ROLE OF LAND CONSTRAINTS

3.1 Introduction

Fertility rates and socioeconomic development exhibit a strong negative association. Around its independence in 1971, Bangladesh was one of the most densely populated and poor countries of the world. The country also had a very high fertility rate. Since then, it underwent an unusually rapid fertility transition. The total fertility rate (TFR) dropped from 6.92 to 2.05 between 1970 - 2020. This drop is faster than any experienced by United Nations (UN) country blocks between 1950 - 2020.[1] The transition in Bangladesh took place without the use of coercive family planning strategies, and amid persistent unfavorable conditions of high but falling mortality, low economic development and contraception hesitance (Caldwell et al., 1999).[2]

The national TFR may hide substantial spatiotemporal differences in the onset of fertility transitions. Stoeckel and Choudhury (1969) document a 27 percent decrease in TFR in some rural areas between 1958 and 1967. However, fertility remained positively associated with husband's education and familial wealth in rural Bangladesh in the early 1970s (Stoeckel & A. K. M. Alauddin Chowdhury, 1980), suggesting a preference for larger families despite possible declines in fertility. In urban settings at around the same time, fertility and contraceptive use were negatively associated with husband's income and wife's education as well (Chaudhury, 1978). Taken together, these facts suggest the possibility of spatiotemporal variation in the onset of the Bangladeshi fertility transition.

Despite the importance of declining fertility for economic development and for increasing the rights and autonomy of individual women within households (Aaronson et al., 2014) and of women on the political stage Doepke et al. (2012), much of the decline in fertility in Bangladesh is not well understood. In first part of this paper, I document the fertility transition in Bangladesh in finer spatial detail and establish the timing, magnitudes and correlates of persistent declines in fertility and fertility preference among different birth cohorts of Bangladesh. In the second

[1]See Figure 3.1

[2]In late 1990s, Bangladesh was the poorest country to have a TFR below 5 (Caldwell et al., 1999)

part of the paper, I seek to add to our understanding of the Bangladeshi fertility transition by analyzing the influence of increasing agricultural land constraint on the fertility transition of Bangladesh.

The rest of the paper is organized as follows - section 3.2 discusses the current state of the literature, section 3.3 describes the data and the empirical approach, section 3.4 presents the results, and section 3.5 discusses the findings.

3.2 Literature Review

Three broad categories of models have been used to explain fertility transitions (Shenk et al., 2013). Risk/mortality based models postulate that lower mortality reduces fertility. Cultural transmission models emphasize the role of evolution of preferences and its diffusion, whereas other models emphasize the increasing returns to human capital, opportunity cost of women and sectoral shifts.

The earliest research to focus on the specific context of Bangladesh studied 547 couples in government housing in 1963 in what is now the capital city in Bangladesh. The authors found a positive correlation between education and family size, a strong preference for male children, a greater desire for more children among women than men, and limited use of contraceptives despite knowledge of it (Roberts et al., 1965). Among elite professionals, support for family planning started to be positively related with education soon thereafter in 1970s Chaudhury, 1975. In more rural areas, between 1967-1971, large declines in fertility were documented amid low contraceptive usage (Stoeckel & Choudhury, 1969), and a positive correlation between fertility and education, and landholding (Stoeckel & A. K. M. Alauddin Chowdhury, 1980).

Declines in childhood mortality may reduce fertility either by changing family size preference, or through child replacement motivations. Chowdhury et al. (1976) finds no evidence of the child replacement motivation at work in Bangladesh at around 1970s. But in a subsequent work, Hossain et al. (2007) finds evidence of volitional replacement of deceased child in the 1982-93 period, suggesting that under lower fertility conditions, target family size may become more salient. Both of these studies examine the influence of mortality on fertility from the perspective of couples. Widespread changes in family size preference as a result of large declines in childhood mortality from its high in 1900 remains unexplored.

In addition to a reduction in child mortality, several explanations have been proposed to account for the fertility decline in Bangladesh. The most often studied aspect of the Bangladeshi fertility transition has been the role of family planning program. The Matlab family planning program seems to have led to a long-term fertility decline explaining about 14-17 percent of the decline in fertility in the treatment villages (Joshi & Schultz, 2013; Sinha, 2005). However, in terms of expenditure per person terms, the Matlab family planning had at least three times the resources of what was allocated to national family planning efforts (DeGraff, 1991). Using nationally representative surveys between 1969-1983, R. Amin et al. (1987) find that the national family planning programs increased awareness of contraceptive options from 28 percent to 81 percent of the population, but did not change fertility preference. However, whether the increase in contraceptive awareness is a direct consequence of the family planning programs, or provided the impetus to a diffusion mechanism as discussed in (Bhattacharya & Chakraborty, 2017; Munshi & Myaux, 2006) is unclear.

Since 1970, and particularly since 1990, female labor force participation and women's schooling had increased substantially in Bangladesh. Heath and Mobarak (2015) find a substantial increase in women's employment, and a modest increase in age of marriage and age of child-bearing due to exposure to the ready made garments industry, Bangladesh's largest employer of women. Chapter 2 of this dissertation also finds that the impact of the ready made garments industry on the labor force participation of Bangladeshi women is substantial. However, I find that the impact on fertility is statistically insignificant. On the other hand, Hahn et al. (2018) find an 8-12 percent decline in fertility resulting from a plausibly exogenous increase in women's education at a time when the TFR was around 4. Fujii and Shonchoy (2020) find that electrification in rural areas lowered the number of children per woman by 0.2 over a five year period. However, it should be noted that the electrification rate in Bangladesh was only 32 percent in 2000 The World Bank (2021), by which time TFR had already fallen to 3.3 from near seven in 1970.

Even if we disregard the arguments against exclusion restrictions in the aforementioned studies, most of the change in TFR in Bangladesh remains unexplained. By my calculations, the aforementioned studies with its emphasis on family planning program, education, and electrification explain about a quarter of the fall in fertility between 1970-2020, and about three quarters remain unexplained. Additionally, women's economic opportunity in the form of employment in the garment industry at best explain only a minor amount of the fertility decline.

The majority of the Bangladeshi population lives in rural areas, and is engaged in agriculture. This was more true at the dawn of the fertility transition in Bangladesh (see chapter 1). To my knowledge, the role of rural agrarian economic conditions in helping initiate the fertility decline in rural Bangladesh, and by extension in Bangladesh overall, has not been studied. Beginning in 1900s, the childhood mortality rate in Bangladesh began to fall, and was halved by 1970 (UN DESA, 2022). This led to a fast population growth in what was already one of the most densely-populated locations in the world. In turn, farm sizes shrinked , and changes in agricultural technology led to more capital-intensive farming (Caldwell et al., 1999), reducing labor demand in rural areas. For the second part of this research, I attempt to partially explain the fertility transition in rural Bangladesh through an income effect of declining land availability in rural Bangladesh.

3.3 Empirical Approach and Data

3.3.1 Empirical Approach

This research chapter uses two different methods to answer two different research questions. Using descriptive analysis, I determine the timing of the onset of rural and urban fertility transition in Bangladesh. And using a difference-in-difference (DiD) approach, I investigate the influence of land constraints on rural fertility in Bangladesh.

Descriptive Analysis

To determine the timing of the onset of fertility transition in Bangladesh, I create a retrospective panel data of birth histories from several rounds of representative national surveys. This retrospective panels from different individuals from different surveys are then stacked together. Sample weights are adjusted following Schmidt and Elkasabi (2020).

The birth history panels allow me to estimate realized age-specific fertility rates for 5 year birth cohorts between 1926-81. Following the same cohort over time controls for the impact of age compositions on measured fertility outcomes such as crude birth rates and TFR. The same measure is estimated for rural and urban population. Using these age-specific fertility rates of different cohorts, I document the timing of the onset of persistent declines in fertility among Bangladeshi women.

I further investigate and establish some of the correlates of completed fertility at the individual level using simple linear regressions.

The findings of the descriptive analysis, discussed in Section 3.4.1, reveals i) a five to ten year delay on the onset of fertility transition in rural Bangladesh, compared to urban Bangladesh; and ii) that land owners had higher fertility rates. In agrarian economies, land is a key but fixed resource. Population growth due to falling child mortality will reduce land per labor, which will in turn reduce income based on land in rural economies. Thus, fertility can start to decline due to the the negative income effect from reduced land availability. I test this mechanism by methods described below.

Examining the role of land constrain

I estimate the effect of land constrain on fertility in rural Bangladesh using a DiD approach. Specifically, I estimate an equation of the following form:

$$\text{Fertility}_{i,t} = \beta_0 + \beta_1 \text{Rural}_i + \beta_2 X_{s,t} + \beta_3 \text{Rural} * X_{s,t} + \delta_t + \epsilon_{i,t} \tag{3.1}$$

Where, $\text{Fertility}_{i,t}$ is the total number of birth given by a woman till time t. Rural is an indicator that the person was born in rural areas, and was staying in a rural area at the time of interview. The first explanatory variable I examine, $X_{s,t}$, is Increased Land $\text{Availability}_{i,t}$. It is a measure of district specific plausibly exogenous increase in land availability. δ_t are year fixed-effects. If land constrains helped with fertility reduction, increased land availability will increase fertility.

According to the 1981 Bangladeshi census data, 70.7 percent of the rural labor force was engaged in agriculture in 1981, whereas 65.8 percent of the households owned land (Bangladesh Burea of Statistics, 1984). This points to an existence of a large group of land-less agricultural workers. The landless agricultural laborers will be affected by land constraints through the supply of agricultural labor. In fact, Stoeckel and A. K. M. Alauddin Chowdhury (1980) provide evidence of an already emerging reduced fertility for landless agricultural workers. Hence, I also construct and use a plausibly exogenous Net Migration $\text{Rate}_{s,t}$ as an explanatory variable. Areas with high out-migration will lead to higher fertility through the positive income effect of reducing rural labor supply and increases rural wages. Below, I discuss construction of these two variables.

Construction of Net Migration Rate and Land Availability Owing to continual religious strife, Bangladesh has been loosing its Hindu population, the largest minority religious group of Bangladesh, to out-of-country-migration at least since the early 1900s. One of the two fastest out-migration occurred in the lead-up, during, and aftermath of the independence struggle of Bangladesh in 1971.[3] Consequently, the Hindu population reduced by 5 percentage points between 1961 to 1974. The region also suffered from famine in 1973-74, increasing incentives to out-migrate.

With neighboring India presenting a less hostile environment for the Hindu population, most of the out-migration was by members of the Hindu community. This resulted in a reduction share of non-Muslim in the country by 6.3 percentage points (pp) between 1961-1981. As per (Internaltional Statistical Insititute, 1976), there was no difference in fertility rates of Muslims and non-Muslims in Bangladesh at least till 1976. This allows me to construct the measure of Increased Land Availability$_{s,t}$ that could be unrelated to other factors influencing fertility.

I first estimate the 1981 district level population that would have resulted in the absence of large scale out-of-country migration as follows:

$$\text{Expected Population}_{s,1981} = \frac{\text{Muslim}_{Bangladesh,1981}}{\text{Muslim}_{Bangladesh,1961}} * \text{Population}_{s,1961} \tag{3.2}$$

Since the Muslim population did not out-migrate from Bangladesh at a large scale, the ratio of Muslim population in 1981 to the Muslim population in 1961 provides an estimate of population growth that would have happened absent the religious component to Bangladesh's war of independence and related non-Muslim out-migration.[4] Note that the ratio captures effects of war, natural fertility and mortality, and out-migrations independent of the religious strife angle.

By applying the ratio to district level population in 1961, I estimate the population that would have existed if religious strife was not part of the 1961-1981

[3]Pro-Muslim majority identity was used by the then Pakistani government as a tool to counteract pro-independence sentiment in current Bangladesh.

[4]The first wave of large scale out-migration of non-Muslim population happened in connection with the 1947 partition of India. Lack of available sub-division, which later was converted to districts, level Hindu and Muslim population data of 1941 census prevents me from using the first wave of out-migration to construct measures of land availability and net out-migration.

demographic changes in Bangladesh. The difference between the expected population and actual observed population is the net migration, and the net migration rate is the difference normalized by district level 1961 population:

$$\text{Net Migration Rate}_{s,1961-81} = \frac{\text{Expected Population}_{s,1981} - \text{Population}_{s,1981}}{\text{Population}_{s,1961}} \tag{3.3}$$

The estimate of Increased Land Availability$_{s,1981}$ as follows:

$$\text{Increased Land Availability}_{s,t} = \frac{\text{Non-river Area}_s}{\text{Population}_{s,1981}} - \frac{\text{Non-river Area}_s}{\text{Expected Population}_{s,1981}} \tag{3.4}$$

Identification The identification depends on three key assumptions. First, the identification assumes that the population pressure affects rural areas but not urban areas. Differences in land availability through out-migration of non-Muslims creates differences in land availability for farming, and agricultural labor supply. Thus the familial income effect acts on rural women, but not urban women. This is because more than 90 percent of the population was engaged in agriculture during 1961-1981. And almost of rural Bangladesh was engaged in land-based agriculture. But agriculture is not practiced at scale in urban regions. Consequently, differences in land availability affects rural women more.

Second, the identification assumes that women who were of fertile age in 1961-1981 were not affected by these to the same degree. This is restrictive, and plausibly not true given the continuous nature of out-migration. Not accounting for the treatment contamination will likely bias the estimates towards zero.

Third, it is assumed that out-migration is unrelated to local labor market conditions. And this assumption is likely to hold since the out-migration is primarily due to religious strife (Mithun (2019); Datta (2013)).

3.3.2 Data

The key data sources for this project are household surveys conducted through the World Fertility Survey (WFS) in 1975-76 (Internaltional Statistical Insititute, 1976), eight waves of standard versions of the Demographic Health Survey's (DHS) Bangladesh survey between 1993 and 2018, and 2001 special issue DHS survey (ICF International, 2021). Combined, these surveys provide data on 217,878 adult women and their households. This data was collected from numerous different clusters in Bangladesh. Administratively, Bangladesh is divided into 8 divisions, 64 districts, and 495 sub-districts at present. However, administrative boundaries underwent substantial changes over the time.

The WFS survey is representative at the national and rural-urban level, and the DHS surveys are representative at the national, rural-urban, and divisional levels at the time of the survey. These surveys provide a detailed look into the realized and desired fertility behavior of Bangladeshi women and couples. A rich set of additional socioeconomic and demographic information about the surveyed women and their households is available as well.

3.4 Empirical Findings

3.4.1 Descriptive analysis

I first estimate age specific fertility rates (ASFR) of 5-year birth cohorts of Bangladeshi women born between 1926-1981. Estimated ASFR table for Bangladesh as a whole as well as ASFRs in rural and urban areas are presented in Appendix A. As shown in Figure 3.2 the fertility transition begins with the 1946-1950 birth cohort. Particularly, the women in this cohort have fewer children by 25 years of age. Relative to previous generations, they also showed strongest decline when they were 40-45 years of age.

Underneath the overall numbers, there is rural-urban differences. The completed fertility in rural Bangladesh has been higher than in urban Bangladesh since 1926-30 birth cohorts. The difference in completed fertility rates started at about 0.06 children, increased to about 0.3 for the 1925-40 birth cohort and then increased to 1 child per woman by the 1941-45 cohort.

Based on persistent declines in cohort fertility, the transition in urban areas starts with the 1941-45 cohort, whereas in the case of rural areas, the transition begins with the 1946-50 cohort. In urban areas, large declines in age-specific fertility relative to the previous cohorts start with ages 25 onward. Thus, the transition may have started by 1970. In the rural areas, the transition happens most strongly after the age of 35. Thus, the rural transition might have started by 1980. One interesting feature of the transition in Bangladesh is the relatively small gap in timing of onset of transition between rural and urban areas of the country.

Correlates of Fertility at the Individual Level

In this sub-section, I establish some of the key correlates of fertility by running regressions of the following form:

$$\text{Fertility}_i = \beta_0 + X_i\beta_x + Z_i\beta_z + \delta_t + \delta_{birth} + \epsilon_i \tag{3.5}$$

The correlates checked include education of husband and wife, working in agricultural sector and land ownership. I also include birth year fixed effects and survey period fixed effects to account for time-trends. The regression results are presented below. In the baseline specification, I do not include a measure of fertility preference – stated ideal number of children, as the measure is likely to be endogenous to fertility itself. In an additional specification, I use fertility preference as a covariate as well. Since I am using data from multiple periods with changing population, I use adjusted sample weights in the regression.

The results of the regression is in table 3.1. Both wife‘s, and husband's education are negatively correlated with fertility. However, the strength of relationship between fertility and wife's education seem to be much greater. Among occupations, working in agriculture is strongly associated with higher fertility. In addition, the limited data does not provide any evidence of relationship between the amount of land and fertility. The qualitative and quantitative strength of correlates discussed above remain similar in regressions with fertility preference as a control (see table 3.2). However, stated fertility preference is strongly correlated with fertility.

Since fertility preferences are such an important correlate of realized fertility, next I check the correlates of fertility preference.

Correlates of Fertility Preference

Correlates of fertility preference are established by running regressions of the following form:

$$\text{Fertility Pref}_i = \beta_0 + X_i\beta_x + Z_i\beta_z + \delta_t + \delta_{birth} + \epsilon_i \tag{3.6}$$

The correlates checked include measures of education of husband and wife, working in agricultural sector and land ownership. Demographic controls include birth year fixed effects and I include survey period fixed effects to account for trends. The regression results are presented below. Since I am using data from multiple periods with changing population, I use adjust sample weights in the regression.

Regression results in table 3.3 indicate that the education level of couples, particularly of wife's, have the strongest impact on fertility preference. In addition, fertility preference is higher in rural areas. However, fertility preference do not seem to depend on working in agriculture or owning land.

3.4.2 Role of Migration and Land Constraint

I investigate the effect of land availability and net migrations on fertility by estimating equations of the form of 3.1. The $X_{s,t}$ are constructed measures of Net Migration Rate$_{s,1961-81}$ and Increased Land Availability$_{s,1981}$. Table 3.4 presents summary statistics on population, density, out-migration, and land availability. The population and thereby the population density almost doubled between 1961 to 1981. As expected, the mean of expected district-level population in 1981 is higher than the mean of actual population in 1981, and net migrations positive (i.e. on average, places experienced out-migration), and the net migration is about 7 percent of the 1961 population. Table 3.5 presents correlations between selected measures. As expected, areas with larger population in 1961 had greater levels of population and expected population in 1961. Moreover, those areas also saw greater outward migration and greater extra land per person.

The sample is restricted to years before and including 2001, to minimize picking up effects of land availability occurring through children of those exposed to the land availability shock by 1981. Moreover, the rural sample consists only of women who were interviewed in a rural area, and were raised in a rural area. The urban sample consists of women interviewed in urban area who were raised in urban area. This controls for the effect of selective rural-urban migration.

Table 3.6 present the estimates of regression equations 3.1. The results show that rural areas had higher levels of fertility, and conform to findings in the descriptive analysis, and the literature more broadly. The results also show a statistically significant and positive effect of land availability. However, the coefficient on land availability and rural interaction is statistically insignificant.

In the specification with net migration rate, similar level differences in total births are observed between rural and urban regions. Net out-migration is negatively relatively with total births. Here, however, the coefficient on net migration rate interacted with rural is positive and statistically significant: implying that outward migration had a positive impact on realized fertility in rural areas.

3.5 Discussion of results and conclusion

This research seeks to add to the understanding of the dramatic fertility transition in Bangladesh. To do so, I first document that the fertility transition begins with the 1941-45 cohort in urban areas and the rural transition starts almost immediately with the 1946-1950 birth cohort. The transition happens within the context of falling mortality rates. Looking into the correlates of fertility, husband and wife's education, and changes in fertility preference are strongly associated with lower fertility. Increased education is also associated with preference for fewer children. This is not surprising given the negative education and fertility relationship around the world.

The transition in Bangladesh started in between 1960-70, when GDP per capita was below 500 USD in 2015 dollars (The World Bank, 2021). At the individual level, participation in agriculture, especially while owning land, is associated with increased fertility. Mortality rates in Bangladesh have been falling since early 1900s. The improved mortality conditions have reduced land availability.[5] Thus, I investigate the possibility that reduced returns to agricultural activities have led to smaller families by examining the role of increased land availability and less supply of labor in rural areas on rural fertility.

My findings suggest that while land availability directly may not have induced fertility reductions, overall effect of rural economic competition through outward migration may have been a contributor to the rural fertility transition in Bangladesh. Given Bangladesh is not unique, and perhaps typical among the broad swath of developing countries undergoing fertility transition in rural areas in 1960s, this presents an additional mechanism of initiation of rural fertility transitions.

There are three key limitations of the empirical exercise linking fertility and rural economic conditions. First, the current set-up makes it hard to speak to the importance of the effect size. This might be addressed by using long differences or other panel data methods, and by redefining our $X_{s,t}$ to make commenting on effect size more straight-forward. Another potential solution is to create district level panel of fertility measures using re-weighting techniques. Second, the measure of Increased Land Availability$_{s,1981}$ likely contains large error due to data quality. This may explain the null effect of increased land availability on fertility in rural

[5]See figure 3.3

areas while out-migration differentially increased fertility in rural areas. Obtaining better measures of arable land could be possible using GIS techniques. Third, a formal model of the argument linking mortality declines to increased rural economic competition and subsequent fertility decisions of households could help with interpretation of the findings.

In the next chapter, I investigate the changes in women's employment in Bangladesh with a focus on rural areas, by comparing to the experience of neighboring Indian states.

3.6 Figures

Figure 3.1. Fertility Transitions Around the World 1950:2000

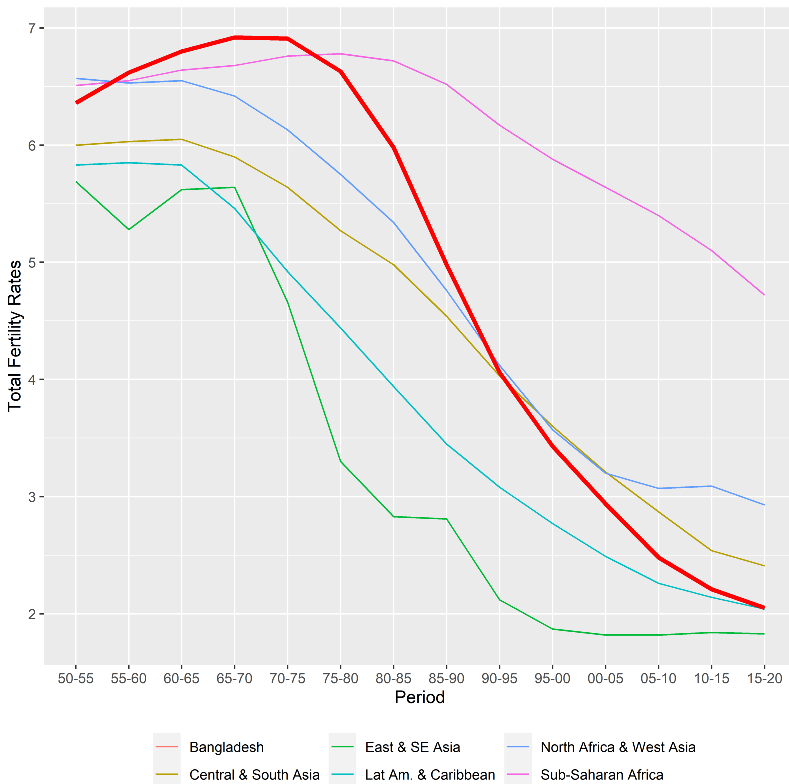


Figure 3.2. Rural and urban Fertility Transitions in Bangladesh

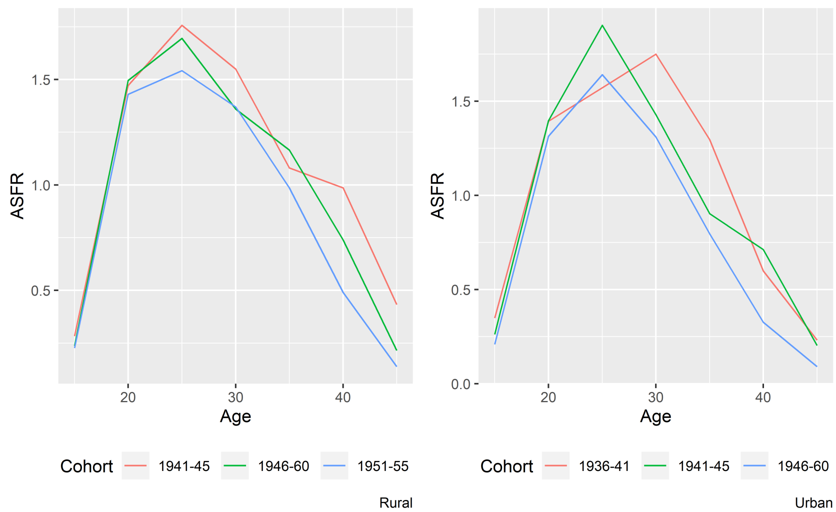


Figure 3.3. GDP, Land and Fertility in Bangladesh

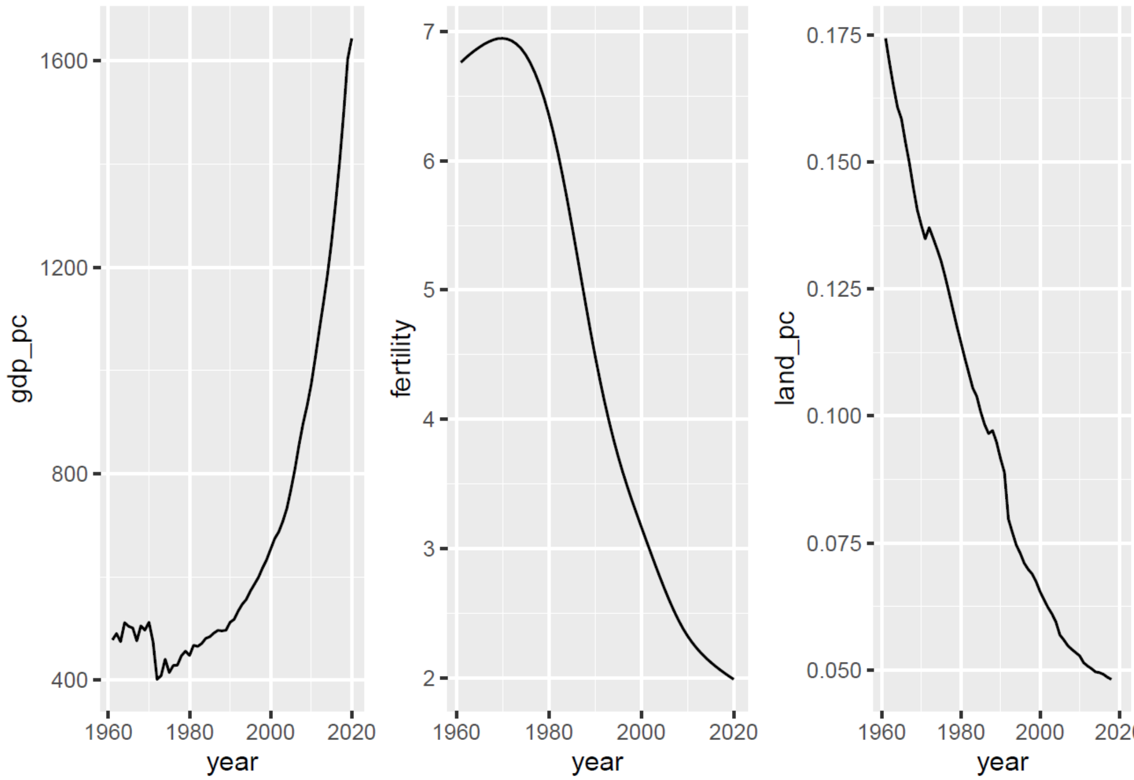


Table 3.1. Correlates of Fertility

	Dependent variable:			
	Fertility			
	(1)	(2)	(3)	(4)
Female Educ	-0.290^{***}	-0.317^{***}	-0.275^{***}	-0.300^{***}
	(0.007)	(0.015)	(0.018)	(0.013)
Male Educ	-0.120^{***}	-0.084^{***}	-0.070^{***}	-0.118^{***}
	(0.006)	(0.013)	(0.014)	(0.011)
Rural	0.279^{***}	0.397^{***}		
	(0.011)	(0.029)		
Engaged in Agri.	0.033^{***}	0.001	−0.048	0.029
	(0.012)	(0.021)	(0.040)	(0.023)
Land Owner		0.056^{**}	0.033	
		(0.023)	(0.033)	
Land Amount				−0.00000
				(0.00002)
Engaged in Agri X Land Owner			0.095^{**}	
			(0.048)	
Engaged in Agri X Land Amount				0.00001
				(0.00003)
Observations	106,338	30,058	23,719	27,480
Adjusted R^2	0.510	0.552	0.558	0.524
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 3.2. Correlates of Fertility (Controlling for Stated Preference)

	Dependent variable:			
	Fertility			
	(1)	(2)	(3)	(4)
Female Educ	−0.251***	−0.277***	−0.232***	−0.260***
	(0.007)	(0.015)	(0.018)	(0.013)
Male Educ	−0.107***	−0.070***	−0.058***	−0.103***
	(0.006)	(0.012)	(0.014)	(0.010)
Rural	0.223***	0.320***		
	(0.011)	(0.028)		
Fertility Preference	0.451***	0.401***	0.408***	0.472***
	(0.006)	(0.011)	(0.012)	(0.011)
Engaged in Agri.	0.028**	0.007	−0.066*	0.042*
	(0.012)	(0.021)	(0.040)	(0.022)
Land owner		0.060***	0.024	
		(0.023)	(0.033)	
Land Amount				−0.00000
				(0.00002)
Engaged in Agri.XLand Owner			0.132***	
			(0.048)	
Engaged in Agri$X$Land Amount				−0.00002
				(0.00003)
Observations	103,154	28,217	22,075	26,894
Adjusted R^2	0.534	0.572	0.578	0.555
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 3.3. Correlates of Stated Fertility Preference

	Dependent variable:			
	Fertility Preference			
	(1)	(2)	(3)	(4)
Female Educ	−0.084***	−0.103***	−0.103***	−0.088***
	(0.004)	(0.008)	(0.010)	(0.007)
Male Educ	−0.032***	−0.042***	−0.041***	−0.034***
	(0.003)	(0.007)	(0.008)	(0.006)
Rural	0.109***	0.158***		
	(0.006)	(0.016)		
Engaged in Agri	0.004	−0.026**	−0.006	−0.015
	(0.006)	(0.012)	(0.022)	(0.012)
Land Owner		0.002	0.015	
		(0.013)	(0.018)	
Land Amount				0.00001
				(0.00001)
Engaged in Agri x Land owner			−0.026	
			(0.026)	
Engaged in Agri x Land Amount				0.00001
				(0.00002)
Observations	103,154	28,217	22,075	26,894
Adjusted R^2	0.084	0.062	0.056	0.086
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 3.4. Summary Statistics: Population, Density, Migration, and Land Availability

Statistic	N	Mean	St. Dev.	Min	Max
Population 61	54	987,955	620,288	86,422	3,663,965
population 81	54	1,684,688	1,136,591	141,045	6,268,521
Expected Population 81	54	1,826,901	1,147,022	159,809	6,775,307
Density61	54	447	277	27	1,631
Density81	54	719	347	66	1,909
Net Migration	54	142,212	701,546	−3,589,919	2,194,943
Net Migration Rate	54	0.07	0.61	−2.74	1.22
Extra Land Per Person (in Acres)	54	−0.002	0.202	−1.198	0.356

Table 3.5. Correlations Between Selected Measures

	Pop 61	Pop 81	Expected Pop 81	Extra Land Per Person	Net Migration
Pop 61	1.00	0.81	1	0.22	0.32
Pop 81	0.81	1.00	0.81	0.002	−0.29
Expected Pop 81	1.00	0.81	1.00	0.22	0.32
Extra Land Per Person	0.22	0.002	0.22	1.00	0.36
Net Migration	0.32	−0.29	0.32	0.36	1.00

Table 3.6. Land Constraint and Fertility

	Dependent variable:	
	Total births	
	(1)	(2)
Rural	0.678***	0.665***
	(0.007)	(0.007)
Increased Land Availability	115.841***	
	(23.636)	
Increased Land Availability x Rural	−34.447	
	(24.033)	
Net Migration Rate		−0.059***
		(0.017)
Net Migration Rate x Rural		0.147***
		(0.018)
Observations	1,372,174	1,372,174
R^2	0.077	0.077
Adjusted R^2	0.077	0.077
Note:	*p<0.1; **p<0.05; ***p<0.01	

CHAPTER 4

FEMALE LABOR FORCE PARTICIPATION IN BANGLADESH AND NEIGHBORING INDIAN STATES: 1987-2011

This chapter is co-authored with Shankha Chakraborty. I had an essential role in developing the initial idea that led to this project. I also wrote a significant amount of code that generates the results in this paper. I also wrote and edited many sections of the paper.

4.1 Introduction

South Asia has one of the lowest Female Labor Force Participation Rate (FLFPR) in the world, and the region as a whole has been experiencing a decline in FLFPR in recent decades (see Figure 4.1). Within South Asia, FLFPR has been declining for countries with relatively higher levels of FLFPR in 1990, including India; and increasing in countries with relatively lower levels of FLFPR in 1990 such as Bangladesh (see Figure 4.2).

There is considerable variation within the geography of South Asian countries.[1] Consequently, there are differences in the relative importance of agriculture, specialization in the type of agriculture, religion, and culture among these countries. Additionally, the recent policy and economic environment have varied substantially. All these factors affect both the levels and dynamics of FLFPR (see section 4.2).

In this paper, we examine the diverging experience of increasing FLFPR in some parts of South Asia and decreasing FLFPR in other parts. We focus on the case of Bangladesh between 1991-2011 and Indian states that border Bangladesh – i.e. Mizoram, Tripura, Meghalaya, Assam, and West Bengal between 1987-2009. Bangladesh and these Indian states, except Mizoram,[2], are part of the Gangetic plains and thereby likely share similar history of agriculture, and have been part of multiple unitary polities before.[3] Section 4.2 discusses the importance of this fact.

[1]For instance, Sri Lanka is an island and Bhutan is a mountainous land-locked country. Bangladesh is mostly the delta of Gangetic plains whereas Afghanistan is mostly a dry desert.

[2]Mizoram was part of Assam till 1972, and shares ethnic and economic similarity to the Eastern Divisions of Sylhet and Chittagong of Bangladesh

[3]The eastern part of the Gangetic plains were often unified under one polity.

The time period choices were dictated by data and the geographic choices are motivated by the size-able increase in FLFPR that Bangladesh experienced in recent decades. In contrast, FLFPR declined in India. Moreover, the focus on Bangladesh, and its neighboring Indian states reduces time-invariant regional differences that pose challenges to drawing conclusions since all states included.

We use Oaxaca-Blinder decomposition to investigate the diverging FLFPR trajectory in Bangladesh and selected Indian states. Results of Oaxaca-Blinder decompositions suggests that differences in coefficients are more influential in explaining the divergent FLFPR dynamics in Bangladesh and its neighboring Indian states regarding women's education, reproductive behavior, and measures of structural change. This implies that the association between changes in education, reproductive behavior, and economic conditions are qualitatively different in Bangladesh and its neighboring Indian states, and the underlying mechanisms of changes in women's employment were different too.

Particularly, we find that women's education reduced FLFPR in selected Indian state but increased the same in Bangladesh. We also find evidence suggesting that this is likely due to a stronger increase in women's education in Bangladesh relative to men's when compared to the neighboring Indian states. Our analysis also finds very weak evidence for increased urban and industrial employment of men creating labor market opportunities for rural women.

The rest of the chapter is organized as follows - section 4.2 discusses the literature, section 4.3 describes the data and empirical approach, section 4.4 presents and discusses the results, and section 4.5 concludes the paper.

4.2 Literature Review

The existing literature attempts to explain both the levels and dynamics of women's employment. Many of the factors that explain the differences in FLFPR

In ancient history of the Indian sub-continent, most of these regions were under Mauryan Empire, Gupta Empire, Pala empire, and to a more limited extent, the Greater Sena Empire. In medieval and early modern India, the Mughal Empire, the Bengal Subha, and the British East India company controlled these regions. Note that many of these polities including the Pala empire, the Greater Sena Empire, the Bengal Subha, and early incarnations of the British East India company were "regional" powers, indicating natural regional demarcations that includes these regions.

across different regions are rooted in deep historical and geographical factors of those regions. For instance, Hansen et al. (2015) finds that in a sample of European county, longer experience with agriculture is associated with reduced levels of contemporary women's employment. Their suggested mechanism is that increased agriculture increased fertility through income effect, which in turn led to women's specialization in home production.

Alesina et al. (2011, 2013) provides evidence that historical plough use helped shape gender norms surrounding fertility and women's employment. Particularly, their 2013 study suggests that historical plough use reduces women's relative productivity in agriculture, leading to lower FLFPR norms in countries with longer history of plough use. With similar mechanisms in mind, Fredriksson and Gupta (2023) suggest that historical irrigation is negatively associated with current FLFPR. Bolstering the same line of argument, Carranza (2014) finds that within India, loamy soil structure that allows for deeper tillage suppressed female labor demand historically and is associated with lower current FLFPR. Despite the potentially historically determined norms regarding women's employment, such norms can and do change (see Fogli and Veldkamp (2011) and Fernández (2013)).

The results of these historical agricultural pattern apply well to the case of Bangladesh and its neighboring Indian states. Considering that Bangladesh, and Tripura, Meghalaya, Assam, and West Bengal (all Indian states under study except Mizoram, previously under Assam) are part of the Gangetic plains, lower levels of FLFPR in these areas relative to rest of the world are in line with the predictions of the literature on FLFP.

Most of the studies examining the FLFPR dynamics explains changes as a result of three broad and often intertwined factors. First, is the role of fertility. Using historical and contemporary data from different sources, Aaronson et al. (2021) find that at lower levels of development, fertility and women's labor supply are unrelated. However, they also find a negative relationship between fertility and FLFPR at further stages of development. Using infertility shocks from 1990s data in Latin America, Aguero and Marks (2008) finds no fertility-FLFPR relationship. Using GDP per capita as a proxy for levels of development, the aforementioned studies suggest a null fertility-FLFPR relationship in our data of 1991-2011 Bangladesh and 1987-2009 neighboring Indian states.

A second set of literature focuses on the dynamics of development and FLFPR. Empirical work such as Goldin (1995) and theoretical models such as Rees and

Reizman (2012) posits that at initial stages of development, movement away from agriculture reduces FLFPR, and further along the path of development, increases FLFPR though reduction in fertility, increase in women's education, and structural change. However, Gaddis and Klasen (2014) finds no evidence that this a general pattern. Instead, they argue that the exact dynamics depends on the initial conditions of labor market. While some research finds that time use trends in developing regions, such as modern Africa, are similar to historical US experience (Dinkelman & Ngai, 2022), the evidence for a general relationship between development and FLFPR is limited.

The third string of literature suggests the specifics history and development process matter. For instance, Goldin and Olivetti (2013) and Rose (2018) find that increased employment opportunity for women through US men's mobilization in World War II, and increased factory work opportunities for war-time industrial production, led to a size able short-term increase in FLFPR. However, both of them find very limited long-term impact. In contrast, permanent shortage of men due to World War II casualties were associated with persistent increases in FLFPR in France (Boehnke & Gay, 2022). Additionally, studies such as Autor et al. (2013), Autor et al. (2019) and the first chapter of my dissertation highlights that changes in women-specific long-term employment opportunity due to trade changes FLFPR.

Focusing on the case of Bangladesh, the second chapter of this dissertation, as well as Heath and Mobarak (2015) find that the expansion of garment industry in Bangladesh have been a very important contributor to increases in FLFPR in Bangladesh. Despite a similar impetus and timing to liberalize in 1990s (Dev, 2000), the Indian states neighboring Bangladesh did not see emergence of a similarly large and female-biased industry.

Investigating the particular case of India, Afridi et al. (2018) find that the lower levels of FLFPR among married women in rural India is attributable to increased education of rural women that increased their relative returns to home production. Additionally, Tumbe (2015) provides evidence of increased FLFPR in Indian agriculture due to rural-urban migration of men for better paid work.

Taken together, the current literature does not allow us to hypothesize whether differences in observed covariates of fertility or different development processes explain the differences in evolution of FLFPR in Bangladesh and neighboring Indian states.

4.3 Empirical Approach and Data

4.3.1 Empirical Approach

We use the Oaxaca-Blinder decomposition method ((Oaxaca, 1973) and (Blinder, 1973)) to examine the diverging FLFP dynamics in Bangladesh and Indian states that border Bangladesh – i.e. Mizoram, Tripura, Meghalaya, Assam, and West Bengal.[4] The Oaxaca-Blinder decomposition first estimates the same regressions model for the two groups separately by using data from two groups separately. The estimated regression can be differenced to examine the contribution of a) differences in mean value of covariates and ii) differences in coefficients, in explaining the differences in outcome. We used the three-fold decomposition to ask how relevant are i) differences in the evolution of observed explanatory variables (endowments), and ii) differences in correlation between endowment and outcomes (coefficients) in explaining the diverging Bangladeshi and neighboring Indian States' experience.[5] The decomposition estimated takes the following form:

$$\bar{\Delta}Y_B - \bar{\Delta}Y_I = (\bar{\Delta}X_B - \bar{\Delta}X_I)'\hat{\beta}_I + \bar{\Delta}X_I'(\hat{\beta}_B - \hat{\beta}_I) + (\bar{\Delta}X_B - \bar{\Delta}X_I)'(\hat{\beta}_B - \hat{\beta}_I) \quad (4.1)$$

Where I denotes selected Indian states and B denotes Bangladesh. The left-hand side, $\bar{\Delta}Y_B - \bar{\Delta}Y_I$, measures the differences in yearly-$\Delta FLFP$ between selected Indian states and Bangladesh. This can be interpreted as the differences in trajectory of FLFPR in the two regions. $(\bar{\Delta}X_B - \bar{\Delta}X_I)$ is the differences in the trajectories of covariates. Hence, the term $(\bar{\Delta}X_B - \bar{\Delta}X_I)'\hat{\beta}_I$ estimates how much of the difference can be attributed to the changes in covariates if both countries had the Indian $\hat{\beta}_I$ coefficients. The term $\bar{\Delta}X_I'(\hat{\beta}_B - \hat{\beta}_I)$ measures the effect of having different coefficients if both regions had the Indian covariate trajectories. The remaining term provides us the interaction effect and does not have a clear interpretation in this analysis. We incrementally add covariates of interest in the same specification above.

Following the literature and descriptive analysis in Section 4.3.3, the first decomposition analysis *(Decomposition 1)* examines the influence of differences in human capital accumulation trajectories of both men and women (measured with

[4]The R package 'oaxaca' (Hlavac, 2022) was used for computation.

[5]Two-fold decomposition assumes that there exists a set of natural correlations between outcome and explanatory variables, and hence not used in this analysis

Yrs. of Schooling) on the divergence in FLFPR in Bangladesh and neighboring Indian states. Influence of both men's and women's education is tested. In both countries, younger women are likelier to be employed. We account for this by using share of 15-39 year old in the district population as a covariate. In addition, we also test the influence of changes in education levels of women relative to men ($\Delta\frac{YrsofEduc_F}{YrsofEduc_M}$).

The second decomposition analysis *(Decomposition 2)* examines the influence of differences in the trajectory of observed reproductive behavior measured with marriage rate (Δ % Married), and rate of having under five children (Δ% With U-5 Child) at home, after controlling for human capital accumulation and age structure.[6]

In the third decomposition analysis *(Decomposition 3)*, we examine whether structural changes were an important driver of the divergent FLFPR trajectory between Bangladesh and the selected Indian states. This is done in two steps. First, the we examine the effects of changes in two proxy measures of structural change – (i) district level urbanization, and (ii) share of men working in the industrial sector, on the divergence in FLFPR between Bangladesh and selected Indian states. This analysis is considered as the baseline decomposition specification as it contains all available covariates typically used in decompositions.

Second, we then examine whether industrialization affected FLFPR differently in rural versus urban areas of Bangladesh and neighboring Indian states. In all specifications, educational attainment and reproductive behavior variables are controlled for. In the specifications investigating the rural and urban FLFPR changes, we use ratio of F/M of working age population as a measure of competition from men in the rural labor market; and use changes in share of men working in industry in the urban area of the district as proxy for industrialization and men's "pull factor".

Standard errors in decomposition are estimated non-parametric bootstrap methods from Efron (1979).

[6]The Bangladeshi data does not allow us to construct reliable completed fertility rates.

4.3.2 Data Sources

Data for the outcome and control variables are obtained by aggregating micro-data to district levels.[7] The Bangladeshi micro-data comes from the Census 1991, 2001, and 2011 sub-samples from Minnesota Population Center (2020). Micro-data for Indian states neighboring Bangladesh comes from the Socio-Economic Survey, Household Schedule 10: Employment and Unemployment conducted by the National Sample Survey Organization, Government of India from Minnesota Population Center (2023); referred to as NSS surveys hereafter. The 1987, 1991, 2004, and 2009 waves of the NSS surveys are used since they have district identifiers.

In the case of Bangladesh, estimates of outcome and control variables are obtained for all 60 districts with harmonized boundaries for 1991, 2001, and 2011. As its Indian counterpart, Indian states of Mizoram, Tripura, Meghalaya, Assam, and West Bengal are chosen as they share geographic boundaries, geographic similarities, cultural and historical similarities with Bangladesh. Estimates of outcome and control variables are obtained for 42 districts from the five Indian states for 1987, 1991, 2004, and 2009. The NSS surveys have a much richer occupational classification. The analysis is limited to broader categories of Agriculture, Industry, and Service as these are the only occupational classifications available in the 2011 Bangladeshi census. Appendix B describes the construction of key FLFPR and education variables.

Given the variation in lengths of periods between the Bangladeshi census and the Indian NSS surveys, and the variation in lengths of periods within different waves of Indian NSS surveys, differences in outcome and control variables are expressed in yearly changes throughout the analysis unless stated otherwise.

4.3.3 Descriptive Statistics

Table 4.1 and Table 4.2 present the gender-specific overall, industrial, and agricultural labor force participation rate.[8] Towards the beginning of the study pe-

[7]Aggregation to a finer geographic unit is possible for Bangladesh, but not for the Indian states neighboring Bangladesh.

[8]The overall FLFPR measure differs significantly from ILO-based estimates presented in 4.1. For example, the 1991 Bangladeshi FLFPR was 6.61 percent in the census-based estimate, whereas ILO estimate obtained from The World Bank

riod, the male labor force participation rate (MLFPR) were similar in Bangladesh (88.05% in 1991) and neighboring Indian States (86.38% in 1987). That similarity has persisted towards the end as well (83.26% in 2011 in Bangladesh, 85.98% in 2009 in neighboring Indian states). Looking at finer details, the industrial MLFPR was lower in Bangladesh, and has been increasing. The industrial MLFPR in neighboring Indian states also increased over similar periods. Both regions experienced a decline in MLFPR in agriculture. This suggests a shift of male workers from the agricultural sector to the industrial sector.

The FLFPR in Bangladesh was one of the lowest in the world in 1991 (6.61%), and much lower than neighboring Indian states in 1987 (17.19%). Roughly over the next two decades, Bangladesh gained 2.91 percentage point (pp) in FLFP, while neighboring Indian states experienced a decline of 0.65 pp. Similarly, the industrial FLFPR increased in Bangladesh whereas it reduced in neighboring Indian states.

Since both FLFPR and agricultural-FLFPR have the same base in my estimates, the importance of agriculture can be measured by $(\Delta FLFPR : Agr)/(\Delta FLFPR)$. Using this metric, roughly 60% of the increase in FLFPR in Indian states between 1987-2004 were increases in FLFPR in agriculture. In later years, 55% of the decline afterwards are accounted for by the decline in agricultural FLFPR. In Bangladesh, almost 100% of the increase in FLFPR between 1991-2001 is due to increase in agricultural FLFPR. However, between 2001-2011 agriculture becomes much less important, losing about 4 percentage point (pp) while FLFPR declined by about 2 percentage point.

Table 4.3 and Table 4.4 shows the levels and changes in schooling, children at home, share of population aged 15-39, and marriage rates of women. Women in India appear to have higher education, and remain more educated in our sample period. The fertility decline is perhaps stronger in Bangladesh. The share of population 15-39 year old was lower in Bangladesh but rapidly catching up. Both geographic units have similar F/M ratio and the changes in F/M are negligible considering the regions as a whole. Moreover, Bangladesh has urbanized slightly more as well.

(2021) puts it closer to 25 percent. There are two key sources of this difference. First, given the data availability, we do not make adjustments for factors such as institutionalized persons. Second, ILO estimates statistically re-adjusts the numbers to include proportion of women who are looking for work at much longer horizons than what the census asks.

Taken together, the descriptive statistics suggest that periods of increases in FLFPR and agricultural-FLFPR seem to coincide with declining male participation in agriculture in both the regions. In addition to examining the influence of available covariates discussed in 4.3.1, we also investigate whether male-out migration pattern of India explains the concentrated relationship between F/M and FLFPR in India.

4.4 Empirical Findings

4.4.1 Cross-sectional Correlates

Table 4.5 presents results of regressions of available covariates on FLFPR in Bangladesh in 1991 and 2011, and in the selected Indian states in 1987 and 2009. Overall, the regressions do not reveal any strong and systematic correlation between FLFPR and the covariates in Bangladesh or Indian states neighboring Bangladesh. It is interesting to note that the correlations do not change systematically despite liberalization of both economies in the early 1990s (Dev, 2000).

In the Bangladeshi data, district level increases in urbanization rate appear to become a statistically and economically relevant correlate in 2011. On the other hand, years of schooling (F), share of 15-39 year old in population, share of women with young children appear to be at home, and local labor market conditions as measured by MLFPR, appears to be uncorrelated with FLFPR. However, F/M is negatively correlated with FLFPR in Bangladeshi districts in both 1991 and 2011.

In the data for selected Indian states, urbanization rate, share of 15-39 year olds in population and F/M is correlated with the FLFPR in both 1987 and 2009. However, years of schooling and share of women with under 5 children at home are positively correlated in the 2009 data, and MLFPR is weakly negatively correlated in the 2009 data.

Taken together, the simple correlations point to the possibility that differences in coefficients are likely important, suggesting different underlying process related to evolution of FLFPR in Bangladesh and neighboring Indian states.

4.4.2 Decomposition results: Human capital and reproductive behavior

Table 4.6 presents results of Decomposition 1 – decompositions using only education and age structure variables . The left-hand side is $\overline{\Delta FLFPR_B} - \overline{\Delta FPFPR_I}$, i.e. the differences in trajectories of FLFPR between Bangladesh and neighboring Indian states. Decomposition analysis 1 shows that differences in trajectories of female and male years of schooling are an important source of divergence in women's employment in the two regions after controlling for changing age structure.

In specification 1, both men's and women's years of education is used as relevant human capital variables. While differences in covariates are statistically important, the effect is dominated by differences in coefficients (see Figure 4.3). Individually, none of the differences in age structure, and gender specific schooling changes has independent explanatory power. However, at the mean levels of changes in India, the coefficients as a whole and individually are statistically significant. Particularly, increases in women's education reduces the gap between the countries whereas increases in share of 15-39 year old and men's education opened up the gap in FLFPR rate trajectories.

In specification 2, we include changes in the ratio of women's to men's education. The relative importance of endowment differences increase substantially. Moreover, figure 4.4 shows that differences increased women's education relative to men has a statistically significant explanatory power. When coefficients are considered, the estimates are nosier, likely due to correlation between changes in men's and women's education and their relative education. However, the sign of the effect remains the same compared to specification 1. Together, results, of specification 1 and 2 suggests that changes in women's in education had different effects on FLFPR in Bangladesh and in its neighboring Indian states, and that these differences are moderated by differences in women's education relative to men.

Specification 3 includes share of women that are married, and share of women with under five children in specification 1. Taken together, the results in Table 4.5 and Figure 4.5 does not change any of the qualitative findings from specification 1. Differences in trajectories of marriage rates, and rates of having under 5 children does not add to the explanation of the diverging trajectory of FLFPRs in Bangladesh and selected Indian states.

4.4.3 Decomposition results: Structural Change

Decomposition 3 is aimed investigating the role of structural change in explaining the divergence of FLFPR trajectories in Bangladesh and selected Indian states. Specification 4 focuses on both rural and urban data combined, and uses changes in urbanization rate, and changes in share of men working in industry in the district as proxy for industrialization. Since the estimating regression covers the entirety of both regions, and includes covariates of all sources of divergence we are considering, this specification is our baseline.

Table 4.8 and Figure 4.6 presets results for specification 4. First, the effect of differences in coefficients is statistically significant, whereas effect of covariate differences is not. Moreover, neither of the structural change variable appear to be statistically important. Both the coefficient and endowment term of the share of men in industrial activity seem to be positive, but not statistically significant.

In both regions, industrial work accounts for very little of employment and agriculture is the dominant source of employment. Additionally, the descriptive statistics point towards a faster rate of industrialization in Bangladesh in this period of time. Hence, in specification 5, we test a mechanism where more men leave the rural areas to gain employment in urban industrial sector of the same district, thereby making it easier for women to enter the rural agricultural workforce.[9] We do so by including changes in share of men in industry in the urban region of the district as a control, and using F/M ratio as a measure of relative abundance of working age women relative to men in a district.

Table 4.8 and Figure 4.7 presents results of specification 5. The results indicate a similar picture where coefficient effects are dominant, particularly for education related variables. However, increases in F/M appear to be a positive, but statistically insignificant contributor to FLFPR in rural areas of Bangladesh.

Specification 6 results are presented in 4.8 and 4.8, and shows that the models do not have a strong explanatory power in explaining the relatively minor divergence in urban FLFPR trajectories between Bangladesh and selected Indian states.

The differences in trajectory of FLFPR in Bangladesh and its neighboring Indian states in the decades of 1990s and 2000s appear to be driven by how changes in education relates to FLFPR in those regions. Increases in women's education affected Bangladeshi FLFPR positively, but it affects FLFPR negatively in the selected Indian states. Results from specification 2 suggests that the greater increase in relative education of women may have made it easier for Bangladeshi FLFPR to

[9]This is a limitation since industrial employment is typically concentrated in Dhaka-Chittagong corridor of Bangladesh. Industrialization rate of a few districts may be more relevant in the Bangladeshi case.

start catching up to the selected Indian states. Additionally, there is very weak evidence that industrialization helped increase FLFPR relatively more in Bangladesh, particularly in farm-employment by nicreasing relative abundance of women in rural areas of Bangladesh.

The results for Indian states, despite being surprising from a theoretical point of view, are in line with the FLFPR literature of rural India. Afridi et al. (2018) used decomposition analysis to show that between 1987-1999, almost all of the reduction in FLFPR of rural married women in India is attributable to changes in household and demographic characteristics. Similarly, most of the reduction in FLFPR in 1999-2011 is also attributable to the same changes. Afridi et al. (2018) posits that these changes resulted from an increased education of rural women that increased their relative returns to home production. Unfortunately, the previous literature for Bangladesh is limited.

In a limited capacity, the findings are also consistent with Tumbe (2015) who provide evidence that men's rural-urban out-migration for employment lead to women's entry in the labor force in India. The Bangladeshi findings are also broadly consistent with the descriptive statistics showing an waning importance of agriculture in Bangladeshi women's employment, and with related literature documenting the emergence of a large and critical "women employing" garment sector (see chapter 2 and Heath and Mobarak (2015)).

4.5 Discussion and Conclusion

Bangladesh, and Indian states neighboring Bangladesh – Mizoram, Tripura, Meghalaya, Assam, and West Bengal; experienced rapid increases in FLFPR in 1990s. Between 1991-2011, Bangladeshi FLFPR increased by about 4.56 percentage point. Between 1987-1999, the number for the selected Indian sates is 5.04 (see Table 4.1. Most of these increases were from participation into agriculture. Since then, Bangladeshi women has increased their industrial FLFPR despite a drop in overall and agricultural FLFPR. In the selected neighboring states of India, the drop was not accompanied by increased in FLFPR.

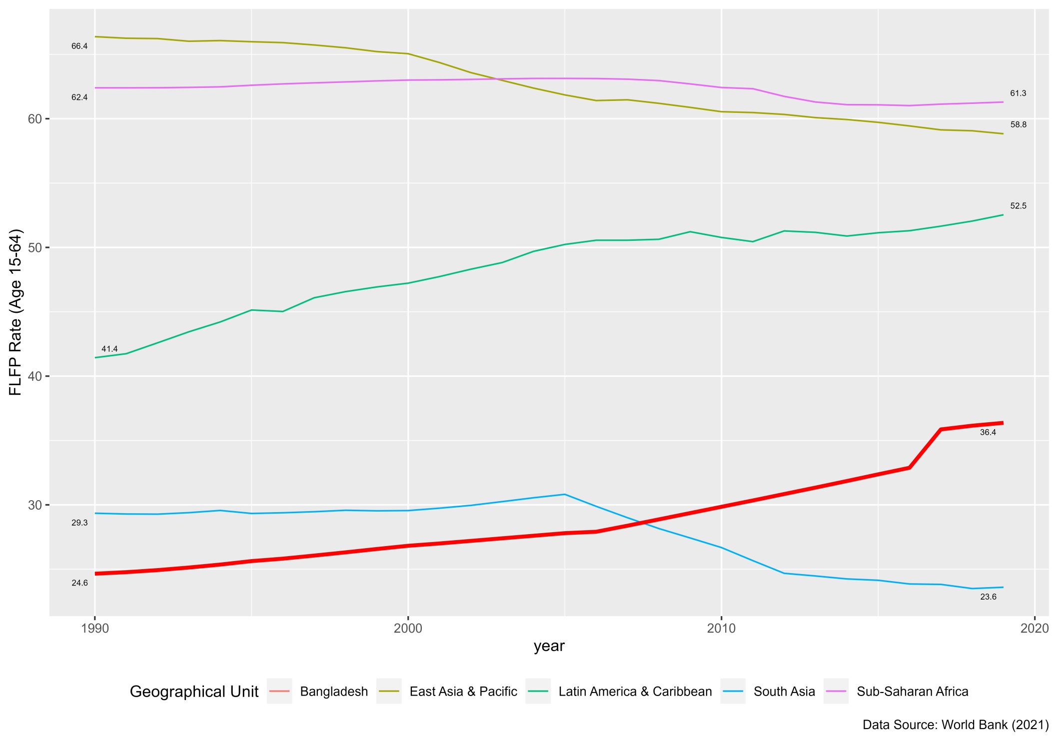
This paper attempts to identify the drivers of this divergence by using Oaxaca-Blinder decompositions. The results paint a picture of two similar regions with different underlying process of changes in FLFPR. When influence of schooling, reproductive behavior, and structural change is considered, the results indicate that differences in women's education relative to men's is associated with increased FLFPR in Bangladesh relative to the selected Indian states. Reductions in pro-marriage and pro-natal behavior does not appear to be important.

The decomposition analysis also focused on one particular channel. Tumbe (2015) shows the importance of out-migration of men in engendering FLFPR agriculture in India. We included changes in F/M, the only available proxy to capture effect of male out-migration, in the analysis. We find that differences in trajectories of $\Delta(F/M)$ and associated coefficients are weakly associated with the diverging FLFPR between Bangladesh and its neighboring Indian states in the cases of overall FLFPR, agricultural-FLFPR in rural areas, but not in the case of industrial FLFPR.

When placing this findings in context of the overall literature the key conclusion is that the underlying processes of changes in FLFPR in Bangladesh between 1991-2011 and the selected Indian states between 1987-2009 are different. Increases in FLFPR is positively associated with women's education in Bangladesh, but not in the case of Indian states. This is likely due to an increase in the relative level of education of women compared to men in Bangladesh. On the other hand, FLFPR is unrelated with reproductive choices. These findings are in-line with agriculture being the primary employer of women in both regions. It appears that although the initial increase in women's employment is due to agriculture, faster changes in non-farm employment of men in urban areas of Bangladesh may have played a role as some men exited the rural labor market.

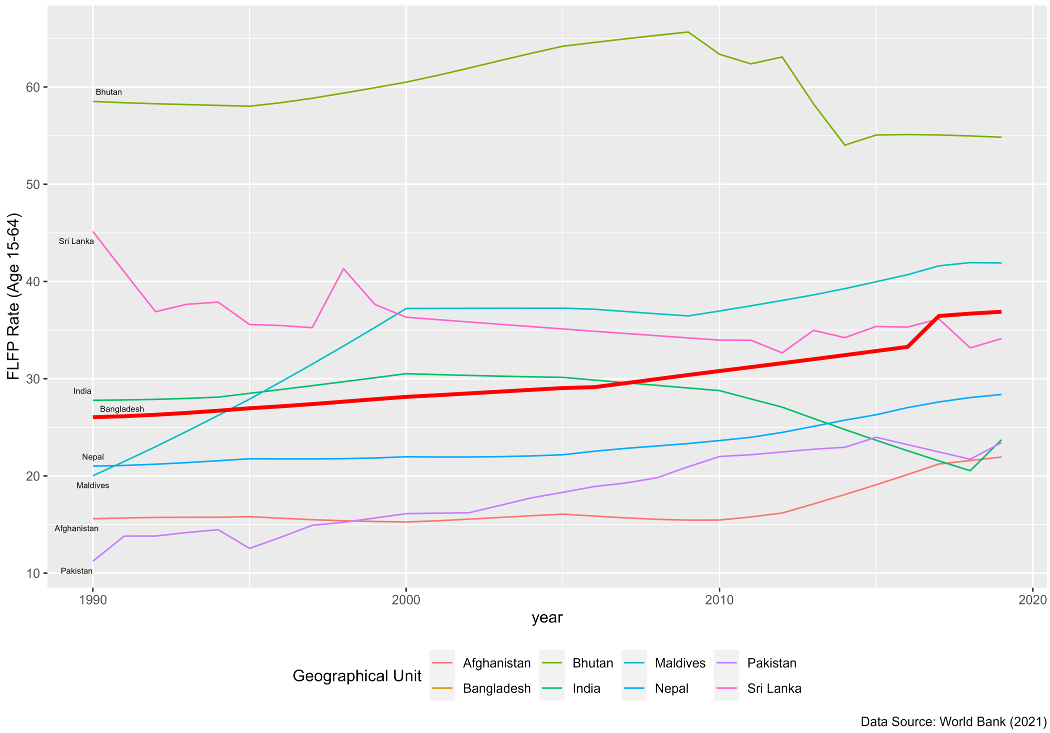
4.6 Figures

Figure 4.1. Female Labor Force Participation in Bangladesh and Elsewhere (1990:2019)



Note: Bangladesh had one of the lowest FLFPR rate in 1990 among developing regions. While most other developing regions saw its FLFPR decline over 1990-2019, Bangladesh's FLFPR increased. Notably, FLFPR of Bangladesh's neighbors in South Asia decreased overall. *Data source: (The World Bank, 2021)* .

Figure 4.2. Female Labor Force Participation in South Asia (1990:2019)



Note: Within South Asia, countries with a high level of FLFPR in 1990 experienced a decline, and the reverse was true for countries with relatively lower FLFPR in 1990, including Bangladesh. It is also interesting to note that Bangladeshi FLFPR was the highest in Muslim-majority South Asian countries in 1990, and in keeping in line with other Muslim-majority countries in South Asia, experienced an increase in FLFPR since 1991. *Data source: (The World Bank, 2021)* .

Figure 4.3. Potential Sources of Divergence in FLFPR Trajectory of Bangladesh and Neighboring Indian States (1987-2011): Education

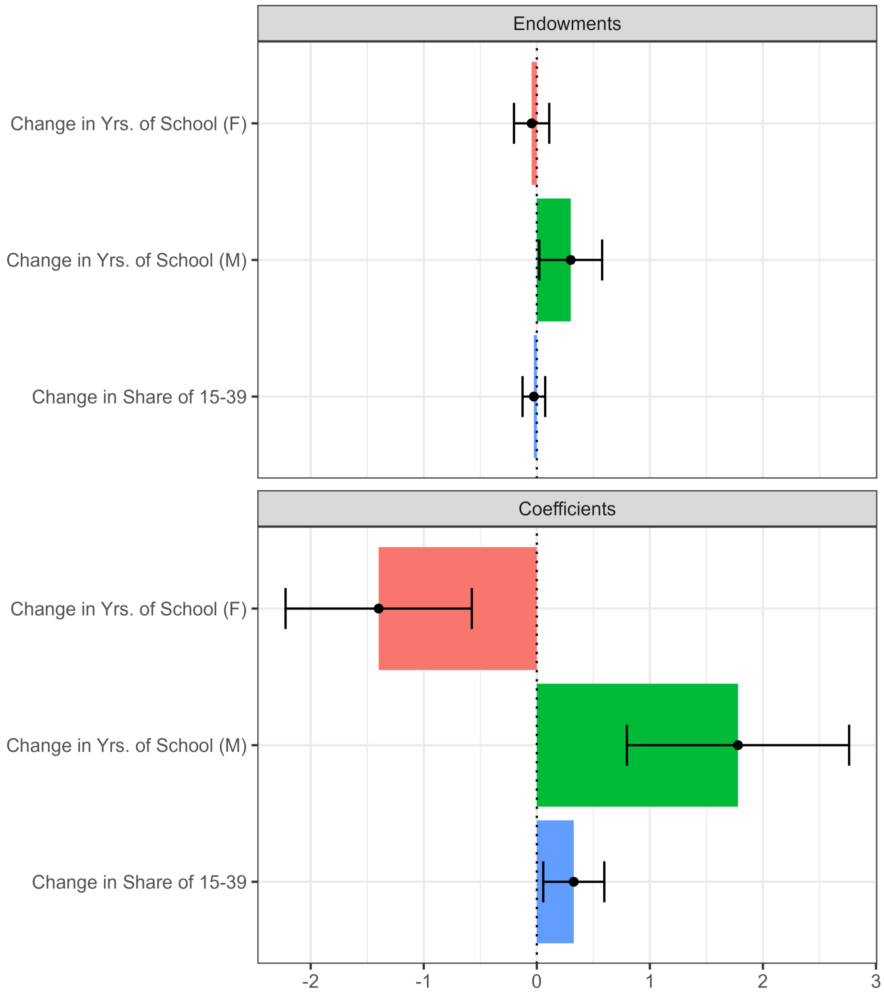


Figure 4.4. Potential Sources of Divergence in FLFPR Trajectory of Bangladesh and Neighboring Indian States (1987-2011): Relative Education of Women

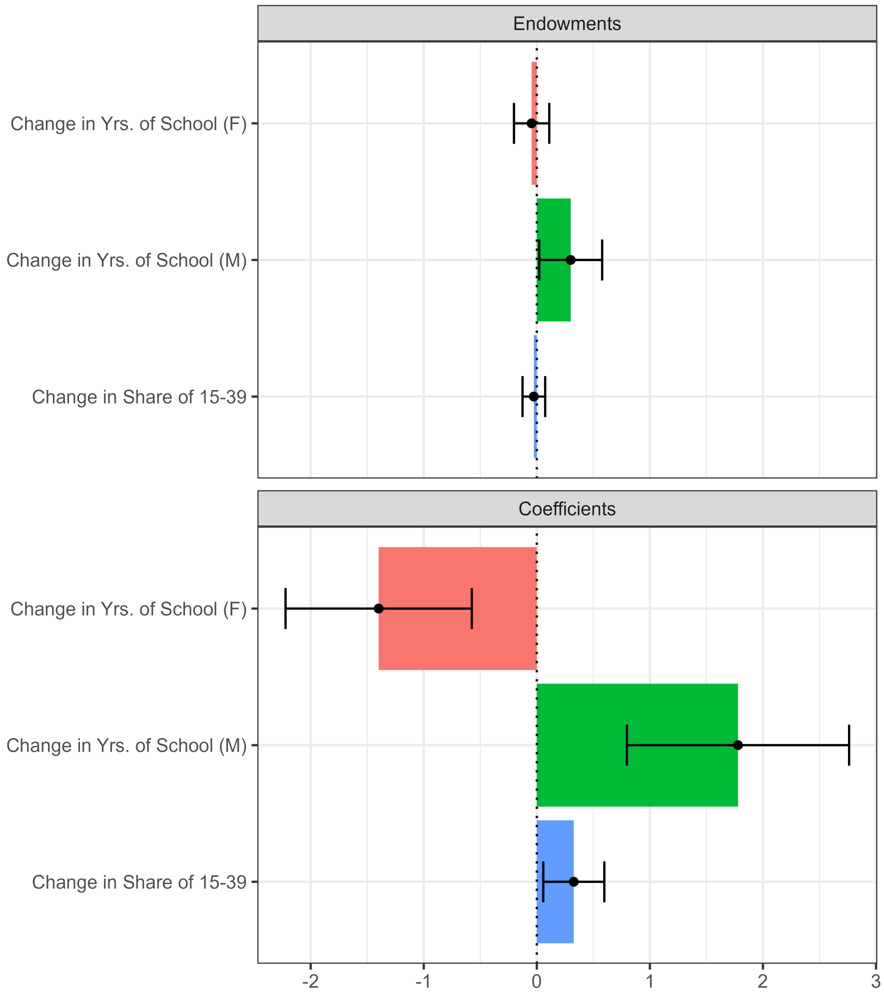


Figure 4.5. Potential Sources of Divergence in FLFPR Trajectory of Bangladesh and Neighboring Indian States (1987-2011): Education and Reproductive Behavior

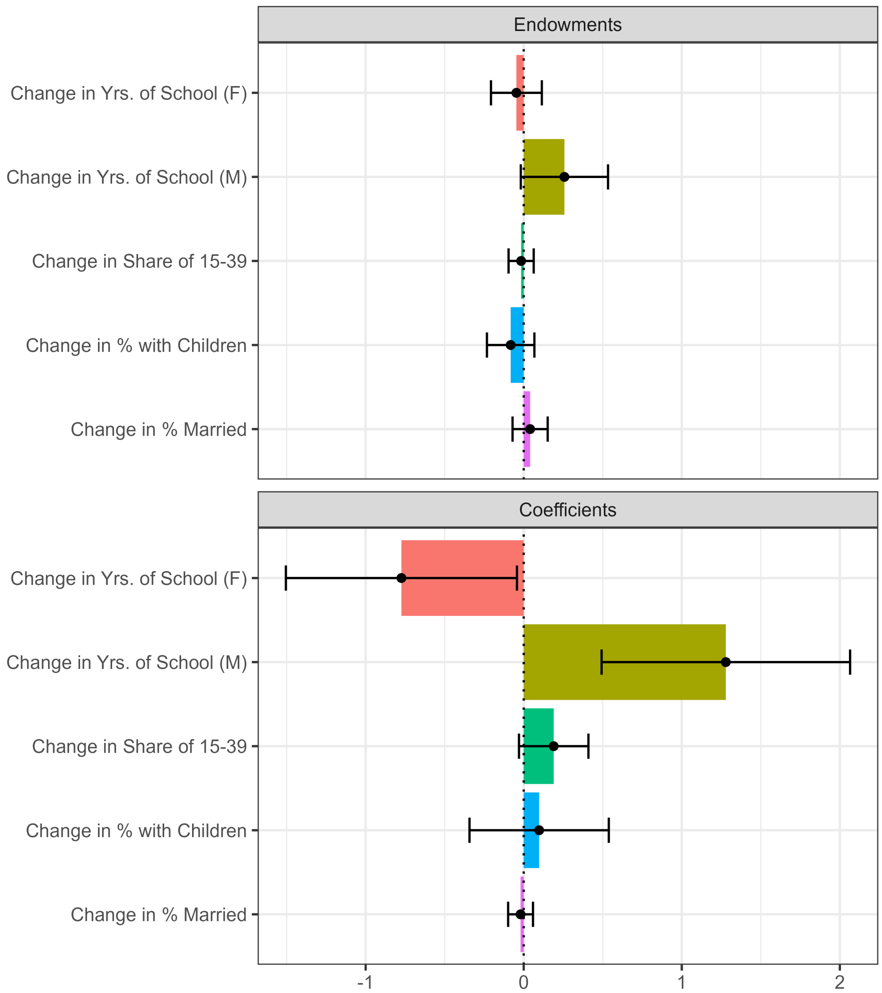


Figure 4.6. Potential Sources of Divergence in FLFPR Trajectory of Bangladesh and Neighboring Indian States (1987-2011): Education, Reproductive Behavior, and Structural Change

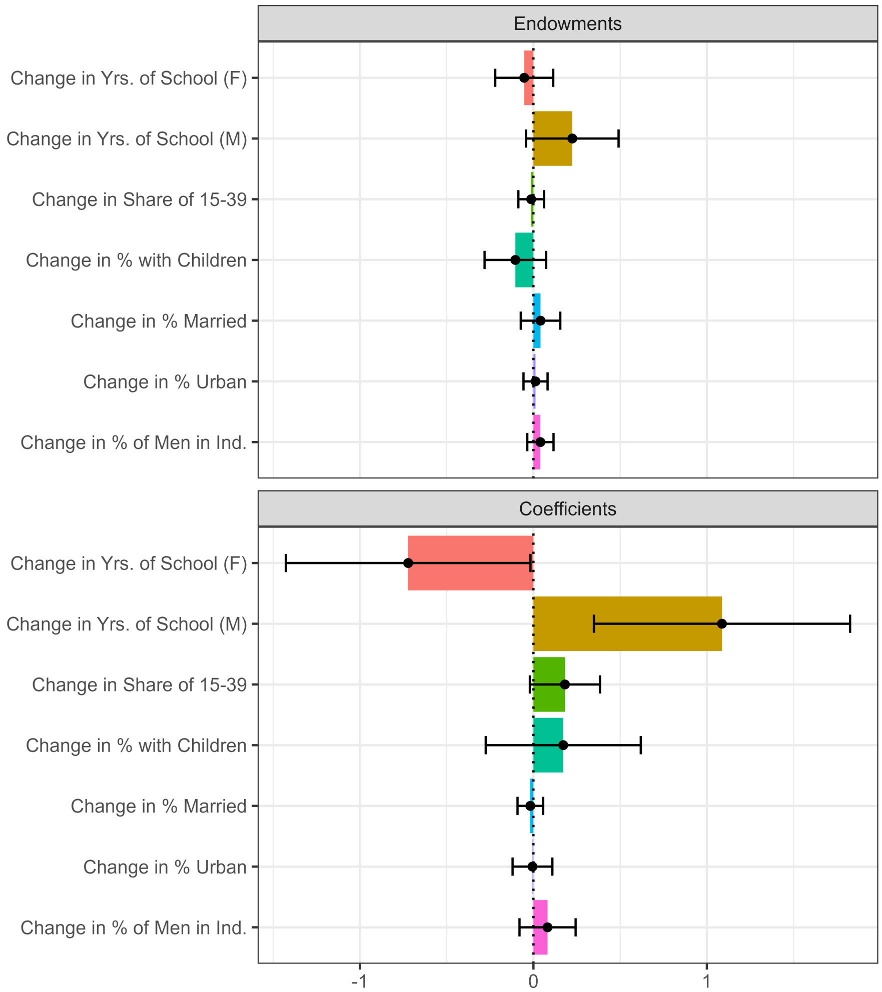


Figure 4.7. Potential Sources of Divergence in Rural FLFPR Trajectory of Bangladesh and Neighboring Indian States (1987-2011): Education, Reproductive Behavior, and Structural Change

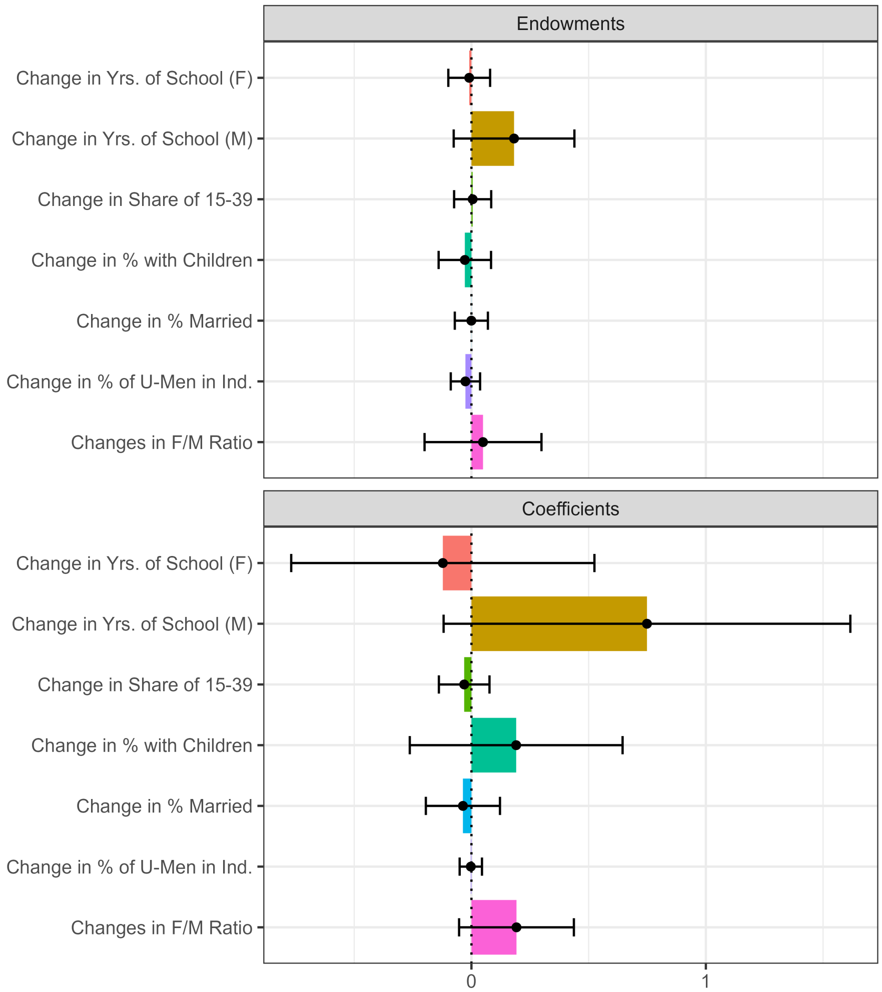
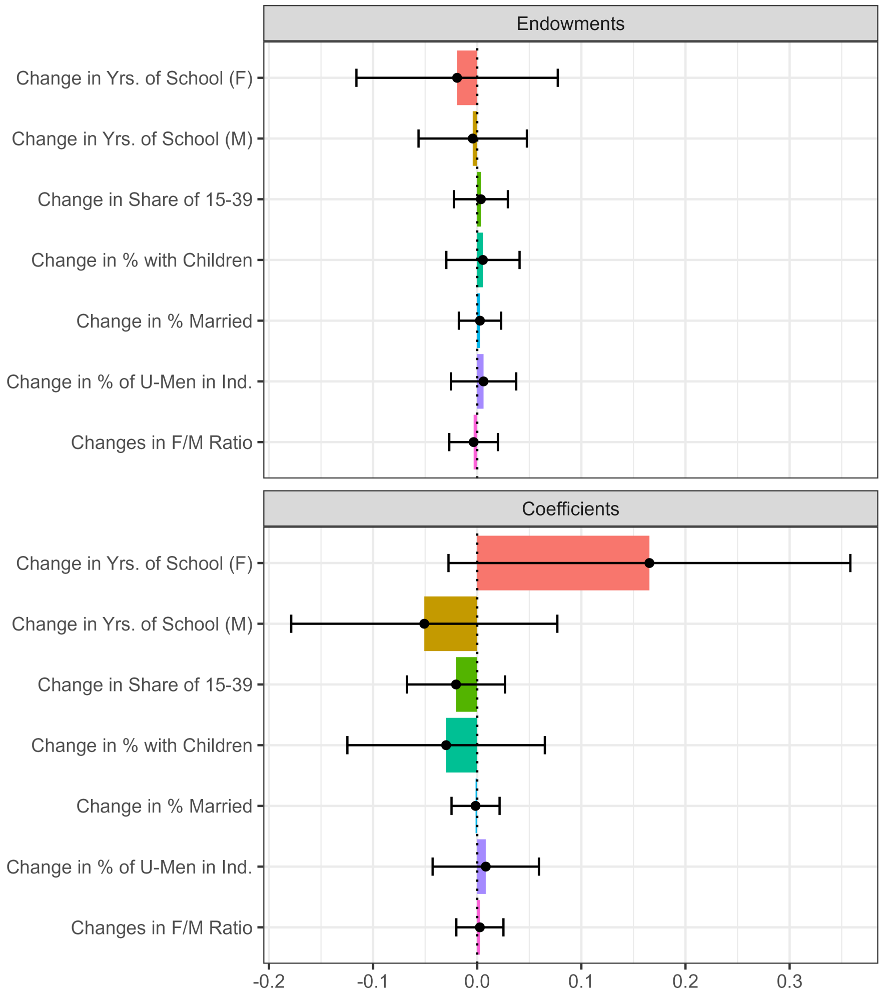


Figure 4.8. Potential Sources of Divergence in Urban FLFPR Trajectory of Bangladesh and Neighboring Indian States (1987-2011): Education, Reproductive Behavior, and Structural Change



4.7 Tables

Table 4.1. Labor Force Participation (Overall and Industry-wise) in Bangladesh and Selected Indian States

Geographic Unit	Year	FLFPR	FLFPR-Ind	FLFPR-Agr	MFLPR	MFLPR-Ind	MFLPR-Agr
Bangladesh	1991	6.61	0.59	1.16	88.05	4.13	49.09
Bangladesh	2001	11.17	0.75	5.74	77.98	4.35	39.25
Bangladesh	2011	9.02	2.54	1.3	83.26	10.59	41.02
Indian States[1]	1987	17.19	3.57	7.65	86.38	13.4	45.38
Indian States	1999	22.23	4.64	10.28	86.22	12.49	41.32
Indian States	2004	24.79	5.69	12.08	86.61	13.97	40.93
Indian States	2009	16.54	3.41	7.52	85.98	16.49	40.68

[1]Mizoram, Tripura, Meghalaya, Assam, and West Bengal

Table 4.2. Yearly Changes in Labor Force Participation (Overall and Industry-wise) Rates in Bangladesh and Selected Indian States in PP terms

Geographic Unit	Period	ΔFLFPR	ΔFLFPR-Agr	ΔFLFPR-Ind	ΔMFLPR	ΔMLFPR-Ind	ΔMLFPR-Agr
Bangladesh	1991-2001	0.44	0.46	0.01	-1	0.01	-0.90
Bangladesh	2001-2011	-0.24	-0.44	0.17	0.53	0.60	0.26
Indian States[1]	1987-1999	0.42	0.22	0.08	-0.03	-0.02	-0.45
Indian States	1999-2004	0.66	0.32	0.25	0.09	0.28	-0.16
Indian States	2004-2009	-1.69	-1.01	-0.39	-0.11	0.57	-0.13

[1]Mizoram, Tripura, Meghalaya, Assam, and West Bengal

Table 4.3. Demographic Conditions in Bangladesh and Selected Indian States

Geographic Unit	Year	Yrs of School (F)	F/M Ratio	% With U-5 child	%15-39 Years Old	% Married (F)	% Urban
Bangladesh	1991	1.83	0.94	41.86	37.02	80.06	19.46
Bangladesh	2001	3.25	0.94	32.86	40.79	76.86	23.51
Bangladesh	2011	4.38	1	26.9	41.46	79.46	23.32
Indian States[1]	1987	2.87	0.92	31.89	41.48	71.28	20.6
Indian States	1999	4.12	0.94	26.08	42.42	73.41	19.23
Indian States	2004	4.63	0.94	23.63	42.89	74.33	21.17
Indian States	2009	5.5	0.91	19.81	44.21	74.14	20.9

[1]Mizoram, Tripura, Meghalaya, Assam, and West Bengal

Table 4.4. Yearly Changes in Demographic Conditions in Bangladesh and Selected Indian States

Geographic Unit	Year	Years of School (F)	F/M Ratio	% with U-5 child (pp)	% 15-39 Years Old	% Married (F) (pp)	% Urban (pp)
Bangladesh	1991-2001	0.1391	0.0001	-0.8875	0.0036	-0.3109	0.2838
Bangladesh	2001-2011	0.1101	0.0061	-0.5847	4e-04	0.2825	-0.1749
Indian States[1]	1987-1999	0.1135	0.0017	-0.5041	8e-04	0.1645	0.0431
Indian States	1999-2004	0.0885	0.001	-0.3644	7e-04	0.2336	0.2726
Indian States	2004-2009	0.17	-0.0064	-0.7482	0.0026	0.0124	0.0586

[1]Mizoram, Tripura, Meghalaya, Assam, and West Bengal

Table 4.5. Cross-sectional Correlates of FLFPR in Districts of Bangladesh and Selected Indian States[1]

	Dependent variable:			
	FLFP			
	Bangladesh 1991	Bangladesh 2011	India 1987	India 2009
	(1)	(2)	(3)	(4)
% of Population in Urban Areas	0.022	0.244***	−0.262	−0.086
	(0.037)	(0.063)	(0.262)	(0.137)
Avg. Years of Schooling (F)	−0.002	−0.0003	0.043	0.061***
	(0.009)	(0.009)	(0.040)	(0.014)
% 15-39 years Old	−0.119	−0.112	−0.877	0.333
	(0.213)	(0.289)	(1.771)	(0.693)
% With U-5 Child	0.010	0.216	−0.097	1.337***
	(0.118)	(0.193)	(0.796)	(0.477)
MLFPR	−0.051	−0.137	0.372	−1.695**
	(0.174)	(0.211)	(1.372)	(0.674)
F/M Ratio	−0.461***	−0.503***	0.489	−0.158
	(0.101)	(0.148)	(0.534)	(0.231)
Observations	60	60	37	37
R^2	0.548	0.668	0.090	0.603
Adjusted R^2	0.497	0.631	−0.092	0.524
Note:				*p<0.1; **p<0.05; ***p<0.01

Notes: No strong correlation of the observed covariates and FLFP. The one exception is the F/M ratio.

Table 4.6. Influence of Human Capital Endowment and Coefficient Differences in Explaining the Divergent Trajectory of FLFPR in Bangladesh and Neighboring Indian States

		Specification 1	Specification 2
Yearly	Endowment	0.228***	0.725***
$\Delta(\Delta FLFPR)$	SE (Endowment)	(0.114)	(0.174)
= 0.370	Coefficient	0.708***	0.408***
in pp terms	SE (Coefficient)	(0.305)	(0.280)
Note:		*p<0.1; **p<0.05; ***p<0.01	

Specification 1 uses changes in male and female years of schooling, and share of population 15-39 as the explanatory variables.

Specification 2 adds changes in female years of schooling over male years of schooling as an additional variable.

Table 4.7. Influence of Reproductive Behavior and Human Capital Endowment and Coefficient Differences in Explaining the Divergent Trajectory of FLFPR in Bangladesh and Neighboring Indian States

		Specification 3
Yearly	Endowment	0.153
$\Delta(\Delta FLFPR)$	SE (Endowment)	(0.134)
= 0.370	Coefficient	0.772***
in pp terms	SE (Coefficient)	(0.297)

Note:
*p<0.1; **p<0.05; ***p<0.01

Specification 3 includes share of women married, and share of women with under five children in specification 1

Table 4.8. Influence of Differences in Urbanization and Industrialization in Explaining the Divergent Trajectory of Key FLFPR Sub-categories in Bangladesh and Neighboring Indian States

	Specification 4	Specification 5	Specification 6
	Yearly $\Delta(\Delta$FLFP$)$	Yearly $\Delta(\Delta$FLFP:Agr$)$	Yearly $\Delta(\Delta$FLFP:Ind$)$
	0.370 pp	0.364 pp	0.076 pp
Endowment	0.147	0.172	-0.009
SE (Endowment)	(0.148)	(0.174)	(0.045)
Coefficient	0.776***	0.939***	0.073
SE (Coefficient)	(0.277)	(0.308)	(0.066)

Note: *p<0.1; **p<0.05; ***p<0.01

Specification 4 includes changes in urbanization rate, and changes in share of men working in industry in the district as proxy for industrialization.

Specification 5 focuses on agricultural FLFP in rural areas. In addition to variables in specification 3, it also includes changes in share of men working in industry in the urban area of the district as proxy for industrialization and men's "pull factor", and changes in ratio of F/M as a measure of competition from men in rural labor market.

Specification 6 focuses on industrial FLFP in urban areas. In addition to variables in specification 3, it also includes changes in share of men working in industry in the urban area of the district as proxy for industrialization and men's "pull factor", as a measure of competition from men in the labor market.

CHAPTER 5

DISSERTATION CONCLUSION

Bangladesh has been undergoing a rapid fertility and FLFP transition since the 1970s and 1990s respectively. The three chapters in this dissertation aims to add to our understanding of the changes in fertility and women's employment through the lens of structural changes through industrialization and evolving rural economic conditions.

In chapter two, I examine the effect of women-favoring industrialization on women's employment, reproductive, and human capital accumulation behavior. I ameliorate some of the concerns related to unobserved location characteristics that may influence the outcome variables by exploiting a combination of spatial variation in RMG product specialization across regions, and temporal variation in product exports to estimate the FLFP, fertility and education response to female labor demand shocks. I find evidence of increases in FLFP, and a small reduction in fertility. However, I find no effect on school enrollment of girls.

In chapter three, I analyze the spatiotemporal variation in the fertility transition in Bangladesh. I begin with a systematic documentation of the fertility transition in different regions of Bangladesh since 1950s using birth histories. I document that the fertility transition begun in urban areas with the 1941-45 birth cohort, and soon in rural areas in the 1945-51 birth cohort. Descriptive analysis suggests that women's education and agricultural land constraint could have been important drivers of the transition. Using a difference in difference approach, I find that rural land constraints have not directly affected fertility transitions, but may have played an important role through income effect of increased labor supply in rural labor market.

The analysis in Chapter four suggests that in India, increased women's education reduces women's economic activity but the reverse is true in Bangladesh. I present evidence weakly suggesting that women's education relative to men's have increased more in Bangladesh, contributing to the difference in women's employment trajectory.

Taken together, this dissertation finds evidence in favor of parts of mechanism of industrialization leading to fertility and FLFP transition. Keeping in line with the literature, differences in FLFPR trajectory appear to be very context depended. In addition, it also finds limited evidence suggesting the role of rural economic conditions through land availability as an originator of rural transition.

APPENDIX A

COMPLETED FERTILITY ESTIMATES

Cohort Fertility Transition in Bangladesh

Cohort Start Year	**10-14**	**15-19**	**20-24**	**25-29**	**30-34**	**35-39**	**40-44**	**45-49**	**Completed Fertility**
1926	0.23	1.18	1.48	1.36	1.21	0.94	0.35	0.07	6.81
1931	0.24	1.27	1.59	1.51	1.41	0.88	0.35	0.07	7.30
1936	0.26	1.38	1.67	1.76	1.35	0.68	0.35	0.07	7.51
1941	0.28	1.46	1.77	1.54	1.06	0.95	0.41	0.08	7.56
1946	0.23	1.48	1.69	1.36	1.13	0.69	0.20	0.04	6.82
1951	0.22	1.40	1.53	1.35	0.94	0.46	0.13	0.03	6.05
1956	0.20	1.21	1.41	1.18	0.71	0.32	0.10	0.01	5.14
1961	0.14	1.13	1.37	1.00	0.57	0.26	0.07	0.03	4.57
1966	0.14	1.12	1.22	0.85	0.52	0.21	0.03	0.01	4.11
1971	0.15	1.04	1.10	0.80	0.43	0.13	0.03	0.01	3.69
1976	0.14	1.02	1.06	0.67	0.32	0.12	0.03	0.01	3.36
1981	0.14	0.97	0.93	0.58	0.32	0.12	0.03	0.01	3.10

Cohort Fertility Transition in Bangladesh (Rural)

Cohort Start Year	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	Completed Fertility
1926	0.23	1.20	1.47	1.34	1.20	0.95	0.35	0.07	6.81
1931	0.23	1.26	1.59	1.51	1.42	0.89	0.35	0.07	7.32
1936	0.25	1.38	1.68	1.76	1.36	0.68	0.35	0.07	7.53
1941	0.28	1.47	1.76	1.55	1.08	0.99	0.43	0.09	7.65
1946	0.24	1.50	1.70	1.36	1.17	0.74	0.21	0.04	6.95
1951	0.23	1.43	1.54	1.37	0.99	0.49	0.14	0.03	6.21
1956	0.21	1.23	1.43	1.21	0.74	0.34	0.11	0.01	5.29
1961	0.14	1.16	1.41	1.04	0.61	0.28	0.08	0.03	4.74
1966	0.15	1.16	1.26	0.88	0.55	0.23	0.03	0.00	4.27
1971	0.16	1.09	1.14	0.82	0.44	0.14	0.03	0.01	3.82
1976	0.14	1.07	1.10	0.70	0.32	0.11	0.03	0.00	3.49
1981	0.15	1.02	0.96	0.60	0.32	0.12	0.03	0.00	3.20

Cohort Fertility Transition in Bangladesh (Urban)

Cohort Start Year	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	Completed Fertility
1926	0.19	0.92	1.59	1.56	1.35	0.89	0.32	0.05	6.87
1931	0.32	1.44	1.51	1.46	1.27	0.73	0.23	0.05	7.01
1936	0.35	1.39	1.57	1.75	1.30	0.60	0.23	0.05	7.24
1941	0.26	1.40	1.90	1.43	0.90	0.71	0.20	0.05	6.86
1946	0.21	1.31	1.64	1.31	0.80	0.33	0.09	0.04	5.73
1951	0.19	1.25	1.43	1.22	0.70	0.29	0.07	0.01	5.17
1956	0.16	1.09	1.33	1.01	0.56	0.24	0.06	0.00	4.46
1961	0.13	0.98	1.23	0.85	0.45	0.20	0.04	0.02	3.90
1966	0.11	0.96	1.08	0.75	0.45	0.17	0.03	0.01	3.56
1971	0.12	0.86	0.98	0.72	0.41	0.13	0.03	0.01	3.25
1976	0.11	0.83	0.93	0.61	0.31	0.12	0.05	0.01	2.96
1981	0.12	0.84	0.86	0.52	0.32	0.13	0.05	0.01	2.84

APPENDIX B

INDUSTRY CODE HARMONIZATION

For Indian data, occupational code 10 (Agriculture, fishing, and forestry) is mapped to Agriculture. Codes 20 (Mining and extraction), 30 (Manufacturing), 40 (Electricity, gas, water and waste management), 50 (Construction), 130 (Other industry, n.e.c.) are classified as Industry. Codes 60 (Wholesale and retail trade), 70 (Hotels and restaurants), 80 (Transportation, storage, and communications), 90 (Financial services and insurance), 100 (Public administration and defense), 110 (Services, not specified), 111 (Business services and real estate), 112 (Education), 113 (Health and Social Work), 114 (Other Services), 120 (Private household services) are classified as services.

For Bangladeshi data, codes 04 (Agriculture) in 1991 and 2011 are mapped to Agriculture. Codes 05 (Industry), 06 (Water/electricity/gas), and 07 (Construction) in 1991 and 2011 are mapped to Industry. Codes 08 (Transport/communication), 09 (Hotel/restaurant), 10 (Business), and 11 (Service) are classified as Service in 1991 and 2011.

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