

ADDRESSING HIGH FERTILITY AND LOW WOMEN'S WORK PARTICIPATION:  
AN EMPIRICAL REFLECTION ON INDIA

by

Debasree Das Gupta  
A Dissertation  
Submitted to the  
Graduate Faculty  
of  
George Mason University  
in Partial Fulfillment of  
The Requirements for the Degree  
of  
Doctor of Philosophy  
Public Policy

Committee:

\_\_\_\_\_ Roger R. Stough, Chair

\_\_\_\_\_ Naoru Koizumi

\_\_\_\_\_ Laurie Schintler

\_\_\_\_\_ David W. Wong

Jean H. Paelinck

\_\_\_\_\_ James P. Pfiffner, Program Director

\_\_\_\_\_ Mark J. Rozell, Dean

Date: \_\_\_\_\_ Fall Semester 2013  
George Mason University  
Fairfax, VA

Addressing High Fertility and Low Women's Work Participation:  
An Empirical Reflection on India

A Dissertation submitted in partial fulfillment of the requirements for the degree of  
Doctor of Philosophy at George Mason University

by

Debasree Das Gupta  
Master of City and Regional Planning  
Clemson University, 2003

Director: Roger R. Stough, Professor  
School of Public Policy

Fall Semester 2013  
George Mason University  
Fairfax, VA



This work is licensed under a [creative commons attribution-noncommercial 3.0 unported license](https://creativecommons.org/licenses/by-nc/3.0/).

## **DEDICATION**

To my beloved father

## ACKNOWLEDGEMENTS

I want to start by expressing sincere gratitude to my parents and extended family. Without their unconditional support and never-ending encouragement this journey would not have come to fruition. I cannot thank my parents enough for the unflinching belief they had in me all along this process. Similar deep conviction held by Soham, who filled the shoes of the sibling I never had, made a trouper out of me during rainy days.

I also would like to extend my heartfelt thanks to my dissertation committee members whose able guidance made the research and writing of this dissertation less arduous. The numerous discussion sessions I had with my advisor and Chair, Dr. Roger R. Stough, throughout my tenure at George Mason University were priceless for the research skills they imparted in me. In the stimulating doctoral classes I took from Dr. Naoru Koizumi, Dr. Laurie Schintler and Dr. David W. Wong, the core of my topical and methodological learning foundation was formed. I am also privileged to have received mentoring from Dr. Jean H. Paelinck who, in addition to playing an integral part in my graduate learning experience, spend an immense amount of time reading the dissertation drafts at the various stages of this research critiquing them thoroughly. The final draft was also enhanced by the detailed comments I received from Drs. Wong and Koizumi for which I am truly grateful. I want to extend a special nod to Dr. Koizumi for mentoring and guiding me, particularly in the last few years.

Finally, this dissertation would not have reached the finish line without the fellowship of the motley individuals I had the fortune to meet in the various stages of my academic life. This appreciation will not be complete without their mention. My closest friends, Uma Kelekar and Carl Turner, have been my ardent advocates never allowing me to lose faith even during the most trying of times and I cherish the bond that I have come to share with them. They are the ones who never stopped to point me in the right direction at the right time throughout the course of this dissertation. My association with my other closest friend and like-minded colleague, Amit Patel, immensely enriched my graduate excursion. Through weekly spirited discussions with me on all things research, he made sure that I kept my sight fixed on the “perks” at the end of the so-called dissertation tunnel. Amit is truly a person who inspires others by example and I thoroughly relish his company for that reason in particular and for countless other. And, last but not the least on this list, are my friends, Debargha and Jaya, whom I have known for what now seems to be more than a lifetime. From tracking down spatial dataset on India to helping me scan and digitize raw data from Census booklets to guiding me with valuable tips on data collection in India, their impact on this dissertation is one that is truly immeasurable.

## TABLE OF CONTENTS

|                                                                                                                          | Page      |
|--------------------------------------------------------------------------------------------------------------------------|-----------|
| List of Tables .....                                                                                                     | vii       |
| List of Figures .....                                                                                                    | viii      |
| List of Abbreviations .....                                                                                              | ix        |
| Abstract .....                                                                                                           | x         |
| <b>CHAPTER 1: INTRODUCTION</b> .....                                                                                     | <b>1</b>  |
| <b>CHAPTER 2: A DOSSIER ON POPULATION</b> .....                                                                          | <b>10</b> |
| 2.1 Contemporary Population Change .....                                                                                 | 10        |
| 2.2 Demographic Transition, Related Transformations and Consequences .....                                               | 12        |
| 2.2.1 Theoretical Demographic Transition Model .....                                                                     | 12        |
| 2.2.2 Inter-related Transitions .....                                                                                    | 13        |
| 2.2.3 Resultant Consequences .....                                                                                       | 14        |
| 2.3 Evidence on Fertility and Women's Work .....                                                                         | 20        |
| 2.3.1 Impact on Economic Advancement .....                                                                               | 20        |
| 2.3.2 Correlates of Fertility .....                                                                                      | 22        |
| 2.3.3 Correlates of Women's Work .....                                                                                   | 25        |
| <b>CHAPTER 3: DISTRICT-LEVEL FERTILITY OUTCOMES: THE RELATIVE<br/>ROLES OF SOCIOECONOMIC FACTORS AND DIFFUSION</b> ..... | <b>27</b> |
| 3.1 Introduction .....                                                                                                   | 28        |
| 3.2 Theoretical Framework .....                                                                                          | 31        |
| 3.2.1 Conventional Perspectives: Economic Theories .....                                                                 | 31        |
| 3.2.2 Alternative Perspective: Cultural Diffusion Theory .....                                                           | 34        |
| 3.2.3 The Blended Framework .....                                                                                        | 36        |
| 3.3 Fertility in India .....                                                                                             | 38        |
| 3.3.1 National Family Planning Program .....                                                                             | 38        |
| 3.3.2 Existing Fertility Trends .....                                                                                    | 39        |
| 3.3.3 Prior Analyses and Evidence .....                                                                                  | 42        |

|                                                                                              |            |
|----------------------------------------------------------------------------------------------|------------|
| 3.4 Research Design .....                                                                    | 46         |
| 3.4.1 Empirical Models and Hypotheses .....                                                  | 46         |
| 3.4.2 Data and Variables .....                                                               | 50         |
| 3.4.3 Spatial Weight Matrix .....                                                            | 54         |
| 3.5 Discussion .....                                                                         | 55         |
| 3.5.1 Results .....                                                                          | 55         |
| 3.5.2 Policy Implications .....                                                              | 62         |
| 3.6 Conclusion .....                                                                         | 67         |
| <b>CHAPTER 4: FEMALE WORK PARTICIPATION: THE HETEROGENEOUS<br/>EFFECT OF FERTILITY .....</b> | <b>70</b>  |
| 4.1 Introduction .....                                                                       | 71         |
| 4.2 Theoretical Framework .....                                                              | 75         |
| 4.2.1 Economic Theories .....                                                                | 75         |
| 4.2.2 Sociological Theory .....                                                              | 77         |
| 4.3 Female Work Participation in India .....                                                 | 79         |
| 4.3.1 Definition of Work and Classification of Workers .....                                 | 79         |
| 4.3.2 Census Versus National Sample Survey (NSS) Definition of Work .....                    | 81         |
| 4.3.3 Pattern of Female Work Participation .....                                             | 83         |
| 4.3.4 Prior Analyses .....                                                                   | 88         |
| 4.4 Research Design .....                                                                    | 89         |
| 4.4.1 Empirical Models and Hypotheses .....                                                  | 89         |
| 4.4.2 Data and Variables .....                                                               | 92         |
| 4.4.3 Choice of Instrument .....                                                             | 96         |
| 4.5 Discussion .....                                                                         | 97         |
| 4.5.1 Results .....                                                                          | 97         |
| 4.5.2 Policy Implications .....                                                              | 105        |
| 4.5 Conclusion .....                                                                         | 108        |
| <b>CHAPTER 5: CONCLUDING REMARKS .....</b>                                                   | <b>110</b> |
| References .....                                                                             | 114        |

## LIST OF TABLES

| Table                                                                                                                                                                 | Page |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| Table 3.1 Estimated Total Fertility Rates (TFR), Major States and All India, 1970-2007 .....                                                                          | 40   |
| Table 3.2 List of Structural Variables included in the Blended Fertility Models.....                                                                                  | 51   |
| Table 3.3 Summary Statistics and Correlation .....                                                                                                                    | 56   |
| Table 3.4 Comparison of Fertility Models (Hypothesis I).....                                                                                                          | 57   |
| Table 3.5 Comparison of Fertility Models (Hypothesis II) .....                                                                                                        | 61   |
| Table 3.6 Socioeconomic Indicators in the High-Fertility Districts of the BIMARU Region and South India, 2001 .....                                                   | 63   |
| Table 3.7 Family Planning (FP) in the BIMARU States and South India, 2005-2006 ....                                                                                   | 64   |
| Table 4.1 Work Participation Rates – Comparison between NSS 2000 and Census 2001 .....                                                                                | 82   |
| Table 4.2 Male and Female Work Participation Rates (% of population 15+) and Gender Inequity in Work Participation Rates in the Middle East and South Asia, 2010..... | 84   |
| Table 4.3 Composition of the Female Workforce, 2001 .....                                                                                                             | 86   |
| Table 4.4 List of Variables included in the Work-Fertility Models .....                                                                                               | 94   |
| Table 4.5 Summary Statistics and Correlation with Fertility .....                                                                                                     | 97   |
| Table 4.6 Summary Statistics and Correlation with Structural Correlates .....                                                                                         | 98   |
| Table 4.7 Comparison of Work-Fertility Models (Hypothesis I) .....                                                                                                    | 101  |
| Table 4.8 Comparison of Work-Fertility Models (Hypothesis II).....                                                                                                    | 104  |



## LIST OF FIGURES

| Figure                                                                                                                           | Page |
|----------------------------------------------------------------------------------------------------------------------------------|------|
| Figure 2.1 Contemporary and Projected Population Growth, 1950 – 2050.....                                                        | 11   |
| Figure 2.2 Four Stages of the Theoretical Demographic Transition Model.....                                                      | 12   |
| Figure 2.3 Comparison of Empirical Demographic Transition, and Population Growth in India, China and East Asia, 1950 – 2050..... | 15   |
| Figure 2.4 Fertility Decline and Ratio of Working to Non-working Age Population in India, China, East Asia, 1950 – 2050.....     | 16   |
| Figure 2.5 Comparison of Fertility and Female Labor Participation in a selection of Developing Countries, 2005 .....             | 19   |
| Figure 2.6 Fertility, Female Work and Working to Non-working Age Ratio in the States of India, 2001 .....                        | 21   |
| Figure 2.7 Theoretical Model of Fertility .....                                                                                  | 24   |
| Figure 2.8 Empirical Model of Fertility.....                                                                                     | 25   |
| Figure 2.9 The Theoretical Work-Fertility Model.....                                                                             | 26   |
| Figure 3.1 Choropleth Maps showing Regional Clustering in District-Level Fertility Outcomes in India in 2001 .....               | 41   |
| Figure 4.1 Male & Female Work Participation Rates and Gender Gap in Work Participation Rates, 1981–2001 .....                    | 85   |
| Figure 4.2 Geographic Variations in Female Work Participation Rate, 2001 .....                                                   | 87   |

## LIST OF ABBREVIATIONS

|                                                                                      |           |
|--------------------------------------------------------------------------------------|-----------|
| Bihar-Jharkhand/Madhya Pradesh-Chattisgarh/Rajasthan/Uttar Pradesh-Uttaranchal ..... | BIMARU    |
| Contraceptive Prevalence Rate .....                                                  | CPR       |
| Crude Birth Rate .....                                                               | CBR       |
| Crude Death Rate .....                                                               | CDR       |
| Demographic Transition Model .....                                                   | DTM       |
| Demographic Transition Theory .....                                                  | DTT       |
| District Level Household Survey .....                                                | DLHS      |
| European Fertility Project .....                                                     | EFP       |
| Female work Participation .....                                                      | FWP       |
| Generalized Spatial 2-Stage Least Square/Instrumental Variable .....                 | GS2SLS/IV |
| Human immunodeficiency virus / acquired immunodeficiency syndrome .....              | HIV/AIDS  |
| Independently and identically distributed .....                                      | iid       |
| Millennium Development Goals .....                                                   | MDG       |
| Ministry of Health and Family Welfare .....                                          | MOFW      |
| National Population Policy .....                                                     | NPP       |
| National Family Health Survey .....                                                  | NFHS      |
| National Sample Survey .....                                                         | NSS       |
| Ordinary Least Square .....                                                          | OLS       |
| Spatial 2-Stage Least Square/Instrumental Variable .....                             | S2SLS/IV  |
| Spatial Autocorrelation .....                                                        | SA        |
| Spatial Autoregressive .....                                                         | SAR       |
| Spatial Autoregressive Autoregressive .....                                          | SARAR     |
| Schedule Caste .....                                                                 | SC        |
| Spatial Durbin Model .....                                                           | SDM       |
| Schedule Tribe .....                                                                 | ST        |
| Total Fertility Rate .....                                                           | TFR       |
| United Nations .....                                                                 | UN        |
| United States Agency in International Development .....                              | USAID     |
| World Fertility Survey .....                                                         | WFS       |

## **ABSTRACT**

### **ADDRESSING HIGH FERTILITY AND LOW WOMEN'S WORK PARTICIPATION: AN EMPIRICAL REFLECTION ON INDIA**

Debasree Das Gupta, Ph.D.

George Mason University, 2013

Dissertation Director: Dr. Roger R. Stough

The window of a one-time economic benefit from “demographic dividend” presents itself as countries undergoing the demographic transition experience fertility decline and a rising share of women in the workforce. India is projected to enter the optimal period of that phase in 2015. Yet, in this soon to become most populous nation of the world, persisting trends of high fertility in the North and low levels of economic activity among urban women pose a dual problem. Conceived against this context, the aim of this dissertation is to investigate regional variations in aggregate level outcomes in fertility and women's work. Using techniques from empirical spatial econometrics, fertility and women's work is modeled across the cross of section of Indian districts in 2001. The key findings of this research highlight cultural diffusion as a salient factor for accelerating fertility decline in the North and identify a greater negative effect of fertility in cities

outside of farm and nonfarm family based work. The policy implications and relevance of this research for other developing countries are discussed at conclusion.

## CHAPTER 1: INTRODUCTION

Population changes that come on the heels of demographic transition have charted the course of modern history as we know it today. At the epicenter of this revolution is fertility. In this dissertation, research is undertaken to interpret fertility outcomes and its impact on women's work. The recent re-emergence of interest in population matters and the pivotal significance of these two indicators towards the achievement of the Millennium Development Goals (MDG) are the broader motivations behind this direction.<sup>1</sup>

In the previous decades, concern over rapid population growth in the less developed regions of the world attracted intense scholarly and policy attention on the ways and means to interpret and control such growth (Donaldson and McNicoll 2012; May 2012a). In the latter third of the twentieth century this concern reached a state of dramatization culminating in the coining of the metaphor "the population bomb".<sup>2</sup> But, by the time the new millennium arrived, much of that hyperbole petered out with the decline in the rate of population growth in the developing world, which reduced from 2.5

---

<sup>1</sup> Realizing full participation of women in productive economic activities is one of the targets of MDG-1 (eradicate extreme poverty and hunger). In addition, women's work is a key indicator for monitoring progress on MDG-3 (promote gender equality and empower women). Although not one of the goals, targets or indicators in the Millennium Declaration refers to fertility, it nonetheless, is the fulcrum that connects the stated set of inter-related purposes in the MDGs (United Nation 2008; World Bank 2010).

<sup>2</sup> The branding of rapid population growth in the developing countries in to the term "population bomb" resulted from a 1969 publication of the same title by Paul Ehrlich (1969). In Ehrlich's account, and a number of others that followed it, the consequence of population growth was equated to that of a nuclear threat.

in the 1960s to a little less than 1.5 in 2000 (Kohler 2012; UN 2011). This reduction combined with the expanding Human immunodeficiency virus / acquired immunodeficiency syndrome (HIV/AIDS) epidemic toppled population from its helm as *the* topic of public and academic ponderance (Bongaarts and Sinding 2011; World Bank 2010; Bongaarts and Sinding 2009).<sup>3</sup>

Nevertheless, around the same time, the publication of Birdsall et al.'s (2000) edited volume, *Population Matters: Demographic Change, Economic Growth and Poverty in the Developing World*, revisited the population-economic development debate. From the evidence presented therein, it concluded the below observation.

First, in contrast to assessments over the last several decades, rapid population growth is found to have exercised a quantitatively important negative impact on the pace of aggregate economic growth in developing countries ... [and] ... secondly, rapid fertility decline is found to make a quantitatively relevant contribution to reducing the incidence and severity of poverty. (Birdsall and Sinding 2001:6)

The population-development debate is not new.<sup>4</sup> Competing arguments rebutting accounts of negative impact, as in the above statement, continue to arise from the opposing economic camp organized around the revisionist view point of Julian L. Simon

---

<sup>3</sup> Until recently, with much of the attention on population growth waning since the decade of 1980s, family planning programs had become less of an international and domestic policy priority. Instead, the HIV/AIDS epidemic became the front and center of policy and programmatic efforts in the developing world (Bongaarts 2008; Blanc and Tsui, 2005).

<sup>4</sup> The root of this debate extends back to the eighteenth century classical Malthusian-Condorcet deliberation over population (Sen 1997; Weeks 2005). The inherent divergence between the population optimists and the population pessimists has framed the population-development debate for over centuries now.

(1977; 1981) (Dyson 2006).<sup>5</sup> Consequently, opinion on the economic effect of population growth in developing countries has been swaying between the contrasting viewpoints of these two dissenting camps (Kohler 2012).<sup>6</sup>

A decade in to the twenty-first century, the population-development discussion in its next phase is now poised with a transformed tone. And, the framing of future impacts of population change is predominantly in terms of its effects on the ecosystem, conservation and climate change instead of famine, plague and food shortages (Donaldson and McNicoll 2012; Canning 2011; Dyson 2010). Side by side, analysts for some time have also been unified in highlighting the compositional and qualitative effects—on sex and age structure, urbanization and migration, health and well-being, and social and political stability, to name a few—in addition to quantitative economic impacts of population (May 2012; Goldstone et al. 2012; Goldstone 2010; WB 2010; Dyson 2006). Greater emphasis is being placed as well on the way in which fertility declines as a response to earlier declines in mortality.<sup>7</sup> The transition from high to low fertility has been unfolding across the regions of the developing world in more than one fashion to

---

<sup>5</sup> Dennis A. Ahlburg (1998) cites the work of Julian L. Simon as the most influential perspective challenging the conventional Malthusian principles that highlighted the detrimental effects of population growth. Ahlburg also credits Simon for making an invaluable contribution to the population-development debate. Simon's main argument has been founded on the long run gains of population growth over short term negative consequences. For additional discussions on favorable economic effects of population growth refer to: Barnett and Morse (1963); Boserup (1965); Kuznets (1968); Kelley (1985); Crenshaw et al. (1997).

<sup>6</sup> For a review of the chronology of the debate around population, development and family planning programs see, for example, May (2012).

<sup>7</sup> The two crucial components that effect demographic change are mortality (death rate) and fertility (birth rate) (Montgomery 2006; Weeks 2005; Cleland 2001). Additional details on these factors are provided in the next chapter as part of the discussion on demographic transition.

create subsequent population bulges that depending on the pace of decline have differed across countries (Canning 2011; Weeks 2005).

In characterizing the current world population at 7 billion, scholars are joining an emerging consensus around the deleterious effects of slow decline in regions of high fertility (Kohler 2012; Canning 2011; World Bank 2010).<sup>8</sup> Numerous studies have reported this pattern of a slowdown or stalling in a number of the developing countries (Garenne 2011; Shapiro et al. 2010; Schoumaker 2009; Bongaarts 2008, 2006; UN 2002; Lim 2002). Most of this high-fertility fueled population growth is clustered in the resource-limited nations of the world. Of greater significance is the trend that even among these nations, the most vulnerable of the regions are growing at a rate that is higher than each of the respective national averages (Haub and Gribble 2011). Analysts caution that, for these countries, the combination of a slow decline in fertility and weak institutions could yield a condition of “demographic duress” and not “demographic dividend” (Canning 2011; Bloom 2012; Bloom et al. 2007, 2003; Bloom and Canning 2008, 2003; Bosworth and Collins 2008; World Bank 2006; Ahlburg 2002; Birdsall et al. 2000).<sup>9</sup>

The short-term and long-run implications of all of the above factors is repositioning population at the center of scholarly discourse and international and domestic development agenda (May 2012; Donaldson and McNicoll 2012; Goldstone

---

<sup>8</sup> See for example, evidence provided in Bleakley and Lange (2009); Bloom et al. (2009); Pop-Eleches (2006); Lam (2011).

<sup>9</sup> Demographic dividend refers to the economic gains that, under certain circumstances, accrue as a result of falling fertility rates and the resultant changes in the labor structure (Bloom 2012; Bloom et al. 2006; Ross 2004). The discussion in the next chapter reflects on this concept in greater detail.



2010; The Economist 2010; Gates 2012; Markham 2012). At this juncture when “population”, after a few “lost decade”, is rising from past obscurity, the intent of the analysis conducted in this dissertation is to contribute to the reversing tide by shining the spotlight on the demographic powerhouse of India.<sup>10</sup> Towards that end, the research focus is devoted first, on examining one of the two basic variables in demographic transition, fertility. And, next on interpreting how this variable is linked to women’s work. The work-fertility relation is a key aspect in the set of inter-related forces that produce demographic dividend in countries undergoing fertility decline (Bloom 2011). Prior analyses have abundantly highlighted the roles of the two population factors in impacting the scope of demographic dividend, economic growth, and human development potential of developing countries (Bloom 2011; Canning 2011; Jain and Jain 2010; Lundberg et al. 2010; Younger 2006). By the same token, addressing high fertility, and women’s work needs in developing countries provide the brick and mortar for attaining the different targets under UN-MDG. Additional specific factors guiding the choice to examine fertility and women’s work in India are as recounted below.

India is the largest contributor to world population growth and, according to the UN medium variant population projection, is set to surpass China as the most populous nation by the year 2025 (UN 2011). Among the developing countries, fertility in India has been a topic of particular interest ever since the country was included as a case study in Coale and Hoover’s 1958 seminal work (May 2012; UN 2002). India also holds the

---

<sup>10</sup> The period subsequent to the 1994 United Nations International Conference on Population and Development (ICPD) in Cairo has been labeled as the “lost decade” in reference to the realignment of focus away from population and family planning issues (Kohler 2012).

distinction of being the first developing nation to adopt a national population policy in 1952.<sup>11</sup> Currently, in the later stages of fertility transition, the country has entered Phase III of the demographic transition but is yet to attain the replacement level fertility of 2.1, a rate at which couples roughly replace themselves in the future population. The recent national estimates reveal that the fertility rate is close to that level having declined from 3.2 in 2000 to 2.6 in 2009 (Registrar General of India 2011).

Yet, similar to a number of other developing countries, India has been showing signs of a slowdown in the decline in fertility since the decade of 2000 (Haub 2002; UN 2002). Further, the national level fertility of 2.6 children per woman masks the wide inter- and intra-state variation in fertility in the country. A North-South fertility divide differentiates the regions of India and, population in poorer and high-fertility Northern India is growing at a rate that is much higher than the rest of the country. This wide variation in fertility between the north and the south and associated demographic outcomes is highlighted in Bloom (2011). For example, at 4 children per woman, fertility in Uttar Pradesh in 2007 was more than double that in Kerala (1.7), a difference that roughly corresponds to the gap in fertility between Ghana and United Kingdom (UN 2013).

Numerous studies stress that much of India's prospect of attaining replacement level fertility as well as benefitting from the demographic dividend is contingent upon fertility outcomes in the North (Haub and Gribble 2011; Jain and Jain 2010; Diamond-Smith and Potts 2010). Spearheaded by the Union Minister of Health and Family

---

<sup>11</sup> Despite the adoption of this Policy in 1952, funding for it became available much later in 1966 (Haub and Gribble 2011).

Welfare, over the past few years, India's politicians at different levels of governance have increasingly been engaging in deliberations over population growth stabilization (Ministry of Health and Family Welfare 2012; Jain and Jain 2010; Yardley 2010; Ray 2009).

One of the many concerns driving official discussions on population growth stabilization is uncertainty over the capacity of the emerging Indian economy to keep pace with rising public services demand from an ever expanding population base in the North (Bloom 2012). A slew of analyses, both scholarly and popular, have already dissected India's climb up the rungs of the global economy and its potential in the coming years to benefit from the demographic dividend (Acharya 2004).<sup>12</sup> Yet, notwithstanding the recent economic growth accomplishments, India still is predominantly a rural agrarian economy where almost 70 percent of the population in 2010 lived below \$2 a day. In 2010, about the same percentage of the population lived in rural areas and half of the labor force was employed in agriculture which contributed a meager 18 percent to the country's gross domestic product (World Bank 2013). On top of these numbers sits the trend of widening economic and social disparities across the states (Kurian 2007).

Moreover, recent evaluations reveal that, absent suitable policies, the country's social and economic institutions will be under-prepared to cash in on population change as the country moves through the demographic dividend phase (Bloom, Canning, and Rosenberg 2011; Acharya 2009; Bosworth and Collins 2008; Chandrasekhar et al. 2006).

---

<sup>12</sup> See for example Corbridge et al. (2012); Acharya (2009); Dossani (2008); Winters and Yusuf (2007); Basu (2004); DeLong and Bradford (2003); Sachs (2002); Cohen (2001).

The accent, among other things, is on stimulating work participation of women and expanding the labor market (Bloom 2012; Klasen and Pieters 2012; Crabtree and Pugliese 2012; Bloom and Williamson 1998). Women's participation in the labor market has consistently been low in India. And, the situation is far worse in the urban parts of the country. Current estimates indicate a downward trend in women's economic activity across all age cohorts despite steady economic growth and fertility decline (ILO 2013). While the inherent role conflict between mothering and working has, across countries, defined a negative linkage between fertility and women's work, in India this relation has followed its own unique trajectory (Rindfuss et al 2010; Lim 2002). In fact, India presents a queer case where women's work has almost remained unresponsive to recent declines in fertility (Mazumdar and Neetha 2011; Lim 2002).

The rest of this dissertation is organized in to four chapters. In chapter 2, population characteristics, associated concepts and relevant evidence are summarized. In the following chapter, the goal of the empirical analysis is to interpret the variations in fertility outcomes across the cross-section of sub-state regions (or districts) in India in 2001. The combination of persisting high fertility in the North and the stall in decline in fertility since 2000 prompted this study on fertility. Within this overall goal of fertility analysis, the specific objectives are to (i) evaluate the relative roles of socioeconomic factors and cultural diffusion in impacting regional fertility outcomes and (ii) identify potential causes of high fertility in North India.

Next, the low rates of women's economic activity in urban areas despite sustained fertility decline urged the analysis on women's work participation. The goal in Chapter 4

is, therefore, to examine women's participation in the workforce with the explicit objective of (i) quantifying the role of fertility, and (ii) how this role varies across work types and by place of residence. In both chapters 3 and 4, relevant theoretical concepts, prevailing trends and prior analyses are discussed before the empirical models and results are presented, and the policy implications are discussed. For, the empirical analyses in each chapter, methodologies from the field of spatial econometrics are used to model district-level fertility and women's work participation in India.

The final chapter concludes with a summary and additional research considerations. The analysis in this dissertation—the first of its kind in terms of its derived theoretical and methodological blend—makes timely contribution to our understanding on variations in regional fertility outcomes and the work-fertility dynamic in India. The empirical findings have broader implications for policymaking in developing countries that are at their early-to-mid stages of demographic transition. In addition, the analytic framework developed will be of particular relevance for conceptualizing and examining fertility and women's workforce participation in developing countries irrespective of the stage of demographic transition they are in.

## **CHAPTER 2: A DOSSIER ON POPULATION**

The origin of the term “demography” is credited to an 1855 book by Achille Guillard in which it is defined as “the mathematical knowledge of population”.<sup>13</sup> This knowledge refers to an insight into the different aspects of population: size, distribution, structure and growth; and the three population processes: mortality, fertility and migration. Understanding these demographic concepts and the inter-linkages between them is critical for any political, social or economic decision-making to be strategic (Weeks 2005). The purpose of this chapter is to introduce to the readers the disparate but inter-linked demographic factors that fuel population change, and a summary on the extant literature analyzing economic impacts and covariates of fertility and women’s work.

### **2.1 Contemporary Population Change**

Alongside its geopolitical significance, World War II is important as an epochal watershed in world demographic trends. World population growth accelerated after the war, when population in less developed countries began to increase rapidly. Annual growth rate in most of these countries rose to 2.0 percent. The resultant effect saw the world population more than double from two and a half billion in 1950 to six billion by

---

<sup>13</sup> Guillard 1855:xxvi cited in Weeks (2005).

the end of the century (Figure 2.1.1). In the same time, population of India tripled to cross the one billion mark in 2000 (Figure 2.1.2). And, as can be seen in Figure 2.1, in 2010 the size of the population in India was as big as the combined population of all the industrialized countries taken together (UN 2011). Much of this population growth in the developing world, including India, result from the way in which fertility change, over the stages of the demographic transition, progress in response to mortality decline (Bloom 2012). In addition, two of the most profound demographic transformations of the twentieth century, changing age structure and increasing participation of women in the labor force, are also tied to the trajectory on which fertility change proceed in the countries of the developing world.

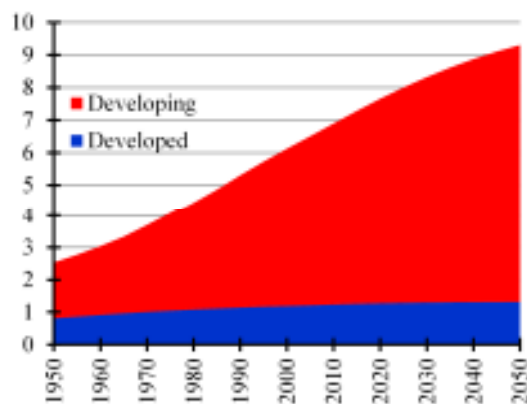


Figure 2.1.1: World Population showing share of Developed & Developing Countries

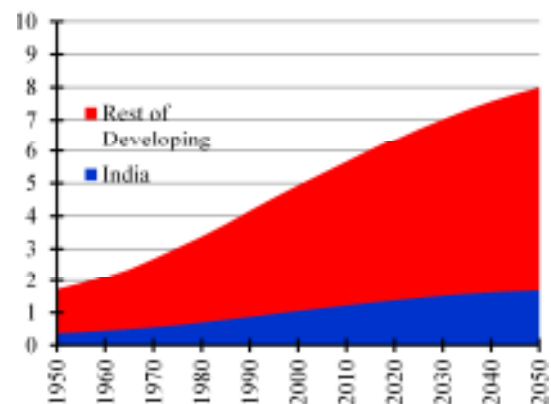


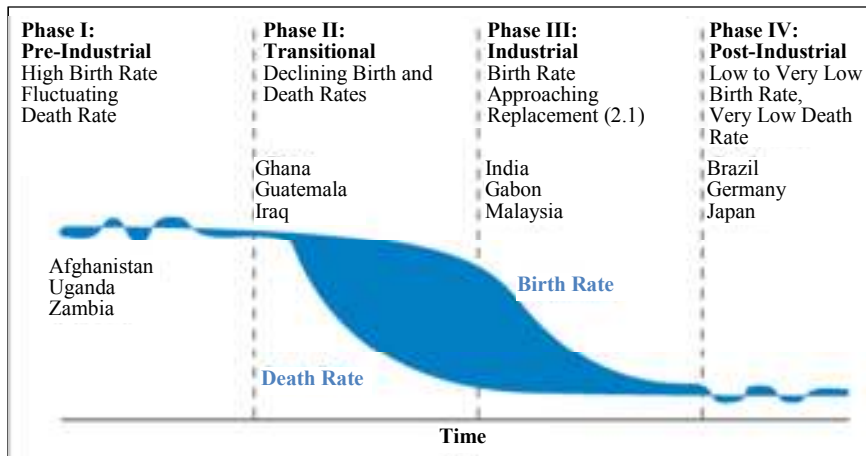
Figure 2.1.2: Population in Developing Countries showing share of India & Rest of the Developing World

**Figure 2.1: Contemporary and Projected Population Growth, 1950 – 2050**

Source: World Population Prospects: The 2010 Revision

## 2.2 Demographic Transition, Related Transformations and Consequences

### 2.2.1 Theoretical Demographic Transition Model



**Figure 2.2: The Four Stages of the Theoretical Demographic Transition Model**

Source: Haub and Gribble (2011)

The term demographic transition originated in the pioneering works of Warren Thompson (1929). It refers to the process in which countries with high population growth potential (due to declining death and high birth rates) evolve towards a growth phase of incipient decline (due to low death and low birth rates) through an intermediate stage of rapid population growth. The demographic transition model (DTM) was developed from the historical pattern of population growth witnessed in the countries of Western Europe and North America. The DTM provides the formal description of the *four phases* that typify demographic transition through a *set of inter-related transitions* over time (Montgomery 2006; Cleland 2001). The focus in the DTM is on the composite effects of the two crucial components: mortality (death rate) and fertility (birth rate)



(Weeks 2005). The successive stages of the theoretical DTM, and the various outcomes that determine the population characteristics occurring over the course of these phases is shown in Figure 2.2 above.

### **2.2.2 Inter-related Transitions**

Demographic transition comprises of a set of inter-linked transformations. The first transition to occur is *mortality transition* or *epidemiological transition*, which is a shift from death at younger ages due to communicable diseases to death at older ages due to degenerative diseases. Initiation of this transition results in the death rate to decline in the transitional (phase II) of the DTM. In the next phase (industrial: phase III), birth rate starts to decline due to the commencement of *fertility transition*, typically as a delayed response to mortality transition. Fertility transition is that decline in fertility which shifts societies from natural fertility characterized by very high levels of fertility to replacement-level fertility which is a value of 2.1 children per woman (Caldwell 1997; Hirschman 2001).

The characteristic lag between the onset of mortality and fertility transitions produces the third type of transition: *age transition*. As a result of this transition, the population age structure shifts from being predominantly young under phase I of the DTM to being predominantly older under phase IV. In addition, an expanding population base sets off a *migration transition* resulting in the relocation of population from the overpopulated rural lands to the urban areas possibly due to greater economic opportunities in the cities (Bloom 2012; Weeks 2005). Finally all of the inter-related transitions converge to bring about the *family and household transition* which

increasingly shifts the focus away from the family and onto the individual (self). This last transition, in combination with falling fertility levels, alters household composition and the structure of families and results in rising participation of women in the labor market (Weeks 2005).

### **2.2.3 Resultant Consequences**

A big jump in population size since the decade of 1950s is recorded in the developing countries as the lag between the onset of the two transitions, mortality and fertility, has been large. In addition, the pace of fertility decline has been slower than that of mortality decline. The readjustment in fertility behavior in response to the lowered mortality rate and away from the cultural norms that favor high fertility has been occurring at a rather gradual rate. In contrast, mortality decline has been faster largely due to a rapid diffusion of technology from the developed world that improved living conditions in developing countries through increased access to vaccines, sanitation and safe water (Bloom 2012; Weeks 2005).

The above scenario is starkly true for India. In the next set of figures (Figure 2.3), a comparison between the progression of demographic transition in India, China and in the countries in East Asia is presented. Demographic transition in the latter set of countries has generated much interest due to the speed at which fertility has declined and its resultant effect on the economy (Bloom 2012). As can be seen from the respective slopes in each of the graphs, the decline in birth rate has been much more gradual in India. Drop in death rate, barring a large dip that distinguishes the course in China and East Asia from that in India, has been somewhat similar. As a result, India has continued

to lag behind both China and the other East Asian countries in the quest to stabilize population growth. While China and East Asia, according to the UN medium variant estimate, is projected to reach the zero population growth scenario around the year 2025, India's population will continue to grow much beyond and at least till the year 2060 (Figure 2.3.2) (UN 2011).

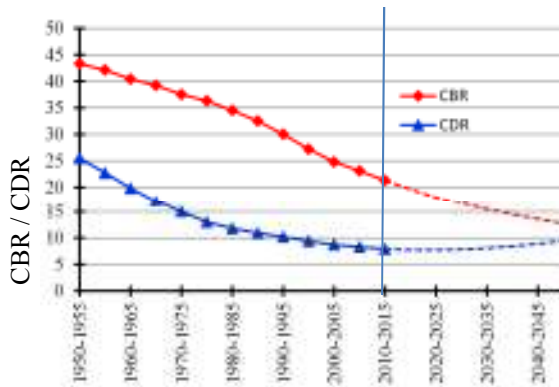


Figure 2.3.1: India

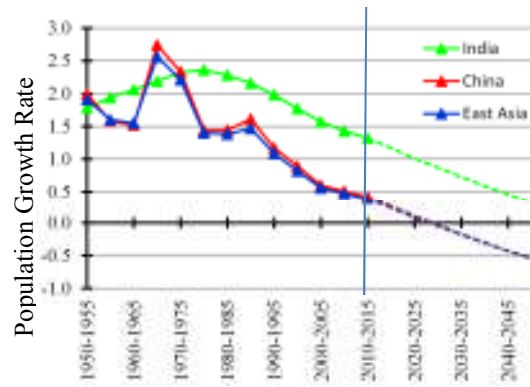


Figure 2.3.2: Population Growth

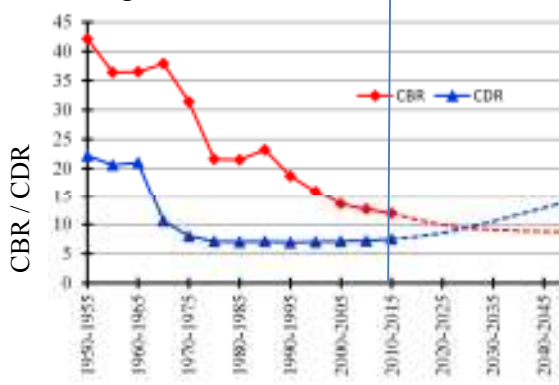


Figure 2.3.3: China

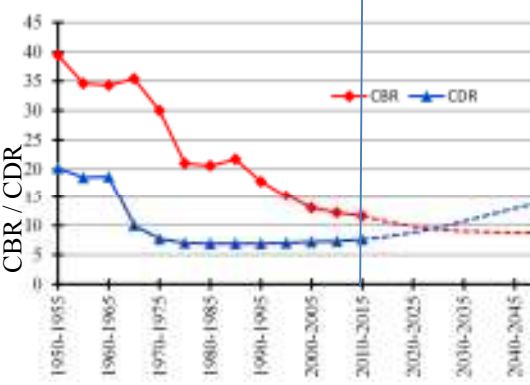


Figure 2.3.4: East Asia

**Figure 2.3: Comparison of Empirical Demographic Transition, and Population Growth in India, China and East Asia, 1950 – 2050<sup>14</sup>**

Source: World Population Prospects: The 2010 Revision

<sup>14</sup> Crude birth rate (CBR) and crude death rate (CDR) are, respectively, the numbers of live births and deaths in a given year per 1000 population.

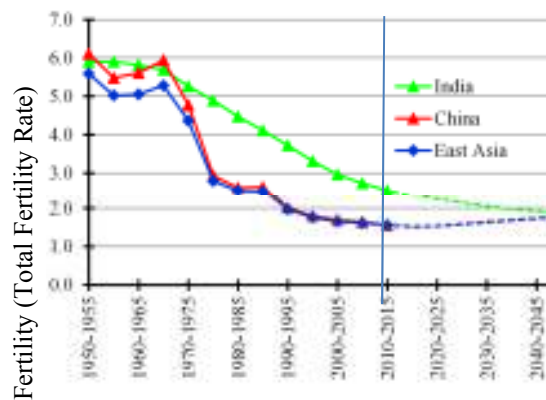


Figure 2.4.1: Fertility Decline

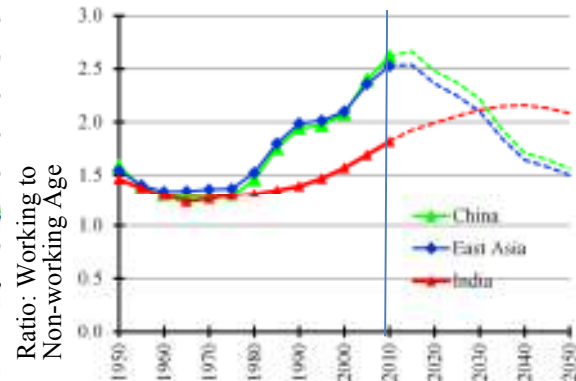


Figure 2.4.2: Ratio of Working Age to Non-working Age Population

**Figure 2.4: Fertility Decline and Ratio of Working to Non-working Age Population in India, China, and East Asia, 1950 – 2050**

Source: World Population Prospects: The 2010 Revision

Population growth is, however, only one of the many consequences of demographic transition. Over the course of the above mentioned inter-related transitions, the scope of more than one bonus that combines to drive the “demographic dividend” is present (Bloom 2012; WB 2010). Two of these demographic benefits are the concomitant lowering of the dependency ratio and increased supply of female labor as fertility declines.<sup>15</sup> With fertility decline, the changing age structure over time lowers the dependency ratio; that is the share of the population in the non-working age cohort decreases in comparison to that in the working age population. The possibility for the

<sup>15</sup> Five different outcomes, four of which are tied to fertility decline, combine to yield the demographic dividend. First of these is the increase in the size of the working age population in comparison to the non-working age that lead to increased productivity. Next is the reallocation of resources from childcare to other types of expenditure and sectors of the economy. Third, is increased participation of women in the labor market who now have reduced burden of childcare. Fourth, is increased rate of savings during the working ages for a reason similar to that in the previous factor. And, finally the last and only one of these factors not following directly from fertility decline, is the later trend of increasing number of elderly who opt for greater personal savings at or after retirement (Bloom 2012; WB 2010).

demographic dividend, therefore, arises as a greater proportion of the adult-age population and a larger share of the females constitute the labor force. With lessened burden (of childcare), *all else being equal*, these conditions provide the opportunity for increased productivity and faster economic growth (Bloom 2012; Lee and Mason 2006; Bloom et al. 2003; Bloom and Williamson 1998).

The optimal phase of the demographic dividend is entered into when following sustained decline in fertility, the dependency ratio is at its lowest. It ends after fertility has been low for an extended time and when due to population aging the dependency ratio starts to rise back again.<sup>16</sup> The duration of this phase, depending upon the speed of the fertility decline, varies and usually lasts about two to three decades, although in some rare instances it has been as long as fifty years (WB 2010). India will enter the optimal phase of demographic dividend in 2015 and is projected to exit out of it in 2045 (UN 2011; Jain and Jain 2010).

How fast fertility declines to sufficiently lower the dependency ratio determines whether, as part of the age transition, a suitable demographic condition is realized (Bloom 2012; WB 2010). A comparison of the curves of the ratios of working age to non-working age population in Figure 2.4 reveals that in India it will continue to be flatter than that manifest in China and East Asia (Figure 2.4.2). These peaks and valleys in the curves form as a direct consequence of earlier declines in fertility (Figure 2.4.1). And, barring a shift from the UN medium to the low variant projection, the working to

---

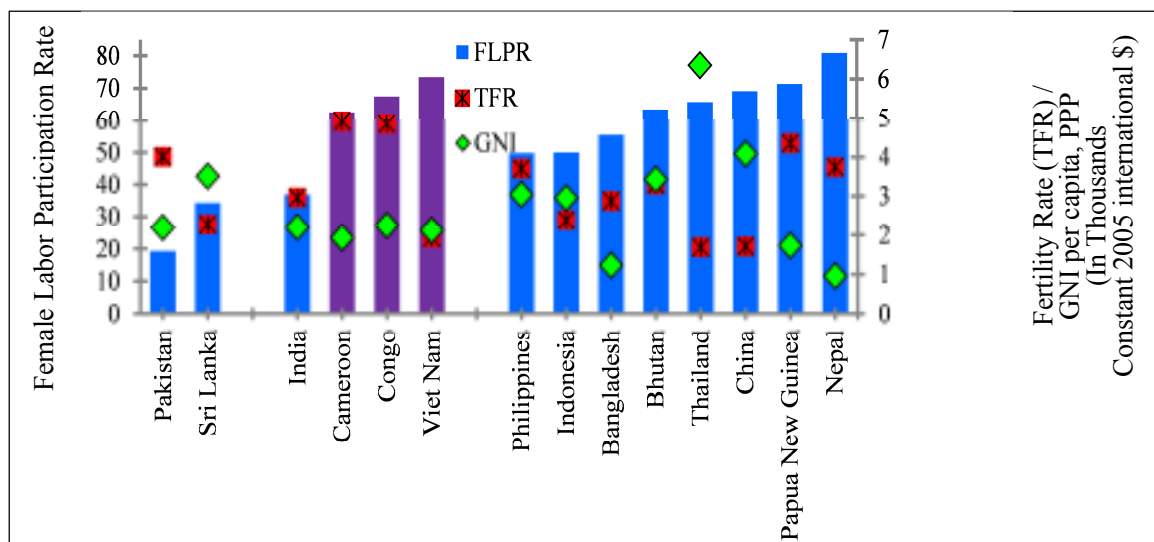
<sup>16</sup> The beginning and the end of this optimal phase, however, are somewhat arbitrary and are linked to the three stages of the dependency ratio (high and decreasing—to favorable but decreasing—to favorable but rising) that unfold as part of the age transition discussed earlier. The optimal dividend phase is attributed to the middle part of the age transition when the population in the working age cohort peaks (ECLAC 2009; Pool 2007).

non-working age ratio in India will be unable to reach the high levels attained in China and East Asia. With the persistent high fertility that has been characterizing North India, the likelihood of that happening is rather slim (Bloom 2012).

In addition to changing the dependency ratio, the progressive lowering of fertility also increasingly frees up women from their child-bearing duties providing them the option to take up other pursuits including market activities. The sharp rise in women's labor force participation in the twentieth century has been linked to declining fertility rates in countries coursing through the phases of the demographic transition (Cáceres-Delpiano 2012; Bloom 2012; Falcao and Soares 2008; Goldin 1990). While the empirical relation between fertility and women's work in the developed world is mostly understood, when it comes to the developing countries, it, however, continues to challenge interpretation (Canning and Finlay 2012; Lim 2002). In some of these countries, the share of female participation in the labor force has followed distinctly different trajectories and has not been commensurate to the fall in fertility or their level of development (World Bank 2012). In Indonesia, for instance, female labor participation has declined as fertility has gone down in the country (Priebe 2010). India is another country where the benefits of fertility decline has not transferred onto increasing levels of female labor participation.

Considering its level of income, India, by far, has one of the lowest rates of female labor participation in the world. In Figure 2.5, female labor participation rates (in the 15+ age group), fertility and income per capita for the year 2005 in a selection of the developing countries is shown. A comparison of India with a number of these countries

helps to bring out a snapshot on female labor participation. The darker blue bars in the middle represent female labor participation in countries that, compared to India, had a much higher share of women in the labor force but levels of per capita income close to that in India. Yet, these comparator countries (Cameroon, Congo, Viet Nam) had levels of fertility that were quite higher than the level prevailing in India. But fertility in both Bangladesh and India was about 3 children per woman. However, in comparison to India, Bangladesh had a much higher female labor participation rate at a much lower level of income. Finally, at below-replacement level fertility and higher levels of income, women's economic activity in the East Asian countries of China and Thailand were almost double that in India.



**Figure 2.5 Comparison of Fertility and Female Labor Participation in a selection of Developing Countries, 2005**

Source: World Population Prospects: The 2010 Revision; International Labor Organization (ILO): LABORSTA Internet; World Bank 2011

## **2.3 Evidence on Fertility and Women's Work**

### **2.3.1 Impact on Economic Advancement**

Prior empirical studies identify a significant contribution of changing demographic parameters that result from fertility decline to economic advancement in developing countries including India.<sup>17</sup> A number of these studies identify the presence (or absence) of rising share of females in the labor force and the changing working to non-working age population ratio as the significant demographic dividends that boosted (or limited) economic growth in countries (Bloom et al. 2009; Bloom et al. 2000). Bloom and Williamson (1998) contend that these two factors explain about a third of the rapid economic growth in East Asia between the years 1965 and 1990. A number of other studies derive results consistently in support of the findings in Bloom and Williamson.<sup>18</sup> Conversely, multiple analyses interpret the slow economic growth in the African countries as a fallout of high-fertility driven demographic inertia.<sup>19</sup> In another study by Kelley and Schmidt (2005), results from a cross-country analysis on a panel of developing countries indicate that the decline in youth dependency ratio resulting from earlier declines in fertility was the strongest predictor of output per capita except in the countries of Africa.

---

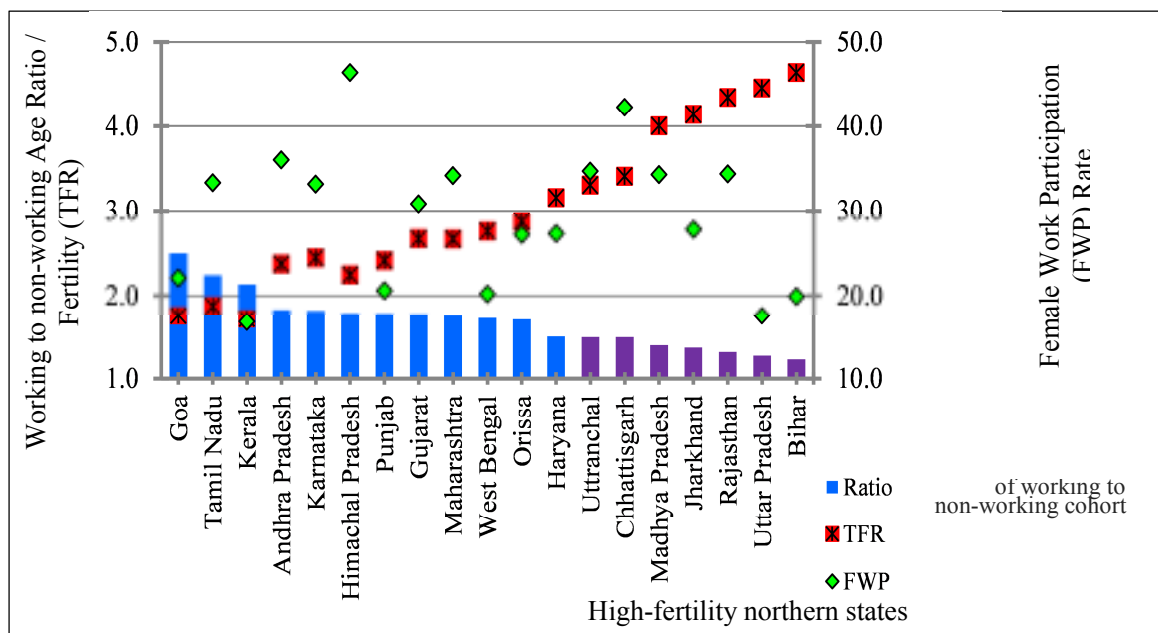
<sup>17</sup> See for example Crenshaw, Ameen, and Christenson (1997), Brander and Dowrick (1994), Bloom and Freeman (1987). For analyses examining the case of India see, for example, Bloom et al (2010), Krueger (2007), Kurian (2007), and Prskawetz, Kögel, Sanderson, and Scherbov (2007), Acharya (2004).

<sup>18</sup> See for example, Bloom and Finlay (2009), Bloom and Canning (2008), and Bloom, Canning, and Malaney (2000).

<sup>19</sup> See for example Bloom, Canning, and Sevilla (2003), Bloom and Sachs (1998), and Bloom, Canning, Fink, and Finlay (2007).



Klasen and Pieters (2012) provide evidence that the demographic benefits of low fertility in India will be limited as female labor participation in urban India over the past few decades has remained almost unchanged from previous historic low rates. In combination, as discussed in the previous section, the fertility projections portend a slow changing dependency ratio unlikely to provide a shock to the economy at par with that seen in East Asian countries. Of greater significance is the fertility heterogeneity that demarcates the North from the South of India (Bloom 2012). This variation is presented in Figure 2.6 that captures the swath over which fertility and related demographic parameters ranged across the bigger states of India in 2001.



**Figure 2.6 Fertility, Female Work and Working to Non-working Age Ratio in the States of India, 2001**

Source: Census of India 2001; Guilmoto and Rajan (2002)

In the above figure, the blue bars represent the state-level ratio of working to non-working age population with the darker blue ones highlighting the high-fertility northern states of India. The red points stand for the prevailing rates of fertility (TFR) and the green points denote the levels of FWP in the each of the respective states. Although the FWP rates do not follow any distinctly singular pattern, a comparison of the blue ratio bars against the red fertility points brings out the clear inverse relation between fertility and working/non-working age ratio. The figure also shows the range of variation in these indicators across the various states. For example, fertility in Bihar is a little over two and half times of that in Goa, and the ratio of working age to non-working age population is about half of that in Goa.

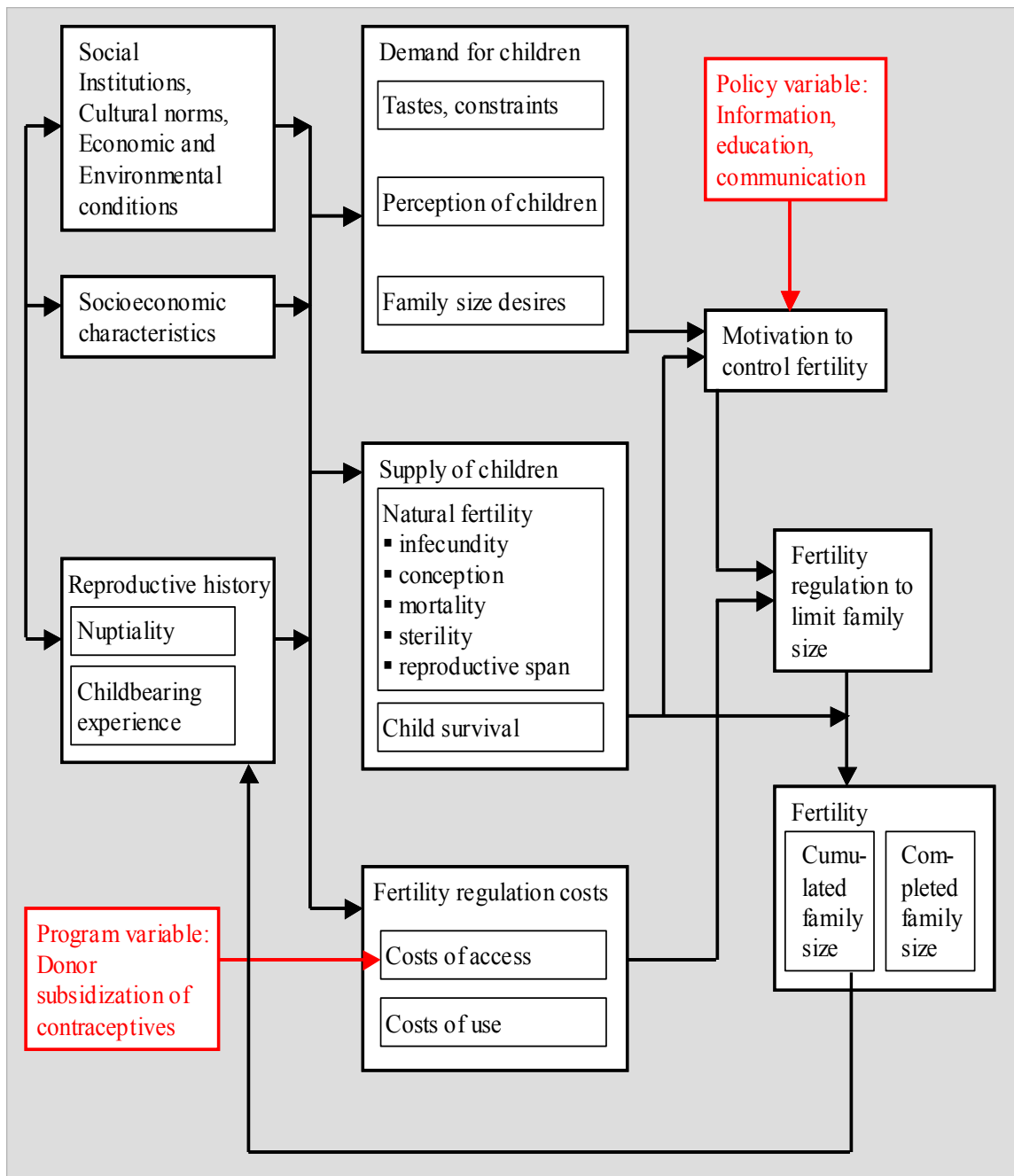
### **2.3.2 Correlates of Fertility**

As a demographic outcome, fertility decisions result out of the combined influence of proximate biological and nonproximate social factors. While the first group of factors pertains to the biophysical ability to reproduce, the latter provides the domain within which reproductive decisions take place. Changes in the nonproximate determinants impact fertility through the proximate (or intermediate) variables (Weeks 2005; Iyer 2002). Fertility is most often measured in terms of total fertility rate (TFR), which is an estimate of the rate at which women are reproducing during their childbearing ages.

Scholarly muse over what determines fertility in developing countries coincides with the rapid growth in population in the latter half of the twentieth century (WB 2010). Davis and Blake (1956) initially forwarded the proximate-determinant model of fertility. In identifying the group of proximate determinants that directly affect fertility, the

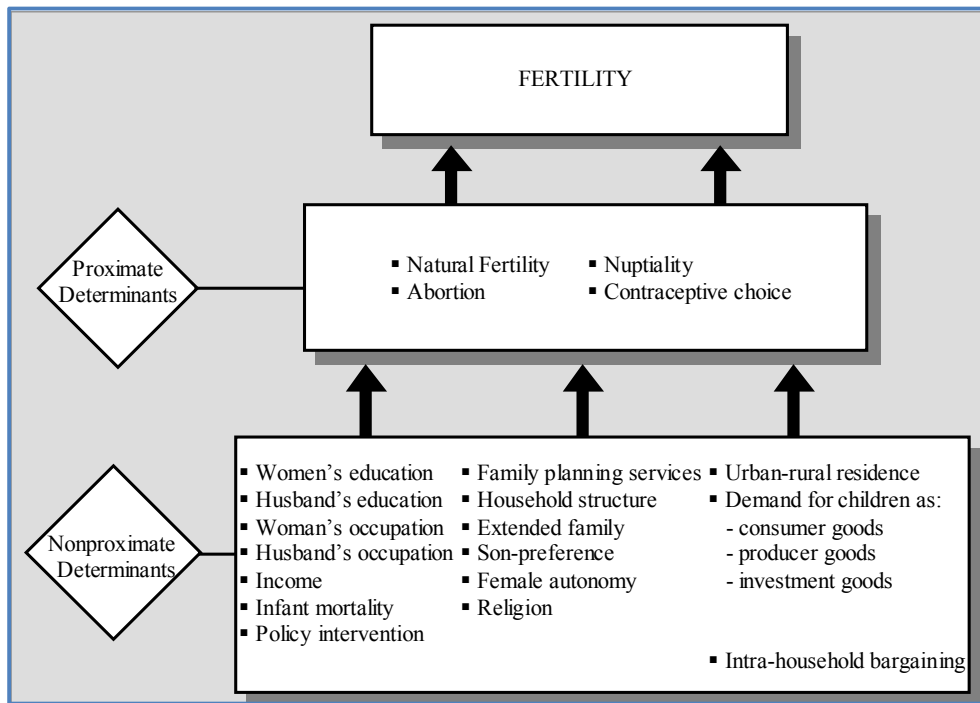
authors highlighted the indirect influence of the nonproximate variables. Freedman (1962) extended Davis and Blake's model by adding a few nonproximate variables such as education, income, occupation, etc. Much later Easterlin and Crimmins (1985) formalized this model of fertility by incorporating a supply-demand framework to it which introduced the economic considerations of fertility control into the model. Bulatao and Lee (1983) further extended the supply-demand framework to provide an encompassing model of proximate-nonproximate fertility determinants in the developing countries (Figure 2.7). This model acknowledged the interdependence between the structural (modernization), behavioral (socioeconomic), cultural (ideational) and policy (programmatic) factors influencing fertility decisions.

Empirical applications of this conceptual model of fertility identify the macro-level exogenous correlates and the micro-level endogenous proximate determinants of fertility in developing countries (Figure 2.8). For example, infant and child mortality is a critical macro-level factor (Hirschman 1994). Status of women, as a sociological agency, is also a significant predictor of fertility choices affecting both the supply and demand for children and in turn adjusting the influence of all other factors (Dyson and Moore 1983; Bulatao 2001). Therefore female education and female literacy rates assume importance in addition to factors embedded in tradition, such as household and family structures, preference for the male child, land-holding patterns, and religion, to name a few.



**Figure 2.7: Theoretical Model of Fertility**

Source: Bulatao and Lee (1983)



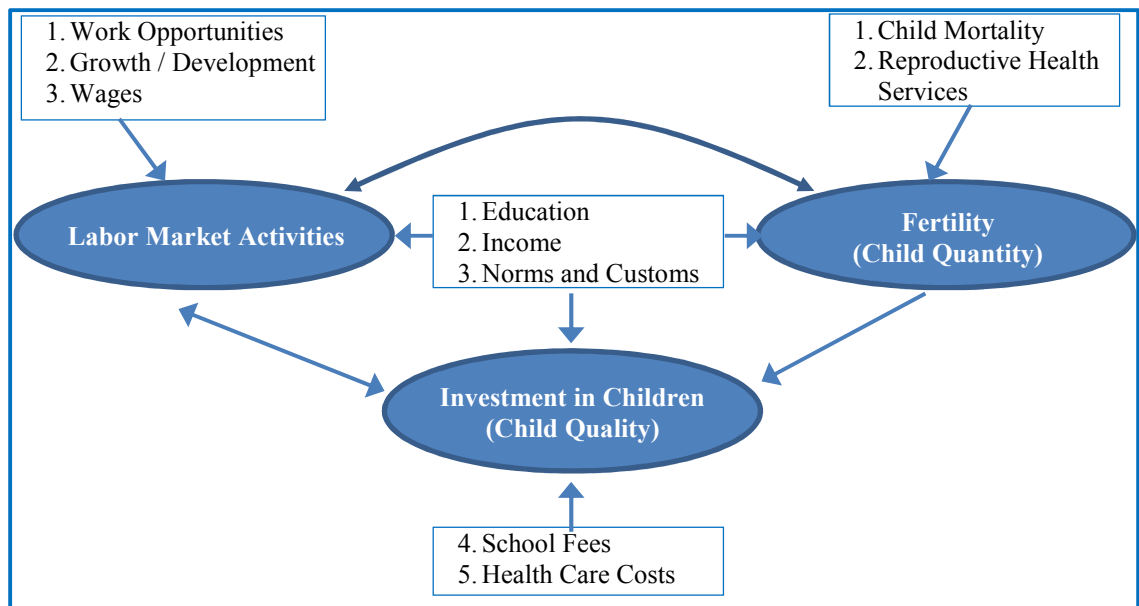
**Figure 2.8: Empirical Model of Fertility**  
Source: Iyer (2002)

### 2.3.3 Correlates of Women's Work

Following the seminal work of Mincer (1962), multiple studies have examined the factors that influence female labor participation at the micro levels and how these individual-level decisions combine to create aggregate trends. In investigating the particular role of fertility, most theorists agree that fertility and labor participation decisions are jointly determined within the household (Browning 1992). Willis (1973) conceptualized a work-fertility model. In Figure 2.9 this model is depicted in which the factors mediating the relation between the two endogenous variables are traced.

Most empirical applications of the model forwarded by Willis identify various individual-level aspects that impact women's work in developing countries. Far fewer

focus on cross-country or country-level studies that examine the structural conditions which correlate with aggregate observed trends in female labor participation. Along with the endogenous effect of fertility, macro-factors that consistently feature in the latter group of empirical analyses relate to levels of economic and social development and sociocultural norms (Younger 2006; Mathur 1994).



**Figure 2.9: The Theoretical Work-Fertility Model**

Source: Younger (2006); Willis (1973)

### **CHAPTER 3: DISTRICT-LEVEL FERTILITY OUTCOMES THE RELATIVE ROLES OF SOCIOECONOMIC FACTORS AND DIFFUSION**

#### **Chapter Summary**

Most scholars agree that spatial diffusion and prevailing socioeconomic conditions are important determinants of fertility. Yet, the application of a framework that incorporates both of these factors to examine fertility in the developing world is limited. This chapter addresses that gap by employing a blended theoretical perspective—and thus a spatial approach—to test the hypothesis that regional fertility outcomes is explained through the combined effects of endogenous diffusion and structural socioeconomic factors. Spatial autoregressive (SAR) empirical specifications are employed to model fertility in India. In so doing, the aim is to interpret high fertility concentrated in the heartland of the country that, absent a faster decline, will limit the demographic lift and any economic benefits thereof. Findings validate the research hypothesis and policy implications of the empirical results are discussed.

### 3.1 Introduction

The international policy community—led most notably by the United Nations and the World Bank, and the United States governmental agencies, mainly USAID, and nongovernmental agencies—played a pivotal role in focusing world attention over the causes and consequences of high fertility in the developing countries. While the population-development debate is not yet settled, a general consensus exists in the international arena that persisting high population growth does indeed overwhelm governmental capacity and public services efficiency (Amalric and Banuri 1994; Tsui 2001; Sinding 2000; Kohler 2012).<sup>20</sup> Governments in developing countries have traditionally been urged to address high fertility through suitable policy measures to maintain the quality and lower the cost of providing public services (Easterlin 1967; Kelley 1985; Chao 2005).

Contemporary fertility transition in many parts of the developing world began alongside the initiation of family planning programs.<sup>21</sup> India, the first developing nation to adopt a national family-planning policy in 1952, entered into fertility transition in the 1960s.<sup>22</sup> Policy efforts in India have addressed high fertility directly through population policy and indirectly through broader socioeconomic development programs (Zodgear

---

<sup>20</sup> As recounted in Chapter 1, the debate over population and development remains open with evidence and counter-arguments dividing opinion on the effect of population growth on economic development (Lee 1983; Simon 1989; Amalric and Banuri 1994).

<sup>21</sup> By the end of the twentieth century, more than sixty percent of the countries of the less developing region had adopted a population policy at the national level to lower their levels of fertility (Tsui 2001).

<sup>22</sup> To reiterate from Chapter 2, fertility transition is that decline in fertility which shifts societies from natural fertility characterized by very high levels of fertility to replacement-level fertility. The value of replacement-level fertility is set at the point where total fertility rate (TFR) is 2.1 as at that rate couples are approximately replacing themselves in the future population. TFR is a composite measure for the level of fertility and is expressed as the average number of children per woman.



1996).<sup>23</sup> Yet, six decades later, the initial goal of the National Population Policy (NPP), i.e., population growth stabilization through the attainment of replacement level fertility, remains unrealized. Further, in India, regional disparities in fertility decline have not only persisted but have progressively increased over the decades resulting in a North-South fertility divide (Bloom 2012; Guilmoto 2005). Moreover, the slowdown in decline in fertility since 2000 has cast a shadow on the country's prospect of benefitting from the demographic dividend (Bloom 2012; Haub 2002). If the stall in decline, particularly in the northern states, persists, a suitable age transition that lowers the young dependency ratio to springboard the demographic dividend process may be unlikely (Bloom 2012; Jain and Jain 2010).

A vast body of literature explains variations in fertility in India and its determinants through various theoretical considerations (Hirschman 1994, Guilmoto 2005). A number of alternative fertility hypotheses have been forwarded and the consequent fragmentation of the theoretical field ensures that state- and sub-state level empirical analyses seldom converge or coalesce to provide a unifying framework. How then can regional variations in contemporary fertility outcomes in developing countries such as India be interpreted? What factors explain varying levels of fertility between regions at similar levels of economic development, or vice versa? What role can government play to facilitate the desired fertility in lagging regions? The goal in this analysis is to address these questions by adopting a blended perspective that incorporates

---

<sup>23</sup> The mandate in the National Population Policy directs states to devise their own policies and programs to lower fertility levels giving priority to local conditions, particularly the prevailing socioeconomic conditions (Ram 2006). The rationale for addressing high fertility through socioeconomic development originates from the dominant classical demographic transition and subsequent economic theories of fertility.

the spatial diffusion theory within the framework of conventional theories of fertility. The conventional classical demographic transition and economic theories of fertility highlight economic development as the factor that transforms societal- and individual-level behavior including fertility choices.

Motivated on the blended perspective, district-level fertility outcome in India is modeled in this study as a joint function of spatial diffusion and structural socioeconomic conditions. Spatial diffusion is defined as geographic trends arising out of information spillover among neighboring regions. When significant, the spread of information on the benefits of a small family norm and diffusion of the innovative behavior of fertility regulation results in distinct geographic clusters of similar levels of fertility in neighboring regions. Spatial autoregressive specifications are used to model this phenomenon and examine determinants of district-level fertility. Isolating potential reasons for high fertility in the heartland of the country is at the center of this analysis. Findings indicate that both diffusion and socioeconomic factors played a significant role in influencing fertility outcomes in India, except in the high-fertility northern districts where the strength of diffusion was weaker.

The rest of this chapter consists of five parts. In the following section the relevant fertility theories are discussed providing the background on the theoretical framework employed. In section two, literature on fertility in India is summarized to present a synopsis of the existing trends, knowledge and prior analyses on fertility. In the third section, the empirical models are specified. The fourth section interprets the results and

potential policy implications of this analysis. The final section concludes with limitations of this analysis and directions for future research.

### **3.2 Theoretical Framework**

Literally every single facet that sets apart a traditional society from a modern one has been considered in explaining fertility outcomes (Cleland and Wilson 1987). Many of the fertility theories are from beyond the traditional discipline of demography, and are contributions from fields as varied as economics, sociology, anthropology, history and behavioral science, to name some (Caldwell 1997, de Bruijn 1998, Hirschman 1994, 2001). Each of these theories has variant sub-domains and a number of these, while stressing one, often have underpinnings of another sub-theory or crosses over to overlap with altogether a different theory. An in depth discussion of these theories is beyond the purpose of this chapter. Instead, the most notable of the relevant conventional hypotheses are summarized in the next sub-section followed by an account of the diffusion theory and the blended perspective on fertility.

#### **3.2.1 Conventional Perspectives: Economic Theories**

The easy measurability of economic indicators marked the ascendancy of economic theories of fertility (Watkins 1987). Among these, the fundamental hypothesis that presages declining levels of fertility is the demographic transition theory (DTT). The theoretical demographic transition model, related concepts and population characteristics was introduced in Chapter 2. As mentioned therein, this theoretical model originated in the works of Warren Thompson (1929). Subsequent contributions by Notestein (1945,

1953) and Kingsley Davis (1945) further refined DTT.<sup>24</sup> It is a macro-level theory that rests on Notestein's fundamental premise of modernization (Caldwell 1976).<sup>25</sup> In other words, it focused on changes such as modernization and urbanization at the societal level in emphasizing economic development as a precondition of change in fertility behavior leading to declining levels of fertility (Cleland and Wilson 1987, Watkins 1987, Weeks 2005).

The neoclassical economic theory of fertility departed from the standard DTT by shifting the focus from macro-level structural changes to micro-level individual household preferences (Watkins 1987). Originally proposed by Becker (1960), the theory has numerous variants that are referred to as the “demand theory”, the “Chicago school approach” and the “new household (home) economics”. It situates fertility outcomes within the context of growth theory and human capital theory and views children as consumer goods and individual fertility preferences as a utility maximizing behavior

---

<sup>24</sup> The demographic transition model (DTM) discussed in the previous chapter represents a process that demonstrates how countries progress from high to low (or declining) population growth scenarios; it however does not offer insights as to why countries undergo such a process. The issue here is twofold – first, why is fertility high for certain societies? And next, why or under what conditions does mortality and fertility decline? It was enquiries into these why parts that inducted a theoretical perspective into demographic transition, transforming it from a concept to a theory known as the Demographic Transition Theory (DTT). As a theoretical base, the DTT developed over the period of 1940-1960 from studies examining the pattern of fertility decline in the countries of Western Europe and North America (Weeks 2005).

<sup>25</sup> In pre-modern societies, a high mortality rate necessitates a high fertility rate to sustain the human population. A high level of fertility rate is also favored by the norms and values—“religious doctrines, moral codes, laws, education, community customs, marriage habits and family organizations”—that define pre-modern societies (Notestein 1945: 39). But the forces of modernization, technological and economic growth, come in to play as communities transition from a pre-industrial and dominantly agrarian to an industrial and subsequently post-industrial urban society. These factors usher in concomitant changes in social and economic life that subvert traditional values and norms. Fertility decline is therefore witnessed as mortality drops and traditional values are changed towards a modern way of life that confronts societies with the benefits of lower fertility through expanded economic opportunities (Notestein 1945, Caldwell 1976; Stzreter 1993; Mason 1997).

(Cleland and Wilson 1987). With economic growth, the economic opportunity/constraint structure changes thereby leading to a rise in the cost and in turn a fall in the demand for children (Robinson 1997; Bulatao 2001). New incentives (female employment, etc.) and disincentives (demand for skilled labor dictating prolonged schooling of children, etc.) are created that raise the opportunity cost of children and reduce the value of children as old-age security (McNicoll 2001). As a result, families and individuals adjust their fertility behavior to have the optimal number of children (Bulatao, 2001).

A series of subsequent work by Leibenstien (1974, 1975) and Easterlin (1969, 1975, 1978, 1983, Easterlin and Crimmins 1985, 1986) introduced an alternative second approach to the microeconomic theory of fertility (Sanderson 1976). These studies were attempts to broaden the consumer choice / demand theory model by marrying standard microeconomic concepts with the sociological factors that shapes fertility behavior. Easterlin's 1978 model, which is the most prominent, considers two additional factors, supply of children and the cost of fertility regulation, other than demand for children as the basic determinants of fertility. While a rise or fall in the demand for children results from economic factors such as modernization as predicted in DTT, on the other hand, cultural factors such as rate of marriage stimulate or constrain the supply of children. Both of these factors converge with the psychological factors related to fertility regulation and its cost to jointly guide the reproductive behavior of couples.

### 3.2.2 Alternative Perspective: Diffusion Theory

In stressing that reproductive behavior is ensconced within a normative environment, the sociological camp has challenged the assumptions of economic theories of fertility.<sup>26</sup> Cultural theories have come in to fill the gap where economic theories have fallen short. Thus even though Notestien's classical formulation together with the earliest theoretical extensions that followed the DTT, marked the ascendancy of economic theories, cultural theories subsequently formed another pole around which fertility has been explained. Among these theories, one major sub-theme is the diffusion theory that is increasingly being accepted to explain fertility outcomes in the developing countries (Gayen and Raeside 2006).

The emergence of diffusion to explain regional fertility outcomes can be traced back to a number of empirical projects that cast a doubt on the validity of economic development as the factor spurring fertility change (Watkins 1987; Cleland and Wilson 1987; Hirschman 1994; van de Kaa 1996).<sup>27,28</sup> Diffusion theorists stress the role played by the spread of ideas that support the ideal of a smaller family size and view fertility

---

<sup>26</sup> For early reviews of these arguments, see for example Caldwell (1976); Ryder (1983). The adequacy of applying macro and microeconomic theories to explain fertility decline is questioned as an economic focus, by itself, has failed to satisfactorily explain the country specific variations in fertility and onset of transition. Also, despite the addition of two important elements, Easterlin's supply-demand model is faulted for failing to resolve the major weaknesses in the DTT. A parallel, albeit secondary, theme of DTT is the reorientation of social norms and values. A storm of counter-arguments, therefore, has emanated from scholars stressing the role of socio-cultural factors (Hirschman 2001; McNicoll 2001; Watkins; Mason 1997; Watkins 1987).

<sup>27</sup> In the literature "diffusion theory" has been alternatively termed as cultural-, information-, spatial-, geographic-, or innovation-diffusion theory.

<sup>28</sup> The most notable among these empirical endeavors are the Princeton Office of Population's European Fertility Project (EFP) and the World Fertility Survey (WFS).

regulation as a social innovation.<sup>29</sup> Social innovation triggers new ideas, information and behavior and diffusion is the spread of this innovation through social learning leading to its greater prevalence within and across societies. Carlsson (1966) first conceptualized fertility regulation as a process of social innovation which in the form of “a popular revolution” spreads from individual to individual, from group to group, and from region to region (Watkins 1987).

The central premise of the diffusion theory is, therefore, the concept of *information spillover* which helps in diffusing the innovative practice of fertility regulation (Rosero-Bixby and Casterline 1993). Two ways in which diffusion of fertility innovation occurs are: first, through contagion as a result of person-to-person social interactions (Hornik and Mcanay 2001).<sup>30</sup> Second, through external-source diffusion resulting out of information spillover from the mass media such as newspapers, magazines, radio, television, and government campaigns (Rosero-Bixby and Casterline 1993). And, in a hierarchy of international, regional and local space within which all individuals exist, innovative information / idea is disseminated across spatial or geographic extents that are “fields of influence” of “newspapers, radio and television broadcasts and books, ordinary talk and observation” (Hagerstrand 1968).

Valente et al. (Valente and Saba 1998; Valente et al. 1996) explore the relationship between the two types of diffusion process as sources of new information.

---

<sup>29</sup> These scholars, to name a few, are Retherford (1979, 1985), Knodel (1977), Knodel and van de Walle (1979), Retherford and Palmore (1983), Cleland and Wilson (1987), and Watkins (1987).

<sup>30</sup> The term contagion, has been expressed variously in the literature as social norms, peer influence, conformity, imitation, epidemics, herd behavior, bandwagons, neighborhood effect, and of course social effects to embody social processes resulting out of information spillover (Manski 1993: 531).

Each form of diffusion may function as the substitute of the other or interact and augment the effect of the other when new ideas diffusing out of the two are in conformance. If not, the contradicting ideas diffusing out of each may temper or even alter the influence of the other. For example, information acquired through social networks may frame the receptivity to information disseminated through the mass media. Alternatively, information gleaned out of the mass media may provide the content for face-to-face interaction (Casterline 2001b).

Further, two forms of diffusion is identified in the literature. Diffusion can be either vertical or horizontal, or a combination of both. Spread of innovation that percolates down from the social elites (higher in status) to the non-elites (lower in status) is a vertical process of diffusion. On the other hand, progressive diffusion across space and over time from specific points of origin, for example from the urban areas to the countryside, constitutes a horizontal form of the process (Tolany 1995). Accordingly an accepted reality in demography is that levels of fertility differ according to social class differentiated vertically by social influence and horizontally by such factors as racial, ethnic, and linguistic compositions (Weeks 2004).

### **3.2.3 The Blended Framework**

With the advancement in computer technology and the greater availability of spatial data, the theory of diffusion has increasingly been applied to examine social outcomes which include the study of fertility. Conventional theoretical models of fertility do not, however, consider diffusion, but instead highlight the role played by socioeconomic factors. Conversely, pure models of diffusion consider the effect of innovative behavior as the



primary exogenous factor for fertility change. In between are blended models in which diffusion of the innovative fertility behavior operates endogenously with the structural conditions providing the exogenous impetus for change in fertility behavior (Casterline 2001b; Cleland 2001). Most scholars agree that region-specific forces of diffusion and structural socioeconomic changes are combinatorial (Burch 1996, Casterline 2001b, Lesthaeghe 2001).<sup>31</sup>

The incorporation of both diffusion and socioeconomic theories as a blended perspective provides the framework for explaining regional variations in fertility behavior. Acknowledging the role of modernization and changing demand for children, the blended perspective stresses the role that diffusion of positive information plays in breaking down barriers or resistance (such as religious, ethical, etc.) to birth control practices for fertility regulation: lack of such positive information impedes the process of fertility decline. In other words, two regions at varying levels of development may experience similar rates of fertility decline in the presence of diffusion and vice versa (Hirschman 1994, Mason 1997).

A blended model of fertility is particularly suited for interpreting regional variations in fertility outcomes in developing countries such as India. Whereas historical fertility transition in Europe progressed in the absence of any policy intervention, the onset of contemporary fertility transition coincided with the introduction of family planning programs in a number of the developing countries. Further, in addition to addressing fertility through socioeconomic development programs, an active policy focus

---

<sup>31</sup> See for example Palloni (2001), Carter (2001), Lesthaeghe and Vanderhoeft (2001), Montgomery and Casterline (1998), Burch (1996), and Mason (1992),.

in India has been the spread of information and ideas that establish the ideal of a small family norm through fertility regulation to counter social practices related to the prevalence of high fertility (Robinson and Ross 2007).

Empirical application of the blended theoretical framework that incorporates both diffusion and socioeconomic factors to analyze fertility in the developing world is, nonetheless, limited (James and Subramanian 2005). Instead, to model regional fertility outcomes, the conventional theoretical perspective and a framework of classical regression have most often been considered. Such an application that ignores diffusion however yields inefficient and inconsistent regression estimators; or in other words, results in biased and inaccurate understanding of the relation between fertility and its correlates.<sup>32</sup>

### **3.3 Fertility in India**

#### **3.3.1 National Family Planning Program**

Rapid population growth in India in the late nineteenth century was a matter of concern to her British rulers. Yet, an official policy to address the issue was not launched until much later. An effort to launch a national population policy for birth control was made around the time India was poised to become a sovereign nation. Firmly entrenched in Malthusian principles, this effort was couched in the bigger context of overpopulation,

---

<sup>32</sup> In most cases, this relation will get inflated (i.e. biased upward) and in particular cases the direction (positive when actually it should be negative, or vice versa) may also be altered. Additionally, endogeneity due to omitted (unobserved / latent) diffusion will cause the independent variable(s) to correlate with the error term.

poverty and national health, particularly child and maternal health (Robinson and Ross 2007; Rao 2004).

National Population Policy (NPP), the Indian family planning policy, was adopted in 1952 by the then Prime Minister of India, Jawaharlal Nehru. India thus became the first country in the developing world that acknowledging its high population growth rate, sought to reduce it through the “positive” agency of family planning. The official national family planning program that evolved thereafter has essentially been an outcome of three factors: India’s successive five-year state plans, a series of consecutive policy approaches built around newly available technology for family planning, and the role played by international donors, such as the United Nations, the World Bank, the Ford Foundation, and International Planned Parenthood Federation. (Rao 2004).

During the last nearly six decades of development, the NPP, along with subsequent state and district level counterparts, underwent various policy phases that attempted to strengthen, augment and improve programmatic performance. A common theme, nonetheless, that typifies these successive policy initiatives is that programmatic targets and goals consistently remained unattained. And, the main objective of reducing the level of fertility in the country to the replacement-level is yet to be realized (Sunil et al. 1999, Rao 2004, Dyson et al. 2004, Connelly 2006, National Commission on Population 2000).

### **3.3.2 Existing Fertility Trends**

Fertility level in India remained at a near constant birth rate until the 1960s, when total fertility rate (TFR) started declining at the national level. In Table 3.1 below, fertility

levels in India and major states are listed. In a number of states, fertility has been declining at a rate faster than the national average. Decline in fertility has mainly been driven by reduction in fertility levels in the southern parts of the country (Murthi, et al. 1995). The southern states of Kerala and Tamil Nadu were the first two states to attain replacement-level fertility of 2.1. And, by 2009, these two states were joined by a number of other states which are Delhi, Himachal Pradesh, and Punjab in the north; Andhra Pradesh, and Karnataka in the south; Maharashtra in the west; and West Bengal in the east (Registrar General of India 2011; 2006). Although district level studies analyzing fertility trends in India are relatively limited, it is reported that the pattern of fertility decline across the districts has been similar to that in the states (Guilmoto and Rajan 2001). In addition to the North-South geographic dimension, variation in fertility outcomes is also recorded by place of residence (rural vs. urban), and by religious and social classes.

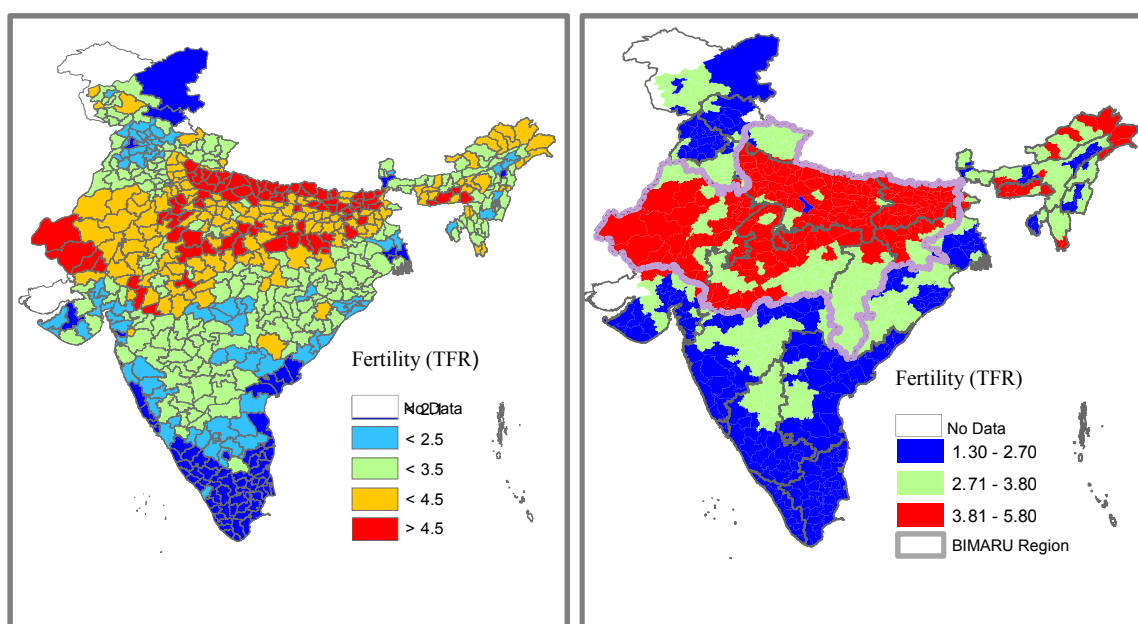
**Table 3.1: Estimated Total Fertility Rates (TFR), Major States and All India, 1970-2007**

| State          | Total Fertility Rate (TFR) |         |         |         |      | Decline<br>(Percent) |
|----------------|----------------------------|---------|---------|---------|------|----------------------|
|                | 1970-72                    | 1980-82 | 1990-92 | 1996-98 | 2007 |                      |
| India          | 5.2                        | 4.5     | 3.7     | 3.3     | 2.7  | 48.1                 |
| Andhra Pradesh | 4.7                        | 3.9     | 3.0     | 2.5     | 1.9  | 59.6                 |
| Assam          | 5.5                        | 4.1     | 3.4     | 3.2     | 2.7  | 50.9                 |
| Bihar          | -                          | 5.7     | 4.6     | 4.4     | 3.9  | 31.6                 |
| Gujarat        | 5.7                        | 4.4     | 3.2     | 3.0     | 2.6  | 54.4                 |
| Haryana        | 6.4                        | 5.0     | 3.9     | 3.4     | 2.6  | 59.4                 |
| Karnataka      | 4.4                        | 3.6     | 3.1     | 2.5     | 2.1  | 52.3                 |
| Kerala         | 4.1                        | 2.9     | 1.8     | 1.8     | 1.7  | 58.5                 |
| Madhya Pradesh | 5.7                        | 5.2     | 4.6     | 4.0     | 3.4  | 40.4                 |
| Maharashtra    | 4.5                        | 3.7     | 3.0     | 2.7     | 2.0  | 55.6                 |
| Orissa         | 4.8                        | 4.2     | 3.3     | 3.0     | 2.4  | 50.0                 |

**Table 3.1 (Contd.)**

| State         | Total Fertility Rate (TFR) |         |         |         |      | Decline<br>(Percent) |
|---------------|----------------------------|---------|---------|---------|------|----------------------|
|               | 1970-72                    | 1980-82 | 1990-92 | 1996-98 | 2007 |                      |
| Punjab        | 5.3                        | 4.0     | 3.1     | 2.7     | 2.0  | 62.3                 |
| Rajasthan     | 6.3                        | 5.4     | 4.5     | 4.2     | 3.4  | 46.0                 |
| Tamil Nadu    | 3.9                        | 3.4     | 2.2     | 2.0     | 1.6  | 59.0                 |
| Uttar Pradesh | 6.7                        | 5.8     | 5.2     | 4.8     | 3.9  | 41.8                 |
| West Bengal   | -                          | 4.2     | 3.2     | 2.6     | 1.9  | 54.8                 |

Source: Registrar General of India, various years



3.1.1: Thematic Map showing District Boundaries

3.1.1: Tercile Map showing State and District Boundaries

**Figure 3.1: Choropleth Maps showing Regional Clustering in District-Level Fertility Outcomes in India in 2001**

The North-South geographic pattern in fertility outcomes in 2001 is portrayed in the choropleth maps (Figure 3.1). Figure 3.1.1 on the left shows replacement level fertility (TFR = 2.1), represented in the dark blue tones, is an occurrence that is confined mainly to the southern parts of the country except the two northern most districts of Leh

and Ladakh. In contrast, the heartland of the country exhibits a much higher fertility level. This region is referred to as the BIMARU Region and comprises of the states of Bihar and Jharkhand (BI), Madhya Pradesh and Chattisgarh (MA), Rajasthan (R) and Uttar Pradesh and Uttranchal (U).

The spatial clustering in fertility outcomes is further highlighted in the tercile map (Figure 3.1B). In 2001, only about a third of the districts in the South had a TFR greater than 2.1. In contrast, majority of the districts in the BIMARU Region represented in red tone in Figure 3.1.2, recorded fertility levels that ranged between 4 to 6 children per woman, comparable to fertility in sub-Saharan Africa—about 5 children per woman (United Nations 2010). Much of India's progress towards achieving population growth stabilization has been held back by the persisting high fertility levels in the BIMARU region. By the year 2027 when the last of the BIMARU state is projected to attain replacement level fertility, India's population will have increased to 1.4 billion: a size that will have serious implications for sustainability, development potential and security of the country (Registrar General of India 2006). This trend alone warrants that policy attention be focused to facilitate fertility decline in the high-fertility BIMARU districts.

### **3.3.3 Prior Analyses and Evidence**

State-level Analysis: A robust number of studies have examined the determinants of fertility behavior and the causes of state-level variation in fertility outcomes. Analysts have forwarded a number of alternative fertility hypotheses and considered a range of explanatory variables to explain variations in fertility including economic change due to modernization, demand and supply of children, socio-culture

and policy intervention. Hypotheses embedded in cultural and historical contexts have often been used to explain higher levels of fertility in the northern parts of the country. Yet, fertility in the northern state of Punjab has been declining rapidly despite a very strong cultural preference for sons. Given a trend of rapidly expanding industrialization with concomitant improvement in levels of income in Punjab, economic prosperity has been linked to fertility outcomes in the state (Dyson et al. 2004; Das Gupta 1995).

Next, for Kerala, a southern state with completed fertility transition, socioeconomic development, particularly female literacy rate, have been highlighted in the literature as the determining factor spurring the decline in fertility (Bhat and Rajan 1990; Sen 1997; Krishnan 1998; Srinivasan 1995). In the adjacent southern state of Andhra Pradesh, fertility decline in the absence of suitable levels of female literacy rate is, however, explained largely in the context of institutional theories stressing the role of effective state-level family planning programs (Rao et al. 1986; Das and Dey 2000). Conversely, for the group of northern states in the BIMARU Region, it is argued that lower levels of socioeconomic development have slowed down the pace of fertility decline, in addition to limiting the effectiveness of state-level programs (Satia and Jeebhoy, 1991). The validity of these hypotheses that explain fertility decline as an outcome of policy performance is, however, seriously challenged: studies analyzing fertility differentials at the sub-state level, district or village comparable respectively to counties and census tracts in the U.S., find that fertility trends do not correspond to, but cut across administrative boundaries (Bhat 1996).

District-level Analysis:

At the district-level, empirical fertility studies fall in two broad groups: the first group of analyses employs econometric modeling technique to examine socioeconomic and cultural determinants of fertility.<sup>33</sup> The other group is more recent studies that apply various modeling techniques originating in spatial statistics and/or geostatistics to interpret the role played by diffusion in creating variations in fertility outcomes.<sup>34</sup> With a research focus to explain fertility differential across the districts, the econometric studies identify a range of significant predictors of fertility behavior. Conversely, the geostatistical studies model spatial variability in fertility behavior across space (districts) and over time. However, neither group of studies adopts a framework suitable to examine the relative roles played by socioeconomic factors and diffusion. The analysis in the present study addresses this deficiency by applying the blended theoretical framework and empirical spatial autoregressive models to examine fertility outcomes across the districts of India.

Next, evidence on the relation between fertility and the determining factors of economic development, for example level of urbanization, income and expenditure, is less than conclusive. A number of scholars have argued that social development instead of economic development and modernization variables, per se, is more important in influencing fertility behavior in India.<sup>35</sup> Others provide evidence that economic

---

<sup>33</sup> Some of the scholars belonging to the first group of studies are Malhotra et al. (1995), Murthi et al. (1995), Dreze and Murthi (2001), Guilmoto (2005), and Bhattacharya (2006).

<sup>34</sup> The spatial statistical studies are Guilmoto & Rajan (2001), Balabdaoui et al. (2001), Bocquet-Appel (2002) and Guilmoto (2005)

<sup>35</sup> The most notable of these scholars are Dreze and Sen (1995, 2002), Murthi, Guio and Dreze (1995) and Dreze and Murthi (2001).



development is significantly impacting fertility outcomes.<sup>36</sup> It is also the aim of this analysis to re-examine the role of social and economic variables in impacting district-level fertility outcomes.

Similarly, understanding on the role of diffusion remains underdeveloped. Malhotra et al. (1995) and Murthi et al. (1995) provide some evidence of diffusion. In addition to economic development and modernization indicators, a spatially correlated error term is considered in these analyses. The spatial error coefficient is statistically significant in both analyses and is interpreted as the effect of “unobserved cultural factors on fertility.”<sup>37</sup> The theoretical or empirical underpinnings of these factors are however not discussed any further beyond this statement. Another study by McNay et al. (2003) provides evidence of vertical diffusion.<sup>38</sup> Finally, geostatistical studies reveal a spatial progression of fertility transition as evidence of horizontal (geographic) diffusion (Guilmoto and Rajan, 2001).<sup>39</sup> The blended empirical models discussed in the next section are derived to add to this evidence base by examining the relative role of diffusion.

---

<sup>36</sup> For example, Bhattacharya (2006, 2004) and Malhotra et al. (1995) have highlighted economic development factors.

<sup>37</sup> Murthi et al. (1995): 761.

<sup>38</sup> The results of this study reveal that a larger share of fertility decline is attributable to uneducated women who learn about the benefits of smaller family from the educated social elites (Bhat 2002; McNay et al. 2003). Diffusion theory has therefore been discussed in this study with the argument that information spillover is playing a major role in driving decline in fertility in addition to what is on account of socioeconomic development (Dyson et al. 2004, McNay et al. 2003).

<sup>39</sup> These studies show that fertility started declining first in the southern coastal districts and the outermost western and eastern states and successively moved inland.

### 3.4 Research Design

#### 3.4.1 Empirical Models and Hypotheses

The spatial autoregressive (SAR) methodology is employed to empirically model district-level fertility outcomes in India. Two alternative specifications of the SAR model, the spatial lag form (equation 1) and the spatial Durbin model (equation 2), are applied to the cross-sectional district-level data to test *Hypothesis I* as stated below.

*Hypothesis I: Across a cross-section of districts, diffusion and a set of socioeconomic variables are significantly associated with fertility outcome in each district.*

The underlining assumption in diffusion is that the spread of information on benefits of family planning leads to an increase in the likelihood of adoption of the innovative fertility behavior in the vicinity of the initial adopters of family planning. Consequently, the aggregate values of fertility observed in spatially contiguous regions are correlated over space, exhibiting “spatial autocorrelation” (SA). A classical form of regression considers structural (socioeconomic) correlates of fertility but ignores geographic interdependency and yields biased and inaccurate model estimates where SA exists. To incorporate the additional dependency the classical regression model is, therefore, modified and expressed as a spatial lag model that includes a spatial lag of fertility ( $\mathbf{W}\mathbf{y}$ ) as shown in equation (1) below (Anselin 1988; Anselin and Bera 1998).<sup>40</sup>

$$\mathbf{y} = \alpha + \rho \mathbf{W}\mathbf{y} + \mathbf{X}\boldsymbol{\beta} + \boldsymbol{\mu} \quad (1)$$

---

<sup>40</sup> All model specifications are expressed in their matrix forms.

where,  $\mathbf{y}$  is an  $N \times 1$  vector of observations of fertility levels over a system of  $N$  regions,  $\mathbf{X}$  is an  $N \times K$  matrix of independent variables where  $K$  is the number of explanatory factors,  $\boldsymbol{\beta}$  is the  $K \times 1$  vector of regression coefficients,  $\rho$  is the spatial lag coefficient,  $\mathbf{W}$  is the  $N \times N$  spatial weight matrix,  $\boldsymbol{\mu}$  is the  $N \times 1$  vector of spatially independent (iid.) error terms and  $\alpha$  is the regression constant.

In the spatial lag model, the effect of diffusion is explicitly parameterized with the introduction of an additional term  $\rho$ . An alternative technique is to treat diffusion between neighboring regions as an unparameterized latent (unobservable) variable such that the blended fertility equation could be written as:

$$\mathbf{y} = \alpha + \mathbf{X}\boldsymbol{\beta} + \boldsymbol{\tau} + \boldsymbol{\mu} \quad (2)$$

where,  $\boldsymbol{\tau}$  is an  $N \times 1$  vector of latent diffusion variable dependent on the structural characteristics defining each region and other notations remain the same as in (1). Since the underlying latent effect of diffusion is not measurable, a model estimated without  $\boldsymbol{\tau}$  yields error terms that are (i) correlated across space, and (ii) correlated with the set of independent variables. Such a situation yields the following set of equations:

$$\mathbf{y} = \alpha + \mathbf{X}\boldsymbol{\beta} + \boldsymbol{\varepsilon} \quad (3.1)$$

$$\boldsymbol{\varepsilon} = \lambda \mathbf{W}\boldsymbol{\varepsilon} + \boldsymbol{\mu} \quad (3.2)$$

$$\boldsymbol{\mu} = \mathbf{X}\boldsymbol{\gamma} + \mathbf{v} \quad (3.3)$$

where,  $\epsilon$ ,  $\mu$  are  $N \times 1$  vectors of spatially correlated error terms,  $\lambda$  is the spatial error coefficient,  $\gamma$  is the  $K \times 1$  vector of regression coefficients, and  $v$  is the  $N \times 1$  vector of spatially independent (iid.) error terms and other notations remain the same as in (1). By substitution, the familiar form of the spatial Durbin model (SDM) as specified in equation (4) below is obtained (Anselin 1988, LeSage and Pace 2010).

$$y = \lambda Wy + X\theta + \psi WX + v \quad (4)$$

where,  $\theta$  is equal to  $(\beta + \gamma)$  and  $\psi$  is equal to  $(-\lambda\gamma)$  and other notations remain the same as in (1).

The above models by themselves may, however, not be adequate for interpreting the role of diffusion. First, a counter-argument against a significant spatial lag ( $\rho$ ) coefficient as the evidence base for diffusion is the role of spatial networks effect.<sup>41</sup> Moreover, a significant spatial lag ( $\rho$ ) or spatial error ( $\lambda$ ) coefficient provides only indirect evidence for the phenomenon. To address these issues and to further examine high-fertility concentrated mainly in the districts in the BIMARU region, *Hypothesis II* as below is tested.

---

<sup>41</sup> Land and Deane (1992) discuss the “spatial networks effect” in the context of social processes. While social science phenomena such as fertility operate in space, for the purpose of measuring and analysis, data on these processes are however compartmentalized into geographic units such as political and administrative boundaries. These units are often drawn arbitrarily or for purposes other than the particular social process of interest. As a result spatial endogeneity is introduced in such a dataset as “the geographical constraints and impacts of these arbitrary units on the social processes are implicitly retained.” (Land and Deane 1992).

*Hypothesis II: Ceteris paribus, (i) fertility outcome in each district is significantly associated to the practice of fertility regulation in neighboring districts; and (ii) this relation in the high fertility districts is distinct from that in the rest of the country.*

The core concept in diffusion is the spread of ideas and information from one district to another leading to the adoption of the innovative behavior of fertility regulation which then impacts fertility outcomes in the neighboring districts. Therefore, it can be argued that if information spillover across districts results in uptake of family planning in neighboring districts, then fertility outcome in each district will be significantly correlated to fertility regulation in the neighboring districts. Next, in view of greater prevalence of socio-cultural prejudices that distinguishes the northern states, particularly the BIMARU Region from the rest of the country, it is hypothesized that such biases limit the role of diffusion in impacting neighbors' uptake of family planning and fertility outcomes (Dyson and Moore 1983; Agnihotri et al. 2002).<sup>42</sup>

A spatial error model, which is the general form of the spatial Durbin model, is considered to test *Hypothesis II*.<sup>43</sup> Two additional terms are considered in the spatial error model. First, a spatial lag of fertility regulation is included as an explanatory variable. A statistically significant coefficient of this variable will provide a more direct interpretation of diffusion. Next, a district-interaction variable for the high-fertility BIMARU districts is added to this model. The interaction variable is included to examine

---

<sup>42</sup> Male-dominated patrilineal institutions relate to widespread gender discrimination and inequity. A much lower status accorded to women sets apart the northern half of the country from the rest of India.

<sup>43</sup> Both forms of the error model, general and spatial Durbin, are derived from the empirical consideration that incorporates the latent effect of diffusion in the model specifications. The difference, however, is in the fact that through its specification only the latter allows significance testing for each of the spatial lags of the independent correlates of fertility.

the role of diffusion in the group of BIMARU districts that have a TFR value greater than 3.8. These are the districts in the third tercile shown in red in Figure 3.1.2 earlier. The spatial error model is, therefore, specified as:

$$\mathbf{y} = \alpha + \mathbf{X}\boldsymbol{\beta} + \omega\mathbf{W}\mathbf{f} + \phi\mathbf{z} + \boldsymbol{\varepsilon} \quad (5a)$$

$$\boldsymbol{\varepsilon} = \lambda\mathbf{W}\boldsymbol{\varepsilon} + \boldsymbol{\mu} \quad (5b)$$

where,  $\mathbf{f}$  is an  $N \times 1$  vector of a fertility regulation variable,  $\mathbf{z}$  is equal to  $\mathbf{d} \mathbf{W}\mathbf{f}$  with  $\mathbf{d}$  as an  $N \times 1$  vector of a dummy variable,  $d_i$  equal to 1 if TFR is greater than 3.8 and a BIMARU region, or 0 otherwise and  $\omega$ ,  $\phi$  are regression coefficients and other notations remain the same as in (1). The generalized spatial 2-stage least square instrument variable (GS2SLS/IV) estimation technique forwarded in the spatial literature is used to estimate this error model.<sup>44, 45</sup>

### 3.4.2 Data and Variables

The empirical analysis is conducted using data from the most recent Census year of 2001 for which detailed district-level data for India has already been published and made publicly available. The unit of analysis is district: a sub-state region comparable to a county in the United States. Previous empirical applications examining fertility identify a range of explanatory factors that impact fertility outcomes in India. There is, however, not sufficient space here to present a review of the theoretical frameworks or the

---

<sup>44</sup> For a review refer to Kelejian and Prucha (1998, 1999, 2004, 2010), Arraiz et al. (2010) and Drucker et al. (2010).

<sup>45</sup> Second and third order spatial lags of a set of exogenous correlates of the fertility regulation variable are used to instrument the endogenous spatially lagged fertility regulation and district interaction variables.

empirical finding of these efforts. The interested reader can refer to the discussion in Sathar and Phillips (2001) and Guilmoto (2005).

**Table 3.2: List of Structural Variables included in the Blended Fertility Models**

| Variable                              | Definition                                                          |
|---------------------------------------|---------------------------------------------------------------------|
| <b>Socioeconomic Indicators</b>       |                                                                     |
| <i>Effect of Economic Development</i> |                                                                     |
| Urbanization                          | Percentage of district population living in rural areas             |
| Level of Infrastructure               | Proportion of villages in a district with paved access road         |
| Agricultural Workers                  | Percentage of workers engaged in agriculture                        |
| <i>Effect of Social Development</i>   |                                                                     |
| Female Literacy Rate                  | Percentage of a district's female population who are literates      |
| Child Mortality Rate*                 | Under-5 Mortality Rate                                              |
| <b>Control Variables</b>              |                                                                     |
| <i>Effect of Socio-culture</i>        |                                                                     |
| Schedule Caste (SC)                   | Percentage of district population belonging to the group SC         |
| Schedule Tribe (ST)                   | Percentage of district population belonging to the group ST         |
| Religion                              | Percentage of district population belonging to the category Muslims |
| Son Preference                        | Ratio of female to male child mortality under age 5                 |

Note: \* This variable is included only in the spatial error (S2SLS/IV & GS2SLS/IV) models.

For a parsimonious set, the choice of structural variables included in the SAR models applied to test *Hypotheses I* and *II* are based on Bhattacharya (2006) and listed in Table 3.2 above. In addition contraceptive prevalence rate (CPR), which is an indicator of

birth control, is used to test hypothesis II.<sup>46</sup> District-level CPR is expressed in terms of percentage of currently married women between the ages of 15-44 who are using any method of family planning and is available from District Level Household Survey (DLHS 2002-04) dataset.<sup>47</sup> In all the models, the dependent variable is total fertility rate (TFR) as estimated in Guilmoto and Rajan (2002) using Census 2001 data.

Economic Development Indicators Since district-level estimates of income and expenditure are not available, two variables, level of infrastructure and share of agricultural workers, are used as indicators that represent the effect of economic development and modernization. With respect to the level of infrastructure, the availability of “paved roads” is considered a critical indicator of economic development in India. Also, economic growth is accompanied by a drop in the share of output and employment in the agricultural sector. This is due to the fact that economic growth is accompanied by a change in lifestyle choices and change in consumer demand for products in non-agricultural sectors. In addition, the pattern of rural-urban residence is another factor that is considered in the literature as an indicator of modernization and industrialization (Bhattacharya 2006).

Social Development Indicators: Status of women, as a sociological agency, is a significant predictor of fertility choices affecting the demand for children (Mason

---

<sup>46</sup> Rate of contraceptive usage or contraceptive prevalence is a gauge that stands for both the supply of and demand for birth control. While the relation between CPR and fertility in a district could, therefore, be endogenous, such should not be the case between fertility outcome in a district and CPR in a neighboring district.

<sup>47</sup> The Ministry of Health and family Welfare (MOHFW), Government of India conducted the DLHS surveys in 1989-99 and 2002-04.



1987; Bulatao 2001). Female education, particularly female literacy, is important in strengthening a woman's authority in making familial decisions including fertility choices. In addition, child mortality is a critical macro-level factor that impacts the number of children a couple bears. To address endogeneity between fertility and child mortality, access to safe drinking water expressed as the percentage of households in a district with access to safe drinking water is used to instrument child mortality.<sup>48</sup>

Control Variables: Factors embedded in tradition, such as preference for the male child, religion and social class are widely discussed in the literature as important determinants of fertility outcome. In India, filial aspiration to have a male child is deep rooted and almost universal. A male child is desirable as it ensures the perpetuation of the family name in addition to assurance of support during old age. To ensure a male birth, couples resort to bearing additional children, especially when the first and/or second born child is a girl (Retherford and Roy 2003). Districts that have a strong preference for the male child often also record higher prevalence of sex selection facilitated by pre-natal diagnostic tests leading to female feticide. This practice of pre-natal bias results in excess female mortality that is further exacerbated by post-natal neglect of the girl child (Oster 2009). In the literature, the factor son preference is, therefore, expressed in terms of female mortality over male mortality in the 0–5 age cohort.

Additionally, fertility in India is higher among the sociological groups scheduled caste (SC) and scheduled tribes (ST) and among the religious group Muslims. These indicators that represent socioeconomic development in terms of urbanization, level of

---

<sup>48</sup> See for example Bhattacharya (2006) for a detailed discussion on endogeneity between fertility and mortality.

infrastructure, agricultural workers, female literacy rate and child mortality rate, and socio-culture in terms of the sociological groups Schedule Caste, Schedule Tribes and Muslims and preference for the male child or son preference are consistently discussed in the literature for their role in influencing fertility (Sathar and Phillips 2001).

### 3.4.3 Spatial Weight Matrix

The spatial weight matrix  $\mathbf{W}$  defines neighbors in two-dimensional space where each component of the matrix,  $w_{ij}$ , is the weight assigned to measure the intensity of the spatial relationship between regions  $i$  and  $j$ . Various methodological frameworks for defining neighbors and assigning weights have been discussed in the literature. The choice for identifying neighbors and assigning weights should however be guided by a theoretical framework of interaction between neighboring regions (Anselin et al. 2007; Baltagi 2008). The role of geographic proximity has been highlighted as the factor defining social interaction, and in turn, information spillover between neighboring regions.<sup>49</sup> Two common proximity-based methods for defining neighbors and assigning weights are the inverse distance function and the k-nearest neighbor function. In this study, results are compared from models in which neighbors are defined using each of these two methodologies. Each element of the row normalized inverse distance spatial weight matrix  $\mathbf{W}$  is specified as below.

$$w_{ij} = \begin{cases} \frac{1/d_{ij}^\alpha}{\sum_j 1/d_{ij}^\alpha} & \text{if } d_{ij} < D \\ 0 & \text{otherwise} \end{cases} \quad (6)$$

---

<sup>49</sup> See for example Guilmoto (2005), Guilmoto and Rajan (2001).

where,  $d_{ij}$  is the Euclidean distance between centroids of districts  $i$  and  $j$ ,  $\alpha$  is a distance decay parameter and  $D$  is a cut-off distance. The distance decay parameter ( $\alpha$ ) is set at 2, a value that is commonly considered in the spatial literature (Anselin 1980). For the cut-off distance  $D$ , a distance of 150 kilometers is used in the empirical models such that each district has at least 1 neighbor. Next, for the k-nearest neighbor function, each row standardized element of the spatial weight matrix  $\mathbf{W}$  is specified as in equation (7) below.

$$w_{ij} = \begin{cases} \frac{1}{\sum_j w_{ij}} & \text{if } j \in N_k(i) \text{ or } i \in N_k(j) \\ 0 & \text{otherwise} \end{cases} \quad (7)$$

The empirical models were run with  $k = 5$  in which only first-order neighbors were picked up and  $k = 10$  that included second order neighbors for most districts. Findings were consistent across these models and results reported in the next sub-section are for  $k=5$ .

### **3.5 Discussion**

#### **3.5.1 Results**

Summary statistics and correlation between the explanatory variables and the dependent variable TFR are shown in Table 3.3 below. The correlation between TFR and all variables, except two (agricultural workers and SC), are significant at  $p = 0.05$  level. Also, the direction of the association between TFR and each of its independent correlates is in the expected direction.

**Table 3.3: Summary Statistics and Correlation**

| Variable                  | Indicator                                                                         | Mean  | Standard<br>Deviation | Min   | Max    | Correlation<br>(w/ TFR) |
|---------------------------|-----------------------------------------------------------------------------------|-------|-----------------------|-------|--------|-------------------------|
| <i>Dependent</i>          |                                                                                   |       |                       |       |        |                         |
| TFR                       | Children per woman in the age group of 15 – 49                                    | 3.31  | 1.01                  | 1.30  | 5.80   | --                      |
| <i>Socioeconomic</i>      |                                                                                   |       |                       |       |        |                         |
| Urban-Rural Residence     | Percentage of district population living in rural areas                           | 76.26 | 19.74                 | 0.00  | 100.00 | 0.4290*                 |
| Level of Infrastructure   | Proportion of villages in a district with paved access road                       | 60.68 | 26.16                 | 10.29 | 100.00 | —0.5513*                |
| Agricultural Workers      | Percentage of population engaged in agriculture (main workers)                    | 13.47 | 10.28                 | 0.06  | 49.30  | 0.0273                  |
| Female Literacy Rate      | Percentage of a district's female population above the age of 7 who are literates | 52.49 | 15.44                 | 18.58 | 96.26  | —0.7267*                |
| Child Mortality Rate      | Mortality rate in the 0-5 age cohort                                              | 98.85 | 31.68                 | 39.00 | 266.00 | 0.6405*                 |
| <i>Control</i>            |                                                                                   |       |                       |       |        |                         |
| SC                        | Percentage of district population belonging to SC                                 | 14.81 | 8.63                  | 0.00  | 50.11  | 0.0249                  |
| ST                        | Percentage of district population belonging to ST                                 | 15.85 | 25.60                 | 0.00  | 98.09  | 0.1263*                 |
| Religion                  | Percentage of district population who are to Muslims                              | 11.65 | 15.14                 | 0.09  | 98.49  | 0.1504*                 |
| Son Preference            | Ratio of female to male child mortality under age 5                               | 1.21  | 0.13                  | .89   | 1.77   | 0.1098*                 |
| <i>Endogenous Spatial</i> |                                                                                   |       |                       |       |        |                         |
| Lag TFR                   | Spatial lag of TFR                                                                | 3.31  | .8367461              | 1.64  | 5.70   | 0.8428*                 |
| Lag CPR                   | Spatial lag of CPR                                                                | 51.06 | 11.10                 | 24.50 | 77.96  | -0.7164*                |

\* p = 0.05

**Table 3.4: Comparison of Fertility Models (Hypothesis I)**

|                             | Classical              | Blended:<br>MLE                             |                                           |                                             |                                           |
|-----------------------------|------------------------|---------------------------------------------|-------------------------------------------|---------------------------------------------|-------------------------------------------|
|                             | OLS                    | Spatial Lag                                 |                                           | Spatial<br>Durbin                           |                                           |
|                             |                        |                                             |                                           | weights w/<br>inverse<br>distance<br>square | weights w/ K<br>(=5) nearest<br>neighbors |
|                             |                        | weights w/<br>inverse<br>distance<br>square | weights w/ K<br>(=5) nearest<br>neighbors |                                             |                                           |
|                             | (model 1)              | (model 2.1)                                 | (model 2.2)                               | (model 3.1)                                 | (model 3.2)                               |
| Urban-Rural Residence       | 0.0002<br>(0.0022)     | 0.0047***<br>(0.0011)                       | 0.0031***<br>(0.0010)                     | 0.0039***<br>(0.0011)                       | 0.0027**<br>(0.0011)                      |
| Infrastructure (Paved Road) | -0.0134***<br>(0.0028) | -0.0028***<br>(0.001)                       | -0.0022**<br>(0.0009)                     | -0.0043***<br>(0.0012)                      | -0.0040***<br>(0.0012)                    |
| Agricultural Laborers       | -0.008<br>(0.0076)     | -0.0021<br>(0.0019)                         | -0.0051<br>(0.0017)                       | 0.0011<br>(0.0029)                          | 0.0014<br>(0.0032)                        |
| Female Literacy Rate        | -0.0377***<br>(0.0055) | -0.0204***<br>(0.0017)                      | -0.0176***<br>(0.0016)                    | -0.0247***<br>(0.002)                       | -0.0264***<br>(0.0022)                    |
| Muslims                     | 0.0046<br>(0.006)      | 0.0041***<br>(0.0013)                       | 0.0023*<br>(0.0012)                       | 0.0104***<br>(0.0018)                       | 0.0099***<br>(0.0020)                     |
| SC                          | 0.0095<br>(0.0078)     | 0.0073***<br>(0.0028)                       | 0.0058**<br>(0.0026)                      | 0.0031<br>(0.0033)                          | 0.0004<br>(0.0031)                        |
| ST                          | 0.004<br>(0.004)       | 0.0061***<br>(0.0011)                       | 0.0041***<br>(0.0010)                     | 0.0096***<br>(0.0012)                       | 0.0045***<br>(0.0012)                     |
| Son Preference              | 2.2302***<br>(0.5101)  | 1.0469***<br>(0.1586)                       | 0.8624***<br>(0.1443)                     | 0.5626***<br>(0.1828)                       | 0.1596<br>(0.1783)                        |
| Lag TFR                     |                        | 0.6520***<br>(0.0292)                       | 0.6868***<br>(0.0252)                     | 0.8096***<br>(0.0327)                       | 0.8091***<br>(0.0250)                     |
| Lag Urban-Rural Residence   |                        |                                             |                                           | 0.0064***<br>(0.0024)                       | 0.0056***<br>(0.0015)                     |
| Lag Paved                   |                        |                                             |                                           | -0.0100<br>(0.0019)                         | -0.0008<br>(0.0015)                       |
| Lag Agricultural Laborers   |                        |                                             |                                           | 0.0029<br>(0.0039)                          | 0.0050<br>(0.0038)                        |
| Lag Female Literacy Rate    |                        |                                             |                                           | -0.0163***<br>(0.0033)                      | -0.0173***<br>(0.0029)                    |
| Lag Muslims                 |                        |                                             |                                           | 0.0116***<br>(0.0027)                       | 0.0098***<br>(0.0024)                     |
| Lag SC                      |                        |                                             |                                           | 0.0065<br>(0.0052)                          | -0.0049<br>(0.0043)                       |
| Lag ST                      |                        |                                             |                                           | 0.0108***<br>(0.0021)                       | 0.0014<br>(0.0018)                        |

**Table 3.4 (contd.)**

|                      | Classical            | Blended:<br>MLE                             |                                           | Spatial<br>Durbin                           |                                           |
|----------------------|----------------------|---------------------------------------------|-------------------------------------------|---------------------------------------------|-------------------------------------------|
|                      | OLS                  | Spatial Lag                                 |                                           |                                             |                                           |
|                      |                      | weights w/<br>inverse<br>distance<br>square | weights w/ K<br>(=5) nearest<br>neighbors | weights w/<br>inverse<br>distance<br>square | weights w/ K<br>(=5) nearest<br>neighbors |
|                      | (model 1)            | (model 2.1)                                 | (model 2.2)                               | (model 3.1)                                 | (model 3.2)                               |
| Lag Son Preference   |                      |                                             |                                           | -0.1491<br>(0.3036)                         | -0.7479***<br>(0.2371)                    |
| Intercept            | 3.2496***<br>-0.7908 | 0.5493**<br>-0.278                          | 0.7304***<br>(0.2446)                     | 0.7721*<br>-0.4311                          | 0.3729<br>(0.2735)                        |
| Moran's I (residual) | 25.740***            |                                             |                                           |                                             |                                           |
| R-squared            | 0.6687               |                                             |                                           |                                             |                                           |
| Log Likelihood       | -511.4656            | -345.5713                                   | -302.1850                                 | -288.8375                                   | -226.6063                                 |
| N                    | 587                  | 587                                         | 587                                       | 587                                         | 587                                       |

Standard errors (robust) in parentheses

\* p<.10, \*\* p<0.05, \*\*\* p<0.01

*Hypothesis I:* Table 3.4 tabulates the results from the classical OLS (model 1), blended spatial lag models (2.1 and 2.2) and spatial Durbin models (3.1 and 3.2) of fertility.<sup>50</sup> The results provide evidence in support of *Hypothesis I*: structural socioeconomic factors and spatial diffusion were both significantly associated with district-level fertility in 2001. Also, in terms of model fit, i.e. log likelihood, the blended models are better than the aspatial OLS model. The coefficient of the spatial lag of TFR,  $\rho$  in the case of spatial lag and  $\lambda$  in the case of SDM, is highly significant. A positive and statistically significant coefficient can be interpreted as a high-high—low-low association in TFR values of neighboring districts. In other words, for each district  $i$ , the higher the

<sup>50</sup> These models were estimated using the Stata modules developed by Jeanty (2010).

fertility  $y_j$  in neighboring districts, the higher the fertility  $y_i$  in that district and vice versa. Such a geographic clustering of similar values of fertility is indicative of the existence of an underlying mechanism of diffusion.

Among the economic development indicators, the level of infrastructure (paved roads), and the rural-urban pattern of residence are significant in the blended models: in a district, higher the share of villages with paved roads, lower the level of fertility; and higher the share of population living in rural areas, higher the fertility. However, contrary to what the literature provides, the share of agricultural laborers in a district is not significantly associated with district fertility. The social development variable female literacy rate is also highly significant and negative, indicating districts with higher levels of female literacy rate have lower levels of fertility. Together, these variables indicate that social and economic development continue to be significant predictors of district-level fertility outcomes. In addition, the SDM-s reveal that rural-urban residence and levels of female literacy rate in neighboring districts significantly impacted fertility outcome in each district. In other words, for each district (i) higher the concentration of population living in rural areas in the neighboring districts, higher the fertility outcome; and (ii) higher the level of literacy in the neighboring districts, lower the fertility outcome. Finally, among the control variables, coefficients for Muslims, ST and son preference are significant and positive. These findings indicate that neighboring levels of urbanization, education and social (ST but not SC) and religious (Muslims) composition significantly impact the fertility outcome in each district.

Hypothesis II: To test *Hypothesis II*, as a first step, fertility models with the spatial lag of contraceptive prevalence rate (model 5.1) and then with the district interaction variable (model 5.2) are estimated using the spatial two-step least square instrumental variable (S2SLS/IV) technique. Next, spatial error forms of these two models are estimated with the generalized spatial two-stage instrumental variable (GS2SLS/IV) technique (models 6.1 & 6.2).<sup>51</sup> The weighting scheme in the GS2SLS/IV models is according to the inverse distance weighting function.<sup>52</sup>

The results of these models presented in Table 3.5 validate *Hypothesis II*. First, fertility in each district is significantly associated to the rates of fertility regulation expressed in terms of CPR in neighboring districts. The coefficient of CPR is significant and negative indicating higher the level of CPR in neighboring districts, lower is the value of fertility in each district. Next, this relation is significantly different in high fertility districts of the BIMARU Region with TFR greater than 3.8. The coefficient of CPR for these high-fertility districts is smaller and equal to  $-0.001$  ( $-0.0214 + 0.0204$ ) compared to  $-0.0214$  for the rest of the country. This result provides evidence in support of the role of diffusion as demonstrated through (i) a significant association between fertility regulation in neighboring districts and fertility outcome in each district, and (ii) a weaker association between fertility regulation in neighboring districts and fertility outcome in each district in the high-fertility BIMARU districts. With regard to the effect of socioeconomic variables, the results of the GS2SLS/IV are compatible with that

---

<sup>51</sup> These models were estimated using Stata commands developed in Drukker et al. (2011).

<sup>52</sup> The models run with the weighting scheme according to the K-nearest neighbor weighting function yielded similar results but are not reported in this section.



obtained in the spatial lag and spatial Durbin models presented earlier. Further, they also indicate that child mortality rate is significantly and positively associated with district-level fertility outcomes in 2001.

**Table 3.5: Comparison of Fertility Models (Hypothesis II)**

| Dependent Variable TFR      | S2SLS/IV               |                        | GS2SLS/IV              |                        |
|-----------------------------|------------------------|------------------------|------------------------|------------------------|
|                             | (Model 5.1)            | (Model 5.2)            | (Model 6.1)            | (Model 6.2)            |
| Rural-urban Residence       | 0.0019<br>(0.0021)     | 0.0024<br>(0.0018)     | 0.0027**<br>(0.0013)   | 0.0025**<br>(0.0011)   |
| Infrastructure (paved road) | -0.0060***<br>(0.0019) | -0.0022<br>(0.0026)    | -0.0060***<br>(0.0013) | -0.0035***<br>(0.0013) |
| Agricultural Laborers       | -0.0020<br>(0.0055)    | -0.0027<br>(0.0044)    | 0.0011<br>(0.0025)     | 0.0010<br>(0.0021)     |
| Female Literacy Rate        | -0.0182***<br>(0.0058) | -0.0116**<br>(0.0052)  | -0.0168***<br>(0.0030) | -0.0129***<br>(0.0027) |
| Muslims                     | 0.0034<br>(0.0046)     | 0.0041<br>(0.0029)     | 0.0040***<br>(0.0015)  | 0.0037***<br>(0.0013)  |
| SC                          | -0.0016<br>(0.0046)    | 0.0002<br>(0.0044)     | -0.0016<br>(0.0038)    | -0.0005<br>(0.0033)    |
| ST                          | -0.0003<br>(0.0038)    | 0.0040<br>(0.0026)     | 0.0018<br>(0.0015)     | 0.0041***<br>(0.0014)  |
| Son Preference              | 2.2642***<br>(0.4824)  | 0.6609<br>(0.6544)     | 1.8017***<br>(0.2353)  | 0.6588*<br>(0.3491)    |
| Under-5 Mortality           | 0.0145***<br>(0.0035)  | 0.0065**<br>(0.0032)   | 0.0112***<br>(0.0025)  | 0.0051**<br>(0.0026)   |
| Lag CPR                     | -0.0174**<br>(0.0086)  | -0.0247***<br>(0.0088) | -0.0177***<br>(0.0053) | -0.0214***<br>(0.0046) |
| Lag CPR * Dummy             |                        | 0.0236***<br>(0.0078)  |                        | 0.0204***<br>(0.0051)  |
| Intercept                   | 1.2258<br>(0.9698)     | 3.3455***<br>(1.0971)  | 1.7694<br>(1.8077)     | 3.4102***<br>(0.7458)  |
| Spatial Error Coefficient   |                        |                        | 1.0116***<br>(0.1240)  | 0.9441***<br>(0.0813)  |

**Table 3.5 (Contd.)**

| Dependent Variable TFR     | S2SLS/IV    | GS2SLS/IV   |                         |
|----------------------------|-------------|-------------|-------------------------|
|                            | (Model 5.1) | (Model 5.2) | (Model 6.1) (Model 6.2) |
| R-square / Pseudo R-square | 0.7459      | 0.8169      |                         |
| Anderson Cannon            | 145.744***  | 45.450***   |                         |
| Hansen J                   | 9.861       | 11.917      |                         |
| N                          | 587         | 587         | 587 587                 |

Standard errors (robust) in parentheses

\* p<.10, \*\* p<0.05, \*\*\* p<0.01

### 3.5.2 Policy Implications

The results discussed earlier established the combined roles of structural socioeconomic development and diffusion in influencing district-level fertility in 2001. Compared to the South, the high-fertility districts of the BIMARU region had much lower levels of socioeconomic development (Table 3.6). Prioritization of resource allocation towards socioeconomic development programs in these districts should continue to remain the policy goal at state and local levels of government.

Among the socioeconomic development indicators, more than one observer has questioned the role of female literacy in lowering fertility levels since fertility decline has also been recorded among the uneducated women.<sup>53</sup> However, to this day, the greatest variation in fertility in India continues to be by the level of education: an uneducated woman, on average, will have two children more than a woman with ten or more years of schooling (World Bank 2010; IIPS and Macro International 2008). Moreover, recent

<sup>53</sup> See for example McNay et al. (2003), Bhat (2002).

country-level finding on fertility in developing countries provides robust evidence that female education is still a strong predictor of fertility change (Angeles 2010). While the thrust of many national as well international donor programs has been on improving the health indicators in the Northern states, such an emphasis is lacking when it comes to low levels of female education in these states.<sup>54</sup> In the context of the results obtained, a policy goal focused on female education is, therefore particularly relevant (Bloom 2012; Jain and Jain 2010).

**Table 3.6: Socioeconomic Indicators in the High-Fertility Districts of the BIMARU Region and South India, 2001**

| Fertility (Total Fertility Rate)    | Number of Districts | Prevailing Economic and Social Indicators                   |                                                                   |                          |                      |
|-------------------------------------|---------------------|-------------------------------------------------------------|-------------------------------------------------------------------|--------------------------|----------------------|
|                                     |                     | Urban-rural Population (share of population in rural areas) | Level of Infrastructure (proportion of villages with paved roads) | Agricultural Labor Force | Female Literacy Rate |
| (child/woman)                       |                     | (%)                                                         | (%)                                                               | (%)                      | (%)                  |
| India                               | 587                 | 76.26                                                       | 60.67                                                             | 13.49                    | 52.49                |
| <i>High-Fertility BIMARU Region</i> |                     |                                                             |                                                                   |                          |                      |
| 3.8 – 4.8                           | 121                 | 83.31                                                       | 48.09                                                             | 14.10                    | 41.81                |
| 4.8 – 5.8                           | 47                  | 88.02                                                       | 46.68                                                             | 19.33                    | 31.49                |
| <i>South India*</i>                 |                     |                                                             |                                                                   |                          |                      |
| 1.3 – 3.5                           | 94                  | 69.59                                                       | 84.78                                                             | 20.44                    | 61.33                |

\* South India includes the four states of Andhra Pradesh, Karnataka, Kerala and Tamil Nadu

<sup>54</sup> Examples of such a few pertinent national programs are the National Rural Health Mission and Janani Suraksha Yojna.

**Table 3.7: Family Planning (FP) in the BIMARU States and South India, 2005-2006**

|                | No<br>Exposure<br>to FP<br>Messages<br>(women) | Need for FP Services<br>(among currently<br>married women) |       | Contraception (among<br>currently married women) |      |
|----------------|------------------------------------------------|------------------------------------------------------------|-------|--------------------------------------------------|------|
|                |                                                | Total                                                      | Unmet | Knowledge                                        | Use  |
| Rajasthan      | 55.4                                           | 61.8                                                       | 14.6  | 99.7                                             | 47.2 |
| Madhya Pradesh | 40.0                                           | 67.2                                                       | 11.3  | 99.8                                             | 55.9 |
| Uttar Pradesh  | 40.2                                           | 64.8                                                       | 21.2  | 99.5                                             | 43.6 |
| Bihar          | 48.9                                           | 56.9                                                       | 22.8  | 100.0                                            | 34.1 |
| Jharkhand      | 56.8                                           | 58.8                                                       | 23.1  | 95.1                                             | 35.7 |
| South India    | 30.4                                           | 73.3                                                       | 7.9   | 98.9                                             | 65.3 |

Source: IIPS & Macro 2007

Next, in the high fertility BIMARU districts, the strength of diffusion was significantly lower than that in the rest of the country. From a policy standpoint it is important to interpret why such a result was obtained. A potential reason behind the weaker strength of diffusion could be the greater socio-cultural biases in the northern parts of India that limit the uptake of family planning. Some evidence in support of this interpretation is available in the National Family Health Survey (NFHS) data. NFHS data show that even though a high proportion of women in the BIMARU states, who were currently married, knew about one or another method of contraception available, use of contraception in this region was, nevertheless, among the lowest in the country (Table 3.7) (IIPS & Macro 2007). NFHS data also indicate that a major reason for this low level of contraception usage in the BIMARU Region is due to “opposition to use” from self, husband, other or for religious reasons. In fact, the proportion of women who indicated “opposition” as their reason for non-usage of contraception was much higher in the

BIMARU Region than that in the rest of the country. For example, in Bihar, at 30 percent, the percentage of women in this state citing opposition as the reason for non-usage was twice the percentage stating the same reason in the nation (IIPS 2007).

Another reason behind the weaker strength of diffusion in the high-fertility BIMARU districts could be that policy effort to spread the ideal of a small family norm through fertility regulation has not been adequate in the BIMARU region. Indeed data from the various rounds of the NFHS reveal that in the BIMARU Region, women who were exposed to family planning messages, which included knowledge on the range of options, benefits of and side effects and problems associated with various methods of contraception, were among the lowest in the country. NFHS data also finds that demand for children in these districts has been much higher than that in the rest of the country. For example, in 2002-2003, 7 out of 10 women in Bihar in the age-group of 15 to 49 who already had two children wanted a third compared to only 3 out of 10 women in Tamil Nadu (IIPS 2006). Moreover, in the BIMARU states unmet need for family planning was among the highest in the country. All these points collectively indicate gaps in the policy effort in the BIMARU Region.

The NFHS data, therefore, validate and provide the context surrounding the empirical result on the differential strength of diffusion. An inference that can be drawn is: a lack of information, as well as policy inadequacy typifies the BIMARU Region. A policy focus on program initiatives that not only addresses unmet need, but also facilitates the spread of information and establishes the ideal of a small family norm in the BIMARU districts is therefore highly recommended.

Such a policy focus is additionally important for India as a previous study has documented that social norms, in comparison to socioeconomic conditions, have a greater impact on fertility behavior in India.<sup>55</sup> Furthermore, diffusion has the potential to fuel change in fertility behavior even in the absence of suitable socioeconomic condition: a situation that characterizes the high fertility BIMARU districts (Hirschman 2001). Bangladesh where fertility, despite a rural and largely agrarian setting, has been declining at an unprecedented rate is a case in point (Kantner and He 2001). To explain Bangladesh's fertility trend, the country's Information Education Communication (IEC) Program has been identified for its critical role in providing impetus towards a small family norm (Gayen and Raeside 2006). In fact, the success of the IEC program in Bangladesh has inspired similar programs in other countries such as Kenya, Tanzania and Brazil (Skolnik 2008).

In Bangladesh, multiple actors that include government, non-government organizations (NGO) and community groups work in consort to identify creative methods to spread information on the benefits of a small-family and fertility regulation. Moreover, NGOs and other self-help community organizations arrange exhibitions, puppet shows, and women's discussion meetings to promote family planning in communities. Government campaigns use such artifacts as leaflets, pamphlets, billboards, film shows, mass rallies, and workshops to disseminate information on the benefits of fertility regulation. In addition these actors also use the media (radio, television and newspapers) to advertise the ideal of a small family norm (Gayen and Raeside 2006). In addition to

---

<sup>55</sup> See Kumar (1997).

these innovative avenues, other critical components of the Bangladesh's IEC program that could be adopted in fertility programs in India, particularly the BIMARU Region, are: (i) a scaling-up of the "door-step" approach or household delivery of family planning services, (ii) generating extra support for legitimacy of such programs from community and religious leaders, and (iii) securing active involvement from male members of households who as primary decision makers in the family often have stronger prejudices against family planning.

### **3.6 Conclusion**

Against the backdrop of a persistent high fertility in North India, this study highlighted the geographic pattern of fertility outcomes across the districts of India in 2001. It also underscored the policy initiatives that state and local governments should continue to undertake to address the incidence of high fertility concentrated mainly in the northern BIMARU districts of the country. Addressing high fertility in these northern districts is particularly stressed as it will determine the timing of population growth stabilization and the scope of the demographic dividend in India. A number of points however warrant mention. These points relate to the limitations of this study and future directions for research.

First, in this study a cross-sectional analysis of fertility is conducted. A number of practical considerations, such as unavailability of suitable time-series data and change in district boundaries between census years, limited the analysis to a cross-sectional model of fertility. But, fertility decline, like any other phenomenon of social change, is a slow

response behavior and its relation with independent correlates needs to be interpreted by studying these associations over time. A second limitation is that this analysis does not examine either the separate effects of the two types of diffusion, social interaction versus external source, or the two forms of diffusion, vertical versus horizontal. Instead, the types and forms of diffusion have been treated as related phenomena that not only co-exist but also interact with each other. However, one type and/or form of diffusion, as opposed to the other, may become the dominant influence depending upon the cultural, societal, institutional and historical settings of a given community or region at a given time. It would therefore be interesting to devise empirical constructs that can suitably unravel the role of the different types and forms of diffusion in India.

Finally, the sources of diffusion have not been investigated in this analysis. In demography, the common understanding is that divergent cultural values and social norms may spawn variations in fertility levels across regions and groups as a result of differential rates of diffusion. In the context of diffusion, “culture” has been interpreted broadly through numerous sociological phenomena or filters, the most common channels being language and ethnic homogeneity that facilitate the exchange of ideas and information (Amin et al. 2002). Future effort is needed to understand the cultural underpinnings that facilitate or augment exchange of information and ideas and therefore diffusion.

All of the above considerations are indeed important research motivations. In this chapter, however, the focus has been the application of the blended theoretical framework to model fertility and to examine the relative roles of diffusion and socioeconomic



development. The empirical findings, which validated the research hypotheses and established the roles of both factors across a cross-section of districts in India, are particularly significant for policy purposes. Availability of such an evidence base is critical for policymaking in not only in India, but for all other countries that are experiencing persistent spatial clustering of high fertility in the later stages of fertility transition. Research that further clarifies the sources, types and forms of diffusion, and the association between fertility and its independent correlates over time are consigned to the domain of future endeavors.

## **CHAPTER 4: FEMALE WORK PARTICIPATION IN INDIA THE HETEROGENEOUS EFFECT OF FERTILITY**

### **Chapter Summary**

Prior empirical studies provide evidence on the significant contribution of rising female labor supply to economic growth in countries undergoing the demographic transition when fertility declines. In India, declining levels of fertility have, however, not been accompanied by higher rates of female work participation. The purpose of the analysis in this chapter is to examine the work-fertility relation across a cross-section of districts in India which remains under-researched as prior empirical studies have predominantly been conducted at the micro-level. The focus is on interpreting heterogeneity in the aggregate relation after considering endogeneity between the two factors, as well as systemic non-random geographic interdependencies that characterize social outcomes such as fertility and female work participation. Contraceptive prevalence rate (CPR) is employed to instrument fertility in a spatial autoregressive model with autoregressive disturbances. Results indicate a higher degree of mother-worker role conflict in urban India for female work outside of agriculture and household industry.

## 4.1 Introduction

The entrance of women in the workplace has generated much interest in the relationship between female work participation (FWP) and fertility. Increases in women's participation in the workforce in the twentieth century have been attributed, among other things, to declining fertility rates (Cáceres-Delpiano 2012; Soares and Falcao 2008). The mother-worker role incompatibility makes fertility a critical factor in women's effort to raise their labor market activity (Bloom et al. 2009). Empirical evidence supports the theoretical "inverse relation" premise and reveals a negative association between fertility and female labor participation.<sup>56</sup>

Higher participation of women in the labor market results in a more effective utilization of the human capital of a region leading to increased productivity (Ghani et al. 2012; ILO 2010; Bloom et al. 2009; Klasen and Lamanna 2009; Esteve-Volart, 2004). And, this factor, in combination with falling fertility rates and suitable institutional and policy support, creates the "right" environment for demographic dividend to takeoff (Jain and Jain 2010; Bloom et al. 2009). In addition to fertility, a plurality of factors, such as level of development, supply and demand conditions, demographic parameters, institutions and social value systems, determines the level at which a population engages in the labor market. As in many developing countries, in India, however, cultural mores, particularly gender norms, take the center stage to influence women's labor market activities (ILO 2013, Field et al. 2010; Mammen and Paxson 2000). Entrenched in strong hierarchical patriarchy, a woman's traditional role as that of a homemaker and a bearer of

---

<sup>56</sup> See for example Soares and Falcao (2008); Kalwij (2000); Goldin (1990); Killingsworth and Heckman (1987); Bloom et al. (2009).

children to this day shapes the frame through which she is viewed.<sup>57</sup> The primary responsibility of child rearing falls squarely on a woman's shoulders with a disproportionate amount of time devoted by her to such tasks. While it may seem that the burden of such effects would be less severe or at least somewhat relieved in urban India, the reality is, however, just the opposite. A 1998 time-use study conducted by the Central Statistical Organization of India found that an urban woman spent 12 times what her male counterpart devoted towards household duties including childcare (NCEUS 2007). Anecdotal evidence suggests that the current situation is no different from what this study reported.

India's female workforce is primarily rural and almost 9 out of 10 women who worked in 2001 was a rustic resident. The rural labor pool is largely agrarian with women regularly partaking in farm and household-industry work. On the other hand, in urban areas where women's work participation has been persistently and precariously low, 70 percent of the female workers in 2001 were employed in non-agricultural and out-of-house jobs.<sup>58</sup> Set against a persisting rural-urban fertility differential, these trends indicate a heterogeneous "role incompatibility" effect on women's work participation in India, one that is mediated by location and by the type of job.<sup>59</sup>

---

<sup>57</sup> Behavioral standards that apply to Indian women are different from that of men. Although these criteria vary from one region to another, the general norm nevertheless is one in which a woman who stays at home to carry-on with her household and child care duties is held at higher regard. On the flip side of it labor market activities, particularly wage labor where she may need to exist as co-equals with men are generally deemed unchaste for women. (Dube 1988; Dube and Palriwala 1990).

<sup>58</sup> The Census of India terms these workers as "other workers". The classification of workers as categorized in the Census is discussed in more detail in the following section.

<sup>59</sup> On average a rural woman had one more child than a woman in urban areas in 2001: a pattern which persisted in to the year 2009 as well (Registrar General of India 2011).

A recent micro-level study provides evidence of such heterogeneity in the work-fertility relation for a panel of 40 developing countries. In this study, Cáceres-Delpiano (2012) conduct analysis using the Demographic and Health Survey dataset. The author reported that the negative impact of fertility is (i) significant for women's participation in jobs that are informal, such as unpaid, seasonal and occasional jobs, and/or those that are not compatible to combine with motherhood, such as out-of-house jobs; and (ii) stronger in urban areas. These results established the applicability of the two main theoretical concepts on the fertility-FWP relation, the economic and sociological perspectives, to developing countries.<sup>60</sup> While both theories posit an inverse relation, the economic theories focus on the tradability between childcare and labor participation; the sociological framework, on the other, highlight the degree of mismatch between mothering and the type of work being pursued.

Given the significance of the micro-level findings in Cáceres-Delpiano, the aim in this analysis is to interpret low levels of women's economic activity in India and examine the aggregate effect of fertility across work categories. Based on the sociological "mismatch" framework, it tests the hypothesis that in comparison to family-based household industry or farm-based agricultural work, the negative effect of fertility is stronger for inflexible out-of-house jobs and that this effect is larger in urban parts of the country. The contribution of this analysis is two-fold. First, it examines the work-fertility dynamic at the aggregate sub-state or district level. Prior studies on FWP that identify a

---

<sup>60</sup> Despite the evidently incongruent linkage between mothering and working, prior empirical findings have often reported weak negative to non-significant association between fertility and women's labor participation (Bianchi 2000; Lloyd 1991; Mason and Palan 1981). The findings in Cáceres-Delpiano are, therefore, of particular significance.

significant inverse relation between fertility and the likelihood that a woman participates in the labor force are predominantly micro-level investigations that leave the current evidence base on aggregate effect of fertility on FWP scant. For the purpose of policy, interpreting the aggregate dynamic and examining the dimensions of heterogeneity in this relation is crucial.

Next, the empirical model considered in this study takes in to account both methodological issues that complicate an empirical analysis of the fertility-FWP linkage. These factors are: (i) reciprocity in the relation between the two factors, and (ii) systemic, non-random geographic interdependencies in social outcomes such as FWP and fertility. While the former is most often addressed, most empirical studies however overlook the latter phenomenon. To address these issues, contraceptive prevalence rate (CPR) is employed as an instrument of fertility in a spatial autoregressive model framework with autoregressive disturbances. The empirical FWP–fertility relation is estimated using the generalized spatial two-stage least square instrumental variable (GS2SLS/IV) technique. The findings of this analysis support the research hypothesis and indicate a greater negative influence of fertility in urban India for non-farm and non-household industry female work.

The rest of this chapter is organized as follows. In the next section the theoretical foundations of the work-fertility relation is presented. Section 3.3 is devoted to a discussion on definition, trends and prior analysis on FWP in India. In Section 3.4, the empirical models are derived. Section 3.5 provides the results summary and related policy implications. Section 3.6 concludes.

## **4.2 Theoretical Framework**

The framework that is applied most often to explain the female work–fertility relation originated from the economic views on labor supply. While this standard theory is based on the neoclassical work-leisure model, a secondary framework is that of the sociological perspective in which the larger socioeconomic fabric defines the linkage tying women’s work to fertility. Both theories are in agreement in hypothesizing an inverse relation between the two factors (Rakaseta 1995; United Nations 1985). In the remainder of this section, the relevant economic theories are summarized followed by a discussion on the sociological perspective.

### **4.2.1 Economic Theories**

The perspective of the work-leisure tradeoff is employed in economic theories to model labor supply and to predict labor market activity both at the individual as well as the aggregate levels. Two strands are the basic neoclassical model of labor supply and its variant, the household production model.<sup>61</sup> Participation in the labor market requires a tradeoff of time between the two pursuits of market work and leisure. Any time spent out of non-market work is defined as leisure in the neoclassical model. Childcare, like any other activity except participation in the labor market, is therefore also treated as a form of leisure. The classification of childcare as leisure is, however, one of the major criticisms of the neoclassical model. A second criticism is that it views the decision to participate in the labor market as an individual choice, and fails to consider that it,

---

<sup>61</sup>To improve labor supply theory, the household production model is one of the modifications that is applied to the basic economic model. Two other variants are the intra-familial collective decision model and the life-cycle model. These latter two models, are however, not discussed in this chapter as they do not relate directly to the work-fertility relation.

instead, is most often a proposition arrived at jointly within the family through intra-familial bargaining (Becker 1965; Cahuc and Zylberberg 2004).

Becker's (1965) "theory of the allocation of time" or the "theory of household production" addressed both shortcomings of the neoclassical model. It considered family as the unit of decision-making in which utility is maximized under a single budget constraint through the optimal allocation of each member's time to the consumption of market work and non-market activities. Non labor-market activities are categorized in this theory into two groups termed as household production, and household consumption (Boyer and Smith 2001). The former includes such activities as cooking, cleaning and childcare, and the latter comprises of activities of pure leisure such as sleeping, entertainment and relaxation. The characteristic that sets apart each category from the other is that while household production entails labor that can be delegated to another person such as a maid or a nanny, household consumption, on the other, does not allow such assignment. With this distinction, the household production model suitably acknowledged that the tradability between household production and work, and between household consumption and work, is not the same.

The accepted economic theory on female labor participation–fertility that thus came about, is ascribed to the influential works of Becker (1960, 1965), Mincer (1962), Becker and Lewis (1973) and Willis (1973). This theory conceptualizes that a woman will take part in labor market activities if and only if the expected market wage rate is higher than the reservation wage which is the lowest per-hour wage rate at which labor market activity is initiated. And, the household-production economists theorized that a



woman with a child has a higher reservation wage than a woman without a child. Between the two, the former is, therefore, less likely to undertake market work than the latter (Klasen and Pieters 2012).

Childcare and increase in family size results in a higher reservation wage and lower likelihood that a woman participates in the labor market due to two effects: the specialization effect and the home-intensity effect. The first effect is based on the notion of division of labor between the genders according to which a woman has a comparative advantage and is primarily responsible for providing childcare. The specialization effect therefore hypothesizes that in the event of an increase in fertility, whereas the mother will allocate more time to childcare, the father, on the other, will intensify his market activities (Becker 1985). Second, Lundberg and Rose (2002) postulate that the addition of a child will enhance the value of time spent at home in household production through childcare. Consequently, both parents will tradeoff their labor market activity to allocate additional time to childcare due to a home-intensity effect. Both the specialization and the home-intensity effects negatively impact women's labor market activity as a result of an increase in family size.

#### **4.2.2 Sociological Theory**

The sociological framework interprets female work through the mother-worker role incompatibility premise according to which the two roles that a woman has to don are viewed essentially as incompatible to each other. A number of theorists highlight this mother-worker role incongruity and posit that higher the degree of mismatch between the

two roles, the greater is the negative effect of fertility on female work.<sup>62</sup> The socioeconomic fabric, mainly the organization of production and of childcare, dictates the degree of incompatibility between labor market activity and motherhood. As a society transforms from a rural and agrarian to an urbanizing and manufacturing-based economy, the separation of home and work environments render childcare and women's work increasingly difficult to combine. In other words, whereas farm- or family-based work are most often in close proximity to home and provide the opportunity to pursue both roles simultaneously, work in a factory, store or office, on the other, is not conducive for such mixing (Goldstein 1972, Goldin 1995, Mammen and Paxson 2000). A second factor is the availability of childcare, either outside of home in daycares and as hired domestic help or through support from extended and non-nuclear family. Termed as "parental surrogates", such help mitigates the conflict between the two roles and is often the reason that the negative effect of fertility on FWP in the developing countries is considerably weaker than that in the developed countries (Mason and Palan 1981, Lehrer and Nerlove 1986).

In addition, individual aspirations for upward social and economic mobility often further aggravate the incompatibility between working and motherhood. For example, Mason and Palan (1981) theorize that factors such as the availability of formal schooling and the need for continued education to secure professional careers for offspring add to the inverse relation between work and fertility. Admitting elder-borns to schools may require mothers, particularly in developing countries, to stay at home to look after the

---

<sup>62</sup> See for example Davis (1937), Jaffe and Azumi (1960), Stycos and Weller (1967), Weller (1968), Presser and Baldwin (1980) Rindfuss (1991), and McDonald (2000).

younger ones who no longer can be entrusted to the care of their elder siblings. Conversely, individual social and economic aspirations may translate in to greater participation of women in the labor market but lower fertility when families opt for “child quality” in lieu of “child quantity” (Becker and Lewis 1973; Becker 1991). In other words, in the former situation with the loss of childcare support, higher fertility restricts women from participating in the labor market; in the second instance, the child quantity-quality tradeoff limits family size and allows the mother to get involved in the labor market. Consequently, as communities undergo socioeconomic transformation and associated changes in the types and locations of jobs available, the desire for upward societal mobility heightens the role conflict between mothering and working (DeTray 1973, Mason and Palan 1981).

### **4.3 Female Work Participation in India**

#### **4.3.1 Definition of Work and Classification of Workers**

The Census of India defines work as “participation in any economically productive activity with or without compensation, wages or profit.”<sup>63</sup> Since the 1981 Census, the concept of a one-year reference period has been applied to classify the Indian labor force in to three categories: (i) main workers are those workers who worked for six months or more during the reference period; (ii) marginal workers are those workers who worked less than six months during the reference period; and (iii) non-workers are those who did

---

<sup>63</sup> Government of India, Census of India (2001). Census Data 2001 / Metadata. Retrieved from <http://www.censusindia.gov.in/Metadata/Metada.htm#2j>.

not work at all during the reference period. Work participation rate is defined by the Census as the percentage of total workers, main and marginal, to the total population.

In the previous 1981 and 1991 Censuses, workers were classified in to nine industrial categories of cultivators; agricultural laborers; livestock, forestry, fishing, hunting, plantation, orchards and allied activities; mining and quarrying; manufacturing and repairs; construction; trade and commerce; transport; storage and communication; and services. In the 2001 Census, however, this industrial categorization was abandoned. Instead a four category classification, that included cultivators, agricultural laborers, household industry workers and other workers, was adopted. The first two categories, cultivators and agricultural laborers relate to workers engaged in farm-based activities. The differentiation between the two categories is in terms of ownership of land: while cultivators work on the land they own (or hold), agricultural laborers, on the other hand, work on land owned by another person for wages in money or kind or share.

Household industry workers are those who are engaged in “an industry conducted by one or more members of the household at home or within the village in rural areas and only within the precincts of the house where the household lives in urban areas. The larger proportion of workers in the household industry consists of members of the household. The industry is not run on the scale of a registered factory which would qualify or has to be registered under the Indian Factories Act.”<sup>64</sup> Finally, the category “other workers” consists of all workers who do not come under the first three categories and include “all government servants, municipal employees, teachers, factory workers,

---

<sup>64</sup> Ibid.

plantation workers, those engaged in trade, commerce, business, transport banking, mining, construction, political or social work, priests, entertainment artists, etc.”<sup>65</sup>

#### **4.3.2 Census versus National Sample Survey (NSS) Definition of Work**

Census’s definition of work is often deemed as broad as what constitutes “economically productive activity” is not refined (Mazumdar and Neetha 2011). The National Sample Survey (NSS), which is the other source of economic data in India, classifies economic activity as any activity “that results in the production of goods and services that adds value to national product...Such activities include production of all goods and services for market, i.e., production for pay or profit and the production of primary commodities for own consumption and own account production of fixed assets, among the non-market activities.” The NSS also uses a reference period of “previous 365 days” and categorizes the workforce into two activity status categories according to major and minor time spent on a “work activity” in the reference period. A work activity on which a relatively longer (major) time is spent by a person is termed “principal usual activity status”. Similarly, another secondary work activity on which a relatively lesser (minor) time is spent is categorized as “subsidiary economic activity status”.

The principal usual activity status and the subsidiary economic activity status are roughly comparable respectively to the main and marginal worker categories used by the Census. Table 4.1 lists the work participation numbers enumerated by the two sources. While the numbers for total workers are close to one another, such however is not the case for the sub-categories. The Census main worker numbers are lower than the numbers

---

<sup>65</sup> Ibid.

for NSS principal usual activity status. Conversely, the NSS subsidiary economic activity status numbers are much lower than the Census marginal worker numbers. Other than possible over- and/or under-enumeration, this inconsistency is most likely due to the cutoff of six months used in the Census to identify workers in to the two work categories. This distinction is, however, not applied by the NSS. The Census, therefore, should be the more appropriate source when it comes to distinguishing between relatively stable as opposed to transient participation in the workforce. Further, NSS data is not compiled at the district-level—the unit of analysis in this study—but only at the larger geographic levels of state and region. The Census data on the other hand is published at all there geographic levels: the nation, state and sub-state (district and villages).

**Table 4.1: Work Participation Rates – Comparison between NSS 2000 and Census 2001**

| Type of Work                                                           |   | National Sample Survey, 2000 |      |        | Census of India, 2001 |       |        |
|------------------------------------------------------------------------|---|------------------------------|------|--------|-----------------------|-------|--------|
|                                                                        |   | Total                        | Male | Female | Total                 | Male  | Female |
| Total                                                                  | T | 39.1                         | 51.7 | 25.6   | 39.47                 | 52.76 | 25.22  |
|                                                                        | R | 41.7                         | 53.1 | 29.9   | 41.97                 | 52.36 | 30.98  |
|                                                                        | U | 33.7                         | 51.8 | 13.9   | 32.23                 | 50.85 | 11.55  |
| Census Main Worker /<br>NSS Principal Usual<br>Activity Status         | T |                              |      |        |                       |       |        |
|                                                                        | R | 38.0                         | 52.2 | 23.1   | 31.03                 | 44.51 | 16.77  |
|                                                                        | U | 32.4                         | 51.3 | 11.7   | 29.30                 | 47.46 | 9.12   |
| Census Marginal Worker /<br>NSS Subsidiary Economic<br>Activity Status | T |                              |      |        |                       |       |        |
|                                                                        | R | 2.05                         | 0.54 | 3.58   | 9.43                  | 6.54  | 12.37  |
|                                                                        | U | 0.98                         | 0.31 | 1.69   | 3.11                  | 3.62  | 2.59   |

Source: Census of India 2001, National Sample Survey 2000

Note: T= Total; R= Rural; U=Urban

### 4.3.3 Pattern of Female Work Participation

Participation of women in economically productive labor activities in India has over the years persisted at low levels. Furthermore, it has consistently been much lower compared to countries at similar levels of economic development (Klasen and Pieters 2012, World Bank 2011a).<sup>66</sup> Compared to her neighbors in South Asia, the rate of FWP in India is among the lowest and only higher than that in Pakistan. For example in 2010, rates of female work participation (in the 15 and above age cohorts) in Bangladesh and Bhutan were 57 percent and 66 percent respectively and double the rate prevailing in India which was 29 percent. This rate, as can be seen from Table 4.2, is almost as low as that in some of the gender-dominated economies in the Middle East. The gender inequity in work participation in India is also among the highest and in terms of gender gap in work participation (in the 15 and above age cohorts) the country has the ninth highest rank in the world (World Bank 2011a).<sup>67</sup>

Until recently, FWP rate has been declining steadily and female work participation has been lower in the recent decades than that in the earlier ones. In the first half of the twentieth century between 1901 and 1961, FWP rates ranged between 28 and 34 percent. By 1981, it had fallen to 19.7 percent. The rates in the subsequent two decades increased modestly to reach 22.3 percent in 1991 and then 25.6 percent in 2001.

---

<sup>66</sup> The World Economic Forum groups countries in to three levels of economic development: factor-driven (stage I), efficiency-driven (stage II) and innovation-drive (stage III). This classification is according to GDP per capita and the share of exports comprising primary goods. In 2011-2012, a total of 37 nations, including India, were categorized as factor-driven economies (Kelley et al. 2011; Schwab 2011).

<sup>67</sup> In only eight other countries, Algeria, Pakistan and the Middle Eastern countries Afghanistan, Syrian Arab Republic, Saudi Arabia, Iran, Iraq, and Oman, the gender gap in work participation is higher than that in India (World Bank 2011a).

Inconsistencies in the definitions of “work” and “work participation”, which did not get standardized until the Census year of 1981, preclude a direct comparison of these numbers. Consequently the exact amount by which FWP rate changed between 1961 and 1981 remains unknown. Nevertheless, that the rate of FWP in 1981 was well below the rate prevailing in 1961 (28 percent) is a clear indication of a downward trend in FWP rates in that period. A similar downward trend was also observed in earlier decades between 1901 and 1971 (Olsen 2006; Sharma 1985).

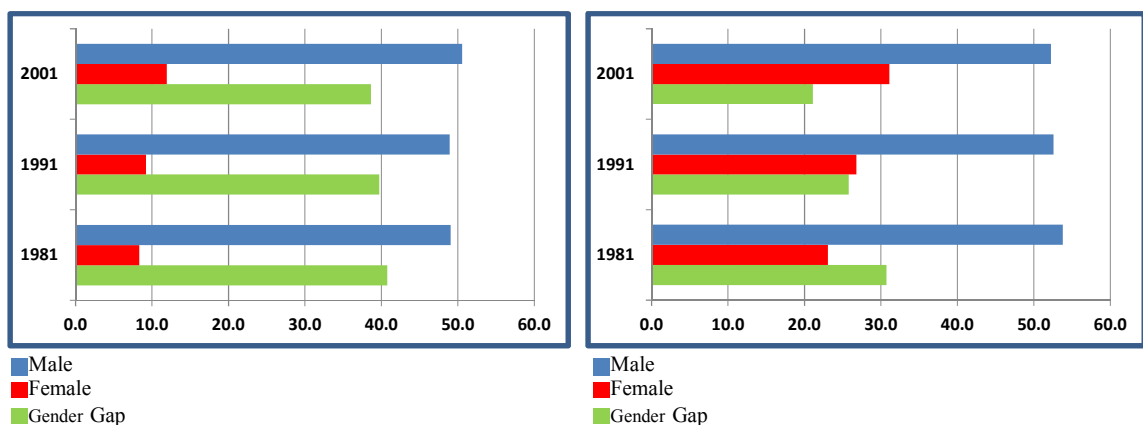
**Table 4.2: Male and Female Work Participation Rates (% of population 15+) and Gender Inequity in Work Participation Rates in Middle East and South Asia, 2010**

| Panel 4.2.1: India & Middle East |                         |             |                                       |             | Panel 4.2.2: India & South Asia |                         |             |                                       |             |
|----------------------------------|-------------------------|-------------|---------------------------------------|-------------|---------------------------------|-------------------------|-------------|---------------------------------------|-------------|
| Country Name                     | Work Participation Rate |             | Gender Inequity in Work Participation |             | Country Name                    | Work Participation Rate |             | Gender Inequity in Work Participation |             |
|                                  | Male                    | Female      | Gap                                   | Ratio       |                                 | Male                    | Female      | Gap                                   | Ratio       |
|                                  | (1)                     | (2)         |                                       | (1/2)       |                                 | (1)                     | (2)         |                                       | (1/2)       |
| Syria                            | 71.6                    | 12.9        | 58.7                                  | 5.55        | Pakistan                        | 83.3                    | 22.4        | 60.9                                  | 3.72        |
| Afghanistan                      | 80.4                    | 15.5        | 64.9                                  | 5.19        | <b>India</b>                    | <b>80.7</b>             | <b>29.0</b> | <b>51.7</b>                           | <b>2.78</b> |
| Iraq                             | 69.3                    | 14.3        | 55.0                                  | 4.85        | Sri Lanka                       | 76.2                    | 34.6        | 41.6                                  | 2.20        |
| West Bank & Gaza                 | 66.3                    | 14.7        | 51.6                                  | 4.51        | Bangladesh                      | 84.4                    | 56.9        | 27.5                                  | 1.48        |
| Iran                             | 71.8                    | 16.1        | 55.7                                  | 4.46        | Maldives                        | 76.4                    | 55.1        | 21.3                                  | 1.39        |
| Jordan                           | 65.4                    | 15.3        | 50.1                                  | 4.27        | Bhutan                          | 76.0                    | 65.5        | 10.5                                  | 1.16        |
| Saudi Arabia                     | 74.2                    | 17.4        | 56.8                                  | 4.26        | Nepal                           | 87.7                    | 80.3        | 7.4                                   | 1.09        |
| Egypt                            | 74.2                    | 23.5        | 50.7                                  | 3.16        |                                 |                         |             |                                       |             |
| Lebanon                          | 70.8                    | 22.5        | 48.3                                  | 3.15        |                                 |                         |             |                                       |             |
| Yemen                            | 71.7                    | 24.8        | 46.9                                  | 2.89        |                                 |                         |             |                                       |             |
| Oman                             | 79.9                    | 28.0        | 51.9                                  | 2.85        |                                 |                         |             |                                       |             |
| <b>India</b>                     | <b>80.7</b>             | <b>29.0</b> | <b>51.7</b>                           | <b>2.78</b> |                                 |                         |             |                                       |             |
| Turkey                           | 71.4                    | 28.1        | 43.3                                  | 2.54        |                                 |                         |             |                                       |             |
| Bahrain                          | 87.2                    | 39.2        | 48.0                                  | 2.22        |                                 |                         |             |                                       |             |
| UAE                              | 92.0                    | 43.7        | 48.3                                  | 2.11        |                                 |                         |             |                                       |             |
| Kuwait                           | 82.2                    | 43.3        | 38.9                                  | 1.90        |                                 |                         |             |                                       |             |
| Qatar                            | 95.2                    | 52.1        | 43.1                                  | 1.83        |                                 |                         |             |                                       |             |

Source: World Bank 2011b



In 2001, male work participation rate was 51.7 percent which was twice as high as the rate in female participation (25.6 percent). Women's work participation was even lower in urban India. At 11.5 percent, participation rate among urban females in 2001 was one third of the rate among rural women. Consequently, gender inequity in work participation has been even greater in urban parts of the country. Figure 4.1 shows urban (4.1.1) and rural (4.1.2) male and female work participation rates and gender gap in participation. Between 1981 and 1971, male work participation rates in rural and urban areas were comparable with numbers for each hovering around the 50 percent mark. In the same period, the gap in work participation between rural and urban females progressively widened with the urban females consistently lagging behind their rural counterparts. As a result, between 1981 and 2001, while gender gap in work participation in the rural areas decreased by almost 10 percentage points, it, on the other hand, remained almost static near the 40 percent mark in the urban areas.



4.1.1: Urban Gap

4.1.2: Rural Gap

**Figure 4.1: Male & Female Work Participation Rates and Gender Gap in Work Participation Rates, 1981–2001**

**Table 4.3: Composition of the Female Workforce, 2001**

|        |   | Panel A<br>(% of total population) |                          |                                  |                  | Panel B<br>(% of total workers) |                          |                                  |                  |
|--------|---|------------------------------------|--------------------------|----------------------------------|------------------|---------------------------------|--------------------------|----------------------------------|------------------|
|        |   | Cultivators                        | Agricultural<br>Laborers | Household<br>Industry<br>Workers | Other<br>Workers | Cultivators                     | Agricultural<br>Laborers | Household<br>Industry<br>Workers | Other<br>Workers |
|        |   | (1)                                | (2)                      | (3)                              | (4)              | (1)                             | (2)                      | (3)                              | (4)              |
| WPR    | T | 8.44                               | 9.96                     | 1.65                             | 5.57             | 32.93                           | 38.87                    | 6.46                             | 21.75            |
|        | R | 11.43                              | 13.22                    | 1.70                             | 4.43             | 37.12                           | 42.95                    | 5.54                             | 14.40            |
|        | U | 0.48                               | 1.27                     | 1.52                             | 8.61             | 4.05                            | 10.69                    | 12.80                            | 72.46            |
| Gender | T | 7.61                               | 0.81                     | -0.01                            | 17.64            | -1.87                           | -18.02                   | -3.28                            | 23.17            |
| Gap    | R | 10.45                              | 1.11                     | -0.13                            | 9.89             | 4.86                            | -15.44                   | -2.52                            | 13.10            |
| in WPR | U | 0.81                               | 0.47                     | 0.31                             | 37.13            | -1.50                           | -7.25                    | -9.19                            | 17.94            |

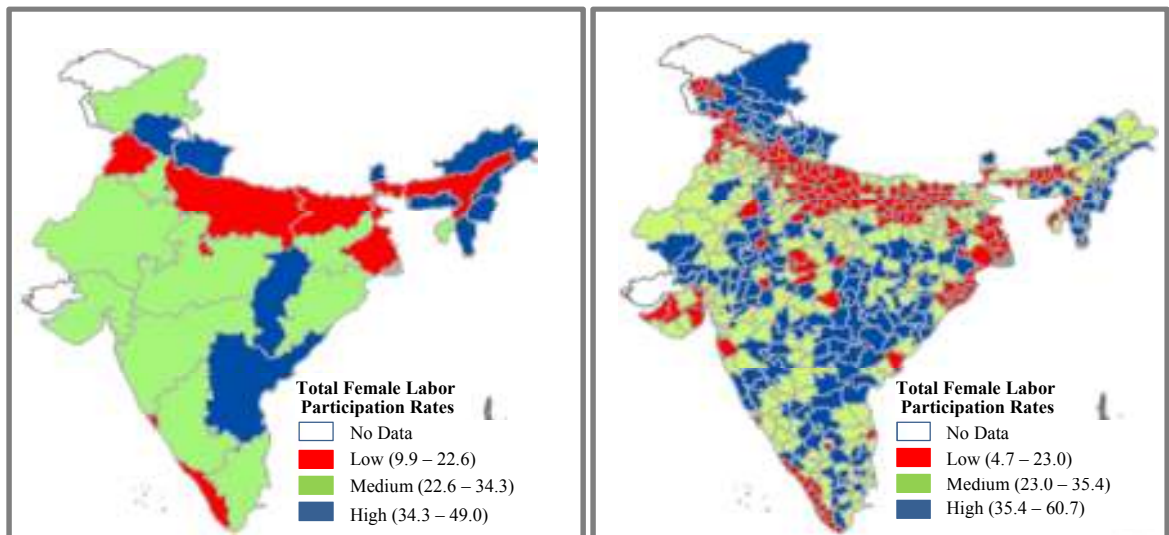
Source: Census of India, 2001

Note: T = Total, R = Rural, U = Urban

With regard to sectoral work composition, rural India, as would be expected, is primarily agricultural. As shown in Table 4.3, Panel A, the largest share of the rural female population in 2001 worked either as a cultivator (11.43%) or as an agricultural laborer (13.22%). Conversely, in urban areas the “other workers” with 8.61 percent of total urban females constituted the largest category. Table 4.3, Panel B lists the breakup of work composition in 2001 as percentages of total workers. Whereas 7 out of 10 female workers in urban areas in 2001 were “other workers”, in the rural areas it was 1 out of 10 female workers. Also, the gender gap in other workers was consistently high in both rural and urban India. In fact, the gender gap in work participation was the largest for “other workers” in urban areas.

Female work participation rate in India also varies by religion, and sociological groups (Schedule Caste and Schedule Tribes). The urban-rural difference in work

participation holds true in FWP across all religion, sociological groups and levels of education. Work participation is the lowest among Muslim females (14.1%), but is highest among Schedule Tribe females (44.8%). Finally, wide variation in FWP has been recorded at the sub-national inter- and intra-state levels. For example, the lowest female participation rate in 2001 was in Delhi (9.37%), and the highest, which was five times the rate in Delhi, was in Mizoram (47.54%). Similar to Mizoram, FWP rate in 2001 was quite high in the majority of the other north-eastern states and ranged between 36.45 and 47.63 percent. It was also high in the northern mountainous region, particularly in the state of Himachal Pradesh. These high participation states, however, were no exception to the trend of rural-urban disparity in FWP. In addition, at the sub-state district level, FWP showed strong geographic clustering which is shown in Figure 4.2.2.



4.2.1: State-level variation

4.2.2: District-level variation

**Figure 4.2: Geographic Variations in Female Work Participation Rate, 2001**

#### 4.3.5 Prior Analysis

Empirical evidence on the impact of fertility on FWP in developing countries is scant (Delpiano 2008, Younger 2006). Similarly, not many empirical studies investigate female labor participation in India, and this number is even more limited for studies interpreting the relation between fertility and FWP (Klasen and Pieters 2012). Those that focus on the two variables report an inverse relation, but typically examine the independent effect of female labor participation on women's fertility choices.<sup>68</sup> Only a handful of studies analyze the reverse relation, which are mostly conducted at the micro individual level.<sup>69</sup> Among the micro studies, one is of particular importance: Sudarshan and Bhattacharya (2009) conduct an individual-level analysis of female work participation in India and find that the macro sociological environment, instead of personal characteristics, play a larger role in influencing woman's decision to participate in the labor market. Although most micro-level studies, including Sudarshan and Bhattacharya, do not focus on interpreting the effect of fertility, they nonetheless include "number of children" as one of the explanatory factors.

Two studies by Mazumdar and Guruswamy (2006) and Mathur (1994) undertake analysis of the work-fertility relation at the aggregate regional level. Mazumdar and Guruswamy focus on interpreting the seeming quandary of low rate of female labor participation in the state of Kerala despite the high levels of social development, particularly high level of female autonomy, attained by that state. The authors examine

---

<sup>68</sup> See for example Jensen (2012, 2010); Kumar (1997); Sen and Sen (1985); Mason and Palan (1981).

<sup>69</sup> See for example Bhalla and Kaur (2011); Das (2006); Kumar (1997); Eapen (1992).

demographic, economic and socio-cultural determinants of female work participation and report fertility to be a significant correlate of fertility. They, however, do not include fertility in their multivariate analysis of female work participation. Mathur, on the other, identify a host of sub-state (district) level significant predictors of female work participation using 1991 Census data. In his analyses, the evidence on the impact of fertility is somewhat indirect: the analytic model incorporates “household size” but not fertility rate as an explanatory factor. The effect of household size on work participation among both urban and rural females is strongly negative. Mathur, however, does not investigate if this relation is heterogeneous across job or occupation types.

#### **4.4 Research Design**

##### **4.4.1 Empirical Model and Hypotheses**

Both theoretical perspectives, economic and sociological, discussed earlier under Section 2, are in accord in viewing the work-fertility relation as essentially an inverse one. It, however, is the sociological degree of mismatch framework that is of particular relevance to this analysis. Based on the mismatch perspective—the higher the degree of role incongruity between mothering and working, the stronger is the limiting effect of fertility on female work participation—two hypotheses that are empirically considered to interpret women’s work across a cross-section of districts in India are as below.

*Hypothesis I: Compared to flexible work types, such as farm- and family-based activities, inflexible non-farm and non-family based work, or “other work”, not suitable to combine with motherhood exhibits a stronger inverse relation to fertility.*

*Hypothesis II: For each of the two broad work categories, farm- and family-based activities, and non-farm and non-family based work, or “other work”, the negative effect of fertility is stronger in urban areas than in rural parts of the country.*

To test hypothesis I, separate work-fertility functions are estimated for two broad work types based on the classification used by the Census of India. These work types correspond to: (i) farm-based activities of agricultural laborers and cultivators and family- and household-based activities of household industry workers; and (ii) all other non-farm and non-family activities of other workers. Next, to test hypothesis II, each of the two work-fertility functions is estimated again with an additional interaction term that captures the effect of fertility in urban areas.

A key element that confounds the estimation of a work-fertility relation is that fertility and work participation decisions are not independent of each other but are concurrently defined (Browning 1992; Weeks 2005). A number of empirical studies, nonetheless, treat motherhood as an exogenous factor and estimate the work-fertility relation with an ordinary least square regression (Aguero and Marks 2008). But, most other studies apply the instrumental variable technique to address endogeneity between the two factors.

A second complicating aspect is the presence of non-random geographic interdependencies that most often characterize social phenomena such as fertility and female labor participation. Indeed, demographic and social outcomes in India display high levels of spatial clustering (Guilmoto 2008). Most prior studies examining social phenomena in India, however, do not address spatial autocorrelation in their analytic

models raising the specter of biased model estimates. To address these issues, a spatial autoregressive specification with autoregressive disturbances or a spatial autoregressive autoregressive (SARAR) framework is used in which the endogenous fertility variable is instrumented with a suitable correlate. This model is estimated using the generalized spatial two-stage least square instrumental variable (GS2SLS/IV) technique (Kelejian and Prucha 2010, 2004, 1999, 1998; Anselin and Bera 1998; Anselin 1988). The SARAR specification used to test Hypothesis I is as below:<sup>70</sup>

$$\mathbf{y} = \alpha + \rho \mathbf{W}\mathbf{y} + \mathbf{X}\boldsymbol{\beta} + \boldsymbol{\varepsilon} \quad (1.1)$$

$$\boldsymbol{\varepsilon} = \lambda \mathbf{W}\boldsymbol{\varepsilon} + \boldsymbol{\mu} \quad (1.2)$$

where,  $\mathbf{y}$  is an  $N \times 1$  vector of observations of FWP rates over a system of  $N$  regions,  $\mathbf{X}$  is an  $N \times K$  matrix of independent variables where  $K$  is the number of explanatory factors,  $\boldsymbol{\beta}$  is the  $K \times 1$  vector of regression coefficients,  $\mathbf{W}$  is an  $N \times N$  spatial weight matrix computed with the inverse distance square function,  $\rho$ ,  $\lambda$  are spatial lag and spatial error coefficients,  $\boldsymbol{\varepsilon}$  and  $\boldsymbol{\mu}$  are  $N \times 1$  vectors respectively of spatially correlated and spatially independent (iid.) error terms and  $\alpha$  is the regression constant. The spatial weight matrix is specified according to an inverse Euclidean distance weighting function with a distance decay parameter and a cut-off distance. The distance-decay function and the cut-off distance are set at the values used in the empirical analyses in chapter 3 before which respectively are 2 and 150 kilometers.

---

<sup>70</sup> The model specification is expressed in its matrix form.

The additional fertility-residence interaction variable included in equation 1.1 to test hypothesis II is of the form  $df$ , where  $d$  is a dummy variable,  $d_i$  is 1 if the district is urban, or 0 otherwise, and  $f$  is an  $N \times 1$  vector of observations of fertility levels over a system of  $N$  regions. Census of India's classification system for designating urban-rural areas is adopted here and applied to identify a district as urban. According to this definition, a district is labeled as urban if (i) the size of its total population is equal to or greater than 5,000, (ii) the percent of male working age population engaged in agricultural pursuits is less than or equal to 25, and (iii) the density of population is equal to or greater than 400 persons per square kilometer.

#### **4.4.2 Data and Variables**

*Variables of Interest:* The unit of analysis for the aggregate-level work-fertility models is sub-state level regions or districts in India. The dependent variable, female work participation rate, is constructed using data from 2001 Census of India. Female work participation rate is computed as the percentage of total female workers, to the total female working age population in the 15 to 64 age cohort. To investigate heterogeneity, in addition to modeling the aggregate work-fertility relation for the two work types, an additional function for all work types combined is estimated as a first step. For each of the three work categories, only those workers who worked six months or more in the reference period of previous one year, or main workers, are considered to interpret more permanent rather than transient workforce characteristics. The FWP measures are as follows:



- i. *main FWP rate* calculated with main female workers comprising of all types of work;
- ii. *main farm- and household-industry FWP rate* calculated with main female workers comprising of farm (agriculture and cultivation) and household-industry work; and
- iii. *main other worker FWP rate* calculated with main female workers comprising of all types of non-farm, and non-household industry work.

The independent variable of interest, level of fertility, is specified as total fertility rate or TFR estimated in Guilmoto and Rajan (2002) using 2001 Census of India data. Total fertility rate is a composite indicator of fertility and is expressed in terms of average number of children per woman.

Control Variables: In addition to the main explanatory variable of interest, a number of structural correlates of work participation are considered in the empirical models as control variables. These variables, constructed using Census of India 2001 data, are listed in Table 4.5 below. Prior analyses on female work participation discussed these variables extensively which relate to level of economic development and prevailing wage structure, socio-cultural norms and sociological groups and population characteristics.<sup>71</sup>

Applying the economic theories, Bloom et al. (2009) derive an optimal empirical FWP model, in which FWP, in addition to decreasing with increasing fertility, is moderated by wage rate and intra-familial transfers. An increase in the wage rate

---

<sup>71</sup> See for example Mathur (1994), Mazumdar and Guruswamy (2006), Klasen and Pieters (2012).

produces two types of effects. It raises the opportunity cost of not working resulting in a substitution effect that decreases the demand for leisure and increases the supply of labor. Conversely, an increase in a woman's own wage rate may instead create an income effect generating the reverse trend of increased demand for leisure and lowered women's work participation. This latter trend may also result out of intra-familial transfers when other household working members' income increases (Klasen and Pieters 2012). In the empirical models, levels of female and male education, expressed in terms of literacy rates, are included to respectively represent the effects of wage rate and intra-familial transfer on FWP (Bloom et al. 2009, Younger 2006).

Also as in chapter 3, level of infrastructure, expressed in terms of percentage of villages in a district with paved roads, is included in the empirical models as an indicator representing the impact of economic development on FWP. Next, district percentages of the sociological groups schedule caste (SC) and schedule tribe (ST) and the religious group Muslim are incorporated as the rate of FWP in each of these groups is distinct from that in the rest of the population. Further, a binary variable that is equal to 1 if the ratio of male to female literacy rate in a district exceeds the value of 1 and the sex ratio in the age cohort of less than one year is greater than 105, or 0 otherwise is considered.<sup>72</sup> This variable is included to represent the effect of socio-cultural norms of gender discrimination that depress women's labor market activity. Finally, three population attributes, size and density standing for scale and congestion effect of population, and

---

<sup>72</sup> Without external intervention, the biological sex ratio at birth is about 105. A sex ratio greater than 105, that is more than 105 male births per 100 female births, indicates a strong cultural preference for sons. This prejudice may spill beyond the selection of gender and in to upbringing of children possibly giving rise to gender gap in the provisioning of expenditures such as education and/or healthcare (Oster; 2009 Weeks 2005).

male labor participation rate representing the size of the district labor market, are included in the empirical models as additional controls.

**Table 4.4: List of Variables included in the Work-Fertility Models**

| <b>Variable</b>                           | <b>Indicator</b>                                                         | <b>Description</b>                                                                                                                            |
|-------------------------------------------|--------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Fertility                                 | TFR                                                                      | Children per woman in the age group of 15 – 49                                                                                                |
| Contraceptive Usage                       | Contraceptive Prevalence Rate (CPR)                                      | Percentage of currently married women between the ages of 15-44 who are using any method of family planning                                   |
| Economic Development                      | Level of Infrastructure                                                  | Proportion of villages in a district with paved access road                                                                                   |
| Level of Female Education                 | Female literacy rate                                                     | Percentage of a district's female population who are literates                                                                                |
| Level of Male Education                   | Male literacy rate                                                       | Percentage of a district's male population who are literates                                                                                  |
| Sociological Groups                       | Schedule Caste (SC)                                                      | Percentage of district population belonging to the group SC                                                                                   |
|                                           | Schedule Tribe (ST)                                                      | Percentage of district population belonging to the group ST                                                                                   |
|                                           | Muslims                                                                  | Percentage of district population belonging to the religious group Muslim                                                                     |
| Sociological Norm / Gender Discrimination | Gender gap in literacy rate in high sex ratio districts                  | Binary: Value assigned is 1 if ratio of male to female literacy ratio is greater than 1 and sex ratio is greater than 105                     |
| Population Characteristics                | Size                                                                     | District population (log)                                                                                                                     |
|                                           | Density                                                                  | District population density (log squared)                                                                                                     |
| Size of Labor Market                      | Male Work Participation Rate of Main Workers                             | Percentage of male main workers as a percentage of male working age population in the 15 to 64 age cohort                                     |
|                                           | Male Work Participation Rate of Main Farm and Household Industry Workers | Percentage of male main agricultural and household industry workers as a percentage of male working age population in the 15 to 64 age cohort |
|                                           | Male Work Participation Rate of Main Other Workers                       | Percentage of male main other workers as a percentage of male working age population in the 15 to 64 age cohort                               |

#### 4.4.3 Choice of Instrument

Work-fertility studies apply various techniques to instrument fertility and address the endogeneity between fertility and FWP. Microeconomic studies use random events, such as same sex sibling composition, or the occurrence of twins that have an exogenous impact on fertility, as instruments.<sup>73</sup> On the other end, scholars examining aggregate-level work-fertility dynamic employ macro-environmental indicators to instrument fertility (Bloom et al. 2009). These studies most often use changes in legislation particularly those related to abortion and usage of contraceptive pills (cf. Bloom et al. 2009). Other macro-level indicators that have also been used to instrument and estimate the effect of endogenous fertility are variation in population policy (China's one child policy; cf. Qian 2009), pattern of contraceptive behavior (cf. Kabubo-Mariara et al. 2009) and sex imbalance ratio (cf. Becker et al. 2010).

In this study, contraceptive usage, an indicator of supply of family planning services, is used to instrument endogenous fertility. For an instrument to be valid it needs to satisfy two criteria: first, that it is correlated to fertility and second, that it is unrelated to female labor supply and therefore orthogonal to the error term (Woolridge 2003). While there is no possibility that contraceptive use impacts FWP, except through its effect on fertility, the practice of employing family planning services as an independent predictor of fertility warrants some space here. This is due to the fact that contraceptive usage, as noted in chapter 3 earlier, is often also interpreted in the literature as an indicator of demand for family planning services. Schulz (2008), however, argues that

---

<sup>73</sup> For a detailed discussion on instrument variable technique used in microeconomic studies examining the work-fertility relation in developing countries see, for example, Cruces and Galiani (2007).

supply of family planning services constitutes valid forms of social policy that through contraceptive usage has an exogenous effect on fertility. In tune, the independent effect of family planning services has been documented by numerous studies (cf. Joshi and Schulz 2007). Data on contraceptive usage, contraceptive prevalence rate (CPR), available from the District Level Household Survey (DLHS 2002-04) is used in this analysis.

## 4.5 Discussion

### 4.5.1 Results

Summary descriptive statistics and correlation of the different FWP measures first with fertility and next with the structural correlates are presented in the tables (3.5 and 3.6) below. As would be expected, fertility is significantly ( $p = 0.05$ ) and inversely correlated to the FWP rate measures. The direction of association between the FWP rates for each of the two work categories and the independent correlates, except for a few, are in opposite direction. This is possibly indicative of the existence of underlying characteristics that differentiate these two work categories.

**Table 4.5: Summary Statistics and Correlation with Fertility (\*  $p = 0.05$ )**

| Variable                            | Mean  | Standard<br>Deviation | Min  | Max   | Correlation<br>(w/ TFR) |
|-------------------------------------|-------|-----------------------|------|-------|-------------------------|
| TFR (endogenous)                    | 3.31  | 1.01                  | 1.30 | 5.80  | --                      |
| Contraceptive Prevalence Rate (CPR) | 51.10 | 15.49                 | 4.90 | 86.60 |                         |
| <i>Dependent: FWP Rates</i>         |       |                       |      |       |                         |
| Main (all)                          | 27.21 | 14.92                 | 4.09 | 76.79 | -0.1332*                |
| Main Farm and household-industry    | 7.98  | 7.47                  | 0.31 | 35.50 | -0.1625*                |
| Main Other                          | 6.80  | 5.20                  | 0.93 | 43.30 | -0.5517*                |

**Table 4.6: Summary Statistics and Correlation with Structural Correlates**

| Variable                                                                          | Mean   | Standard<br>Deviation | Min   | Max    | Correlation<br>(w/ FWP rates) |                                 |         |
|-----------------------------------------------------------------------------------|--------|-----------------------|-------|--------|-------------------------------|---------------------------------|---------|
|                                                                                   |        |                       |       |        | Total                         | Farm &<br>Household<br>Industry | Other   |
| Level of Infrastructure<br>(paved roads)                                          | 60.67  | 26.18                 | 10.29 | 100.00 | -0.099*                       | 0.119*                          | 0.459*  |
| Female Literacy Rate                                                              | 52.49  | 15.45                 | 18.58 | 96.26  | 0.065                         | -0.105*                         | 0.539*  |
| Male Literacy Rate                                                                | 74.55  | 11.19                 | 39.75 | 97.38  | 0.053                         | -0.074                          | 0.388*  |
| Schedule Caste (SC)                                                               | 14.83  | 8.62                  | 0.00  | 50.11  | -0.287*                       | 0.070                           | -0.130* |
| Schedule Tribe (ST)                                                               | 15.74  | 25.47                 | 0.00  | 98.09  | 0.495*                        | -0.086*                         | 0.026   |
| Muslims                                                                           | 11.65  | 15.15                 | 0.09  | 98.49  | -0.367*                       | -0.110*                         | -0.100* |
| Male-to-female Literacy<br>Rate                                                   | 160.88 | 34.00                 | 87.99 | 298.01 | -0.172*                       | -0.050                          | -0.448* |
| Population Size (log)                                                             | 14.02  | 1.00                  | 10.35 | 16.08  | -0.408*                       | 0.268*                          | -0.167* |
| Population Density (log<br>squared)                                               | 11.61  | 2.33                  | 1.75  | 20.58  | -0.612*                       | -0.076                          | 0.062   |
| Male Work Participation<br>Rate of Main Workers                                   | 75.11  | 7.45                  | 51.10 | 91.63  | 0.398*                        | --                              | --      |
| Male Work Participation<br>Rate of Main Farm and<br>Household Industry<br>Workers | 13.91  | 9.27                  | 0.69  | 51.26  | --                            | 0.689*                          | --      |
| Male Work Participation<br>Rate of Main Other<br>Workers                          | 32.63  | 14.46                 | 8.59  | 85.41  | --                            | --                              | 0.723*  |

\* p = 0.05

Hypothesis I: Table 4.8 lists the results from the SARAR models estimated with each of the FWP measures as the dependent variable. Across these models, the coefficients of spatial lag and spatial error are consistently significant. This result indicates spatial clustering in the model input variables and justifies the use of the SARAR framework for estimating the empirical work-fertility functions.

The coefficients of fertility obtained in the multivariate analysis validate hypothesis I: the effect of fertility is negative and statistically significant only in the case of female other workers (model 3), but not for total female (model 1) and female farm and household-industry workers (model 2). These results agree with prior findings, though mostly at the micro level, of varying negative work-fertility relation with some studies reporting evidence of non-significant to often a significant positive association between the two.<sup>74</sup> The results also establish the applicability of the sociological mismatch framework to female work participation in India indicating a significant negative effect of fertility for work categories, i.e. non-farm and non-household-industry work, which are of higher degree of incompatibility to women's mothering responsibilities.

With regard to the independent control variables, associated parameter estimates are mostly, except for a few, in conformance to the discourse included in the literature. The coefficient for the indicator of economic development (level of infrastructure) is significant only for other workers. In other words, districts at higher levels of economic development have higher levels of female participation in non-farm and non-household industry work. The coefficients for female literacy rate indicate that the effect of an increase in own wage rate produces opposite results for the two female work categories. Whereas in the case of other workers, the positive coefficient indicates that the substitution effect prevails over the income effect to increase FWP, the reverse is true for the farm- and household-based female work.

---

<sup>74</sup> See for example Agüero and Marks (2008); Posel and van der Stoep (2008); Connelly et al. (2006); Bianchi (2000); Wong and Levine (1992); Lloyd (1991); Mason and Palan (1981).

An increase in wage rate creates income effect through intra-familial transfer from male working member of the family reducing the rate of work participation among female other workers. However, the positive coefficient of the male literacy rate for farm and household-industry workers does not indicate any such effect from intra-familial transfer. Although not evident from model 2, but this positive coefficient could be indicative of higher levels of female participation occurring to balance a possible fall in male work participation due to income effect of increased male wage rate in farm and household industry work.

Among the sociological groups, whereas traditionally the SC and Muslims have had lower rates of female work participation, the ST females' labor market involvement, on the other hand, has been higher than the rest of the population. The results provide evidence that this trend is partly prevalent in 2001. The FWP rate is lower for SC and higher for ST for the farm- and household-industry work category. However, work participation is lower for Muslim females across both types of work categories. Also, sociological norm that lead to higher gender gap in literacy and higher sex ratio close to birth is associated with depressed rates of FWP for the "other" work category. The corresponding coefficient for farm and household-industry work is, however, not significant, perhaps indicating a greater acceptability of these types of work for females that prevails over the broader gender-based biases (Lim 2002). This reasoning is, however, subject to further scrutiny for each of the work type, agriculture, cultivation and household industry, that make up farm and household industry work. Finally, the remaining indicators provide evidence that: (i) FWP is lower in larger and more densely



populated districts for both types of work, and (ii) the greater the size of the respective labor markets, the higher is the level of FWP in that work category.

**Table 4.7: Comparison of Work-Fertility Models (Hypothesis I)**

|                                                                                 | <b>SARAR Models<br/>(GS2SLS/IV)</b> |                                  |                       |
|---------------------------------------------------------------------------------|-------------------------------------|----------------------------------|-----------------------|
|                                                                                 | Total                               | Farm &<br>Household-<br>industry | Other                 |
|                                                                                 | (model 1)                           | (model 2)                        | (model 3)             |
| TFR                                                                             | -1.2878<br>(1.1623)                 | -1.7753<br>(1.1`510)             | -0.3443*<br>(0.2419)  |
| Level of infrastructure (paved road)                                            | -0.0189<br>(0.0235)                 | -0.0091<br>(0.0235)              | 0.0199***<br>(0.0076) |
| Female literacy rate                                                            | -0.4316***<br>(0.0966)              | -0.3517***<br>(0.0962)           | 0.0650**<br>(0.0292)  |
| Male literacy rate                                                              | 0.6331***<br>(0.1034)               | 0.5600***<br>(0.1025)            | -<br>(0.0308)         |
| SC                                                                              | -0.1017<br>(0.0658)                 | -0.1169*<br>(0.0691)             | 0.0143<br>(0.0199)    |
| ST                                                                              | 0.1516***<br>(0.0274)               | 0.1265***<br>(0.0283)            | 0.0004<br>(0.0095)    |
| Muslims                                                                         | -0.1442***<br>(0.0310)              | -0.1181***<br>(0.0316)           | -<br>(0.0104)         |
| Socio-cultural norm                                                             | -2.8567*<br>(1.6200)                | -2.2496<br>(1.6985)              | -<br>(0.5648)         |
| Log population                                                                  | -0.9604*<br>(0.5445)                | -1.0609*<br>(0.5628)             | -0.3848**<br>(0.1785) |
| Log population density square                                                   | -1.8054***<br>(0.2723)              | -1.5412***<br>(0.2856)           | -<br>(0.0941)         |
| Male work participation rate (main workers)                                     | 0.7062***<br>(0.0604)               |                                  |                       |
| Male work participation rate (main agricultural and household industry workers) |                                     | 0.4103***<br>(0.0390)            |                       |
| Male work participation rate (main other workers)                               |                                     |                                  | 0.2173***<br>(0.0133) |

**Table 4.7 (contd.)**

|               | <b>SARAR Models<br/>(GS2SLS/IV)</b> |                                  |                       |
|---------------|-------------------------------------|----------------------------------|-----------------------|
|               | Total                               | Farm &<br>Household-<br>industry | Other                 |
|               | (model 1)                           | (model 2)                        | (model 3)             |
| Intercept     | -20.0424<br>(58.8472)               | 8.7979<br>(11.5756)              | 14.1782**<br>(3.6104) |
| Spatial lag   | 0.4817**<br>(0.1997)                | 0.6533***<br>(0.1808)            | 0.2990***<br>(0.1016) |
| Spatial error | 1.0001***<br>(0.1583)               | 0.7874***<br>(0.1320)            | -0.6993**<br>(0.2989) |
| N             | 587                                 | 587                              | 587                   |

Standard errors in parentheses

\* p<.10, \*\* p<0.05, \*\*\* p<0.01

Hypothesis II: Findings from the work-fertility models estimated with the residence-fertility interaction variable for each of the three FWP measures are presented in Table 4.9. With regard to the control variables, the results are compatible with that obtained in the work-fertility models presented in Table 4.8 and discussed earlier. The spatial lag and spatial error coefficients stays significant in these models also.

In the first three models (models 4, 5 & 6.1), as discussed previously under Section 3.4.1, Census of India's urban-rural classification is used to define the fertility-residence interaction term. These models partly validate hypothesis II. The work-fertility relation for female work remains the same: the relationship is not significant for the main total and main farm and household-industry work (models 4 and 5), but is significant for the other work category (model 6.1). The coefficient of the interaction term is significant for the first two categories, but not for the "other" work classification. In other words, the negative effect of fertility on female work is manifest in urban districts only when all

female work or female farm and household-industry work is considered. Conversely, compared to all districts, the significant negative relation between fertility and other work is no different in urban districts. Model 6.2 is, therefore, estimated next to examine if compared to the rest of the country, the work-fertility relation for other work is distinct in the cities.

In this last model (6.2), for the interaction term districts are identified as urban with an additional criterion added to the urban-rural classification used by the Census of India. Districts are ascertained as urban if, together with the three factors of population size, density and percentage of male working age population engaged in agriculture, an additional condition of two-third or more of the population being urban is satisfied. This additional condition was considered as it successfully identified urban districts that correspond to the tier 1 metropolitan cities and the larger tier 2 cities in the country.<sup>75</sup> The coefficients of both the fertility and the interaction variables in this model are significant and negative indicating that the inverse relation is stronger ( $= -0.3631 - 0.7669 = -1.1300$ ) in cities. This result together with those obtained in the earlier models (4, 5 & 6.1), provides additional evidence in support of the premise of hypothesis II. These findings suggest that the negative effect of fertility is (i) significant only in urban India for female farm and household industry work, and (ii) stronger in urban districts that correspond to cities for female non-farm and non-household-industry other work.

---

<sup>75</sup> The classification of Indian cities in to groups is done differently depending upon the purpose behind the categorization. For example, cities are divided into categories of A1/A2, B, C, D; or X, Y, and Z, according to cost of living to determine governmental allowances such as house rent allowance (HRA) and city compensatory allowance (CCA) (GOI 2008). An alternative, and probably more popular, classification is one in which cities in India are grouped in to Tier 1, 2, or 3, on the basis of the size of their population. (Sankhe et al. 2010, Gupta 2009). Categorizing cities according to their population size is also employed by the United Nations to classify them as small, medium, large and mega cities (Nallari et al. 2012).

**Table 4.8: Comparison of Work-Fertility Models (Hypothesis II)**

|                                                                                 | Total                  | Farm &<br>Household-<br>industry | Other                  |                        |
|---------------------------------------------------------------------------------|------------------------|----------------------------------|------------------------|------------------------|
|                                                                                 | (model 4)              | (model 5)                        | (model 6.1)            | (model 6.2)            |
| Fertility                                                                       | -0.4917<br>(1.1980)    | -0.7385<br>(1.2249)              | -0.4203*<br>(0.2702)   | -0.3631*<br>(0.2298)   |
| Fertility*Urban                                                                 | -1.1690***<br>(0.3579) | -1.2994***<br>(0.3721)           | -0.0227<br>(0.1190)    | -0.7669*<br>(0.4606)   |
| Level of infrastructure (paved road)                                            | 0.0020<br>(0.0243)     | 0.0087<br>(0.0243)               | 0.0192**<br>(0.0077)   | 0.0174**<br>(0.0075)   |
| Female literacy rate                                                            | -0.4035***<br>(0.0961) | -0.3229***<br>(0.0955)           | 0.0608**<br>(0.0300)   | 0.0597**<br>(0.0287)   |
| Male literacy rate                                                              | 0.6291***<br>(0.1022)  | 0.5556***<br>(0.1008)            | -0.1299***<br>(0.0310) | -0.1275***<br>(0.0304) |
| SC                                                                              | -0.0901<br>(0.0649)    | -0.1023<br>(0.0679)              | 0.0139<br>(0.0202)     | 0.0143<br>(0.0195)     |
| ST                                                                              | 0.1575***<br>(0.0270)  | 0.1365***<br>(0.0277)            | 0.0005<br>(0.0095)     | 0.0032<br>(0.0095)     |
| Muslims                                                                         | -0.1306***<br>(0.0309) | -0.1043***<br>(0.0312)           | -0.0315***<br>(0.0107) | -0.0322***<br>(0.0103) |
| Socio-cultural norm                                                             | -2.0097<br>(1.6159)    | -1.1134<br>(1.7024)              | -1.5277***<br>(0.5759) | -1.5533***<br>(0.5615) |
| Log population                                                                  | -0.8754<br>(0.5383)    | -0.9210*<br>(0.5536)             | -0.3907**<br>(0.1791)  | -0.3811**<br>(0.1763)  |
| Log population density square                                                   | -1.4820***<br>(0.2830) | -1.1832***<br>(0.2935)           | -0.2841***<br>(0.1029) | -0.2134**<br>(0.0971)  |
| Male work participation rate (main workers)                                     | 0.6701***<br>(0.0605)  |                                  |                        |                        |
| Male work participation rate (main agricultural and household industry workers) |                        | 0.3842***<br>(0.0393)            |                        |                        |
| Male work participation rate (main other workers)                               |                        |                                  | 0.2165***<br>(0.0133)  | 0.2233***<br>(0.0140)  |

**Table 4.8 (contd.)**

|               | Total                  | Farm &<br>Household-<br>industry | Other                  |                        |
|---------------|------------------------|----------------------------------|------------------------|------------------------|
|               | (model 4)              | (model 5)                        | (model 6.1)            | (model 6.2)            |
| Intercept     | -25.1937*<br>(14.7099) | 0.5747<br>(12.0228)              | 14.7229***<br>(3.7056) | 13.2772***<br>(3.5921) |
| Spatial lag   | 0.4113*<br>(0.2114)    | 0.5333***<br>(0.1865)            | 0.2989***<br>(0.1018)  | 0.3174***<br>(0.0984)  |
| Spatial error | 1.0800***<br>(0.1661)  | 0.8658***<br>(0.1426)            | -0.7039**<br>(0.3029)  | -0.8771***<br>(0.3297) |
| N             | 587                    | 587                              | 587                    | 587                    |

Standard errors in parentheses

\* p&lt;.10, \*\* p&lt;0.05, \*\*\* p&lt;0.01

#### 4.5.2 Policy Implications

The empirical results revealed a higher degree of incongruity between women's childbearing responsibilities and workforce participation in urban districts across all types of female work. This finding is indicative of the fact that the work-fertility relation in urban India is somewhat akin to that experienced in developed nations before the decade of 1980 when the negative relation between the two started declining (Kogel 2004). As evidenced in sociological theories and discussed earlier, this incompatibility in urban India in part can be ascribed to the social organization that distinguishes urban from rural way of life, namely separation of work from home, absence of extended family to support filial duties, unavailability of childcare outside of home, and greater inflexibility of work schedules (Mammen and Paxson 2000).

While the ability of policies to influence macro-level economic and social forces that define progressively urbanizing regions is minimal, policy interventions that have worked in developed countries merits vigorous reconsideration for their applicability to urban India. For developed countries, multiple studies provide evidence that social and family-friendly policies designed to allow women to concurrently have children and work have been successful in raising women's labor market participation.<sup>76</sup> Examples of policy measures that have been identified for their contribution in relaxing the negative association between work and fertility since the decade of 1980 include such measures as increased provision of childcare, pre-schooling and extended care options, childcare allowances and subsidies, and arrangement of flexible schedules and part-time work opportunities (Brewster and Rindfuss 2000). The extant empirical literature on the positive effect of affordable and subsidized childcare on female labor supply in developed countries is extensive.<sup>77</sup> Moreover, current trends in industrialized nations that have a high share of women in the workforce reveal that a large proportion of the working females are engaged in part-time employment (BLS 2012).

The large informal sector that dominates the Indian labor market and sets it apart from that in developed countries should not restrict the utility of these policies for female work in India. It, instead, necessitates that the translation of these policies to the Indian context be suitably innovative to fit the requirements of female work in the informal sector. Currently, in India there exists a patchwork of policies, schemes and programs

---

<sup>76</sup> See for example Del Boca and Wetzels (2008) Del Boca (2002) and Brewster and Rindfuss 2000.

<sup>77</sup> See for example Gustafsson and Stafford (1992), Gelbach (2002), Baker et al. (2008), Cascio (2009), Rindfuss et al. (2010).

that attempt to address childcare needs among urban as well as rural women working in formal and informal sectors of the economy.<sup>78,79</sup> While it is beyond the scope of this chapter to provide a review of these endeavors, it, however, would suffice to mention that one common thread limiting these disparate efforts is shortage of resources and trained staffs (Awofeso and Rammohan 2011; Datta 2003).

Also, options other than child daycare are limited and when available are inadequate or are not suitably implemented (USAID 2009; Wang et al. 2008). For example, eligibility requirement for Government of India's childcare allowance limits this benefit to disabled women and in the first two years of child rearing (Central Government Staff News 2008). The creation of working conditions that mitigate much of the conflict between mothering and working and provide women greater access to work, particularly in non-farm and non-household based "other" work in urban India, is, therefore, worth additional exploration. Recently, under the Health Policy Initiative, the USAID pilot tested the "Family Friendly Workplace Model" in India.<sup>80</sup> Roll out of such testing and evaluation initiatives is of the essence and a step in the right direction.

---

<sup>78</sup> In India, like other developing economies, the larger share of female work exists in the informal sector. The two sectors, formal and informal, are respectively referred to as the "unorganized" and "organized" sectors. Enumeration of the organized sector is covered under the Annual Survey of Industries (ASI) and comprises of units registered under the Factories Act that employs (i) 10 or more workers if using power, or, (ii) 20 or more workers if not using power. Units that are not covered under the ASI constitute the unorganized sector of the economy. The National Commission for Enterprises in the Unorganized Sector was established in September 2004. Under the National Sample Survey Organization (NSSO), a survey of the units in the unorganized sector was conducted for the first time in 1999-2000 (Chakraborti 2009).

<sup>79</sup> For a review of these initiatives see, for example, Saqib (2008); Datta (2003).

<sup>80</sup> The Family Friendly Workplace Model was developed by Futures Group. For additional information on this model refer to Plosky and Winfrey (2009).

An additional need is some degree of standardization of work conditions across government, private and non-governmental sectors as workplace policies has existed as ad hoc and as organization specific schemes (Datta 2003). But what probably should precede such efforts is a review of the policy environment that has been in place in India to encourage female employment and work participation since the country became a sovereign nation. Policy institutions, programs and schemes have typically been devised focusing on economically backward rural women and on women's self-employment within an overall goal of empowering women and developing their self-reliance and autonomy (Deshpande and Sethi 2009). However, given the findings of the empirical analysis in this chapter, a realignment of existing policies towards factors depressing women's participation in urban areas and in occupations under the "other" work category is due. A critical element of this endeavor would, however, be the need to address broader gender-based biases that adversely impact the social acceptability of female work outside of farm and household-industry. In addition, norms that make it prestigious for women, particularly mothering ones, to stay at home are particular candidates for policy attention (Olsen 2006). In this regard, reinforcing women's right to property is particularly discussed in the literature for its potential in reducing gender bias by raising women's bargaining power and status in society (Jensen 2010).

#### **4.6 Conclusion**

The analysis presented in this chapter was motivated by the low rates of participation and high gender gap typifying women's work in India. Empirical findings validated the



research hypotheses and highlighted the greater negative effect of fertility for all types of women's work in urban India. As fertility in urban parts of the country is already quite low, the persistence of the role incompatibility in urban India makes the provision of childcare facilities and family-friendly workplace policies that much more important. Such a policy environment is one of the prerequisites if India is to benefit from its demographic dividend phase.

For future research directions a number of points come in focus. In this research, neither sector- nor industry-wise analyses of female work were conducted. Such an evaluation is essential to better interpret trends and form a more nuanced account of the work-fertility relation. Of similar significance is the examination of how female work varies between the organized (formal) and unorganized (informal) sectors of the economy. For example, factors that are important for formal-sector employment, such as education, experience, and continuity of work to name a few, are usually not that important for low-paying informal jobs. Accordingly the effect of fertility might be altogether different between the two sectors in India. Furthermore, to forge a richer understanding, it becomes necessary that the work-fertility dynamic be evaluated with women's workforce participation disaggregated by age cohorts particularly as the demands of childbearing varies over the course of the reproductive life-cycle. All or any of these additional considerations would, however, bring the analyst to the proverbial bottleneck in data that, more often than not, remain insurmountable for developing countries such as India.

## **CHAPTER 5: CONCLUDING REMARKS**

In recent decades, global and local forces have been transforming the regional landscape of the developing world. Among these forces, declining fertility and rising women's participation in economic activities have played iconic roles in the past century. Findings from previous studies indicate that both factors are crucial to derive a one-time benefit from demographic dividend as countries undergo demographic transition. Motivated on this context, the research presented in this dissertation investigated the work-fertility dynamic after examining the cross-sectional factors of fertility in India. The focus was on addressing the research questions relating to: (i) what factors correlate with high fertility in the North?; and (ii) what role does fertility play in explaining low women's work participation in urban areas?

The hypotheses related to the first research question were attended to by applying the blended theoretical framework that amalgams the diffusion theory within the conventional socioeconomic theories to empirically examine fertility across the districts of India. The role of fertility in urban areas was tested using the sociological mismatch framework that hypothesizes a larger negative effect of fertility for those work types that are incompatible to combine with childcare duties. The line of research followed in this analysis will be of value under two specific scenarios: first, it offers a framework for modeling and interpreting fertility outcomes in developing countries at mid-to-late stages

of transition, and next, it provides a basis for interpreting the heterogeneous effect of fertility on women's work in countries regardless their station on the demographic transition trail.

The empirical findings of the first analysis indicated the importance of diffusion and reestablished the role of socioeconomic factors for fertility outcomes. This finding is compatible with the recent realignment of opinion highlighting both diffusion and socioeconomic variables after a period in which the latter was relegated to a secondary status (WB 2010; Bryant 2007). In countries at the mid-to-late transitioning phases that are experiencing either a slowdown in fertility decline and/or stable high-fertility clusters, evaluating the relative role of each of these factors will be salient for policymaking. As demonstrated in the case of India, in mid-to-late transition developing countries both these factors might be crucial for further lowering fertility and deriving associated benefits such as the demographic dividend and the completion of the demographic transition.

For diffusion in particular, the effectiveness of policy in disseminating information on the benefits of birth control and contraceptive usage through family planning programs and social networks has already been tested. Using a quasi-experimental methodology, Freedman and Takeshita (1969) conducted a study decades ago in Taiwan. Stratified amount of information ranging from explicit to rudimentary was provided to different neighborhoods of the country. At the completion of the experiment, compared to control neighborhoods, most women in the experimental localities who adopted family planning did so after receiving information from their social network of

relatives, neighbors or friends and/or from family-planning field workers. Harnessing the strength of this type of positive externalities should constitute policy efforts that target social behaviors such as fertility or female labor choices, especially in areas of high fertility and low women's work participation. Although not a focus of this investigation, diffusion of female labor participation through social learning has been identified as a contributory factor impacting women's labor market decisions (cf. Fogli and Vedkamp 2011; Fogli et al. 2007; Bollinger 1991).

The analytic framework derived to test the roles of various factors and fertility in this study also has relevance for developing countries at earlier stages of the demographic transition. For example, in these early-transition stage countries, majority of which are in sub-Saharan Africa, application of a framework as used in this investigation of fertility is appropriate for two reasons. First, fertility decision is a complex behavior, one that most often involves interaction between not only the conventional socioeconomic predictors but also includes the local and global forces of diffusion. More importantly, interpreting the contribution, or the lack thereof, of the latter factor could be critical as it has the potential to fuel fertility change even when socioeconomic conditions are not conducive.

Next, when it comes to examining the work-fertility dynamic, the analytic relevance of this study to developing countries holds regardless of the stage of transition. To take the instance of Africa again, particularly sub-Saharan Africa, whereas high fertility is of endemic significance, in contrast female labor participation is high. In fact, female labor participation rates in Africa are much higher than that in countries of South Asia including India. Yet, some common trends are of point. These equivalent patterns in

Africa are: (i) wide inter- and intra-country variations with low participation of women in North Africa; (ii) clustering of outcomes in both fertility and female participation in labor; and (iii) concentration of women's participation in agriculture and in the informal sectors of the economy (Chen 2008).

While a number of prior studies have reported an inverse relation between fertility and women's work at the individual level in certain African countries, evidence on a possible heterogeneous effect of fertility at the aggregate levels remains under-developed (Cleland et al 2009).<sup>81</sup> The analytic approach adopted in this dissertation to model the work-fertility dynamic should, therefore, be of particular significance in investigations on female labor participation in Africa as well. It will allow the testing of how the effect of fertility varies across work types and by places of rural-urban residence.

Notwithstanding the above broader applicability of the research in this dissertation, the present endeavor is limited by cross-sectional results. It, therefore, cannot offer an understanding on the evolution of either fertility or women's work in countries across time. Dynamic spatial and/or spatio-temporal empirical analyses would, therefore, serve as suitable research extensions to this dissertation. Another next natural research stop would be cross-border analyses wherein similar trending regions in South Asia—such as West Bengal and Bangladesh, or the two Punjabs in India and Pakistan, or South India and Sri Lanka—or elsewhere in the world could be comparatively and contrastingly tested.

---

<sup>81</sup> For studies examining the work-fertility relation in Africa at the micro-level, see for example, Canning and Finlay 2012; Buguy 2009; Lokshin et al. 2000; Shapiro and Tambashe 1997.

## REFERENCES

- Acharya, S. (2004). India's Growth Prospects Revisited. *Economic and Political Weekly*, 39(41), 4537–4542.
- Acharya, S. (2009). India's Growth: Past and Future. In N. E. Dinello & S. Wang (Eds.), *China, India and beyond: development drivers and limitations* (pp. 23–46). Cheltenham, UK ; Northampton, MA: Edward Elgar.
- Agnihotri, S., Palmer-Jones, R., & Parikh, A. (2002). Missing women in Indian districts: a quantitative analysis. *Structural Change and Economic Dynamics*, 13(3), 285–314.
- Aguero, J., & Marks, M. S. (2008). Motherhood and Female Labor Participation: Evidence from Infertility Shocks. *American Economic Review*, 98(2), 500–504.
- Ahlburg, D. A. (1998). Julian Simon and the population growth debate. *Population and Development Review*, 24(2).
- Ahlburg, D. A. (2002). Does Population Matter? A Review Essay. *Population and Development Review*, 28(2), 329–360.
- Akhter, H. H. (1987). Development of IEC program in Bangladesh. *Network (Research Triangle Park, N.C.)*, 8(3), 6.
- Amin, S., Basu, A. M., & Stephenson, R. (2002). Spatial variation in contraceptive use in Bangladesh: looking beyond the borders. *Demography*, 39(2), 251–267.
- Angeles, G., Guilkey, D. K., & Mroz, T. A. (1998). Purposive Program Placement and the Estimation of Family Planning Program Effects in Tanzania. *Journal of the American Statistical Association*, 93(443), 884–899.
- Angeles, G., Guilkey, D. K., & Mroz, T. A. (2005). The Effects of Education and Family Planning Programs on Fertility in Indonesia. *Economic Development and Culture Change*, 54, 165–2001.
- Anselin, L. (1980). *Estimation methods for spatial autoregressive structures : a study in spatial econometrics* (Ph.D. Dissertation). Cornell University, Ithaca, NY.

Retrieved from Regional science dissertation & monograph series ; 8.

- Anselin, L. (1988). *Spatial Econometrics: Methods and Models*. Dordrecht, Boston: Springer Publishers.
- Anselin, L., & Bera, A. (1998). Spatial dependence in linear regression models with an introduction to spatial econometrics. In A. Ullah (Ed.), *Handbook of Applied Economic Statistics* (pp. 237–289). Marcel Dekker: New York: CRC Press.
- Antony, T. V. (1992). *The Family Planning Program: Lessons from Tamil Nadu's Experience*. Presented at the Symposium on India's Development in the 1990s, March, Nehru Memorial Museum and Library, Center for Policy Research, New Delhi, India.
- Arraiz, I., Drukker, D. M., Kelejian, H. H., & Prucha, I. R. (2010). A Spatial Cliff-Ord-Type Model with Heteroskedastic Innovations: Small and Large Sample Results. *Journal of Regional Science*, 50(2), 592–614.
- Awofeso, N., & Rammohan, A. (2011). Three Decades of the Integrated Child Development Services Program in India: Progress and Problems. In A. Śmigórski (Ed.), *Health Management: Different Approaches and Solutions* (pp. 243–258). Croatia, Shanghai: InTech Publishing.
- Baker, M., Gruber, J., & Milligan, K. (2008). Universal Child Care, Maternal Labor Supply, and Family Well-Being. *Journal of Political Economy*, 116(4), 709–745.
- Balabdaoui, F., Bocquet-Appel, J.-P., Lajaunie, C., & Irudaya Rajan, S. (2001). Space–time evolution of the fertility transition in India, 1961–1991. *International Journal of Population Geography*, 7(2), 129–148.
- Baltagi, B. H. (2008). *Econometric Analysis of Panel Data*. Chichester, UK: John Wiley & Sons.
- Barnett, H. J. (1963). *Scarcity and growth; the economics of natural resource availability*. Washington: Published for Resources for the Future by Johns Hopkins Press, Baltimore.
- Basu, A. M. (1992). *Culture, the Status of Women, and Demographic Behaviour: Illustrated with the Case of India*. Oxford: Clarendon Press. Retrieved from <http://www.barnesandnoble.com/w/culture-the-status-of-women-and-demographic-behaviour-alaka-malwade-basu/1000548926>
- Basu, K. (2004). *India's emerging economy: performance and prospects in the 1990s and beyond*. Cambridge, MA: MIT Press.

- Bbaale, E. (2011). *Female Education, Labour-force Participation and Fertility: Evidence from Uganda* (Final Report). Nairobi, Kenya: The African Economic Research Consortium.
- Becker, G. S. (1960). *An Economic Analysis of Fertility* (NBER Chapters) (pp. 209–240). National Bureau of Economic Research, Inc.
- Becker, G. S. (1965). A Theory of the Allocation of Time. *The Economic Journal*, 75(299), 493–517.
- Becker, G. S. (1985). Human Capital, Efforts, and the Sexual Division of Labour. *Labour Economics*, 3(1), S33–58.
- Becker, G. S. (1991). *A Treatise on the Family*. Cambridge, MA: Harvard University Press. Retrieved from <http://ideas.repec.org/b/nbr/nberbk/beck81-1.html>
- Becker, G. S., & Lewis, H. G. (1973). On the Interaction between the Quantity and Quality of Children. *Journal of Political Economy*, 81(2), S279–S288.
- Becker, S. O., Cinnirella, F., & Woessmann, L. (2010). The trade-off between fertility and education: evidence from before the demographic transition. *Journal of Economic Growth*, 15(3), 177–204. doi:10.1007/s10887-010-9054-x
- Berry, B. J. L., Marble, D. F., & Hägerstrand, T. (Eds.). (1968). Monte Carlo Approach to Diffusion. In *Spatial analysis: a reader in statistical geography*. New Jersey: Prentice-Hall.
- Bhalla, S., & Kaur, R. (2011). *Labour force participation of women in India: some facts, some queries* (Working Paper No. 40). London, UK: Asia Research Centre, London School of Economics and Political Science.
- Bhat, P. N. M. (1996). Contours of Fertility Decline in India: A District Level Study based on 1991 Census. In D. K. Srinivasan (Ed.), *Population Policy and Reproductive Health: Proceedings of the Seminar on "Policy Direction and Strategy of Action in Population and Reproductive Health in India"*, New Delhi, December 1995 (pp. 96–179). New Delhi, India: Hindustan Publishing Corporation.
- Bhat, P. N. M. (2002). India's Changing Dates with Replacement Fertility: A Review of Recent Fertility Trends and Future Prospects. In *Completing the Fertility Transition* (pp. 347–358). New York: United Nations Publications.
- Bhat, P. N. M., Preston, S., & Dyson, T. R. (1984). *Vital Rates in India, 1961-1981* (Committee on Population and Demography No. Report No. 24). Washington



DC: National Academy Press.

Bhat, P. N. M., & Rajan, S. I. (1990). Demographic Transition in Kerala Revisited. *Economic and Political Weekly*, 25(35-36), 1957–1980.

Bhattacharya, P. C. (2004). *Economic Development, Gender Inequality, and Demographic Outcomes: Evidence from India*. Presented at the Heriot-Watt University Discussion Paper 2004-E01, Edinburgh. Retrieved from <http://www.sml.hw.ac.uk/documents/dp2004-e01.pdf>

Bhattacharya, P. C. (2006). Economic Development, Gender Inequality, and Demographic Outcomes: Evidence from India. *Population and Development Review*, 32(2), 263–292.

Bianchi, S. M. (2000). Maternal employment and time with children: dramatic change or surprising continuity? *Demography*, 37(4), 401–414.

Birdsall, N., & Sinding, S. W. (2001). How and why population matters: New findings, new issues. In N. Birdsall, A. C. Kelley, & S. W. Sinding (Eds.), *Population matters: demographic change, economic growth, and poverty in the developing world*. New York: Oxford University Press.

Blanc, A. K., & Tsui, A. O. (2005). The dilemma of past success: insiders' views on the future of the international family planning movement. *Studies in family planning*, 36(4), 263–276.

Bleakley, H., & Lange, F. (2009). Chronic Disease Burden and the Interaction of Education, Fertility, and Growth. *The Review of Economics and Statistics*, 91(1), 52–65.

Bloom, D., Canning, D., & Sevilla, J. (2003). *The Demographic Dividend: A New Perspective on the Economic Consequences of Population Change*. Santa Monica, CA: RAND Corporation.

Bloom, D. E. (2012). Population Dynamics in India and Implications for Economic Growth. In C. Ghate (Ed.), *The Oxford Handbook of the Indian Economy*. Oxford: Oxford University Press. Retrieved from <http://www.oxfordhandbooks.com/view/10.1093/oxfordhb/9780199734580.001.0001/oxfordhb-9780199734580-e-15>

Bloom, D. E., & Canning, D. (2003). Contraception and the Celtic Tiger. *The Economic and Social Review*, 34.

Bloom, D. E., & Canning, D. (2008). Global Demographic Change: Dimensions and

- Economic Significance. *Population and Development Review*, 34, 17–51.
- Bloom, D. E., Canning, D., Fink, G., & Finlay, J. (2007). *Realizing the Demographic Dividend: Is Africa any different?* (PGDA Working Paper No. 2307). Program on the Global Demography of Aging.
- Bloom, D. E., Canning, D., Fink, G., & Finlay, J. E. (2009). Fertility, female labor force participation, and the demographic dividend. *Journal of Economic Growth*, 14(2), 79–101.
- Bloom, D. E., Canning, D., Linlin, H., Yuanli, L., Ajay, M., & Winnie, Y. (2006). Why Has China's Economy Taken Off Faster than India's? Presented at the The Annual Meetings of the American Economic Association, January 2006, Boston.
- Bloom, D. E., Canning, D., & Malaney, P. N. (2000). Demographic Change and Economic Growth in Asia. *Population and Development Review*, 26(Supplementary), 257–290.
- Bloom, D. E., & Williamson, J. G. (1998). Demographic Transitions and Economic Miracles in Emerging Asia. *The World Bank Economic Review*, 12(3), 419–455.
- Bocquet-Appel, J. P., Rajan, I. S., Bacro, J. N., & Lajaunie, C. (2002). The Onset of India's Fertility Transition. *European Journal of Population / Revue européenne de Démographie*, 18(3), 211–232.
- Bocquet-Appel, J.-P., & Jakobi, L. (1996). Barriers to the spatial diffusion for the demographic transition in Western Europe. In J.-P. Bocquet-Appel, D. Courgeau, & D. Pumian (Eds.), *Spatial analysis of biodemographic data* (pp. 117–129). Paris: John Libbey Eurotext/INED. Retrieved from [http://www.academia.edu/2024542/Spatial\\_analysis\\_of\\_biodemographic\\_data](http://www.academia.edu/2024542/Spatial_analysis_of_biodemographic_data)
- Bollinger, L. (1991). *Diffusion, fertility and female labor force participation* (Ph.D. Dissertation). University of Pennsylvania, Pennsylvania.
- Bongaarts, J. (2002). The End of the Fertility Transition in the Developing World. In *Completing the Fertility Transition* (Vol. Special Issue Nos. 48/49). New York: Department of Economic and Social Affairs, Population Division.
- Bongaarts, J. (2006). The causes of stalling fertility transitions. *Studies in family planning*, 37(1), 1–16.
- Bongaarts, J. (2008). Fertility Transitions in Developing Countries: Progress or Stagnation? *Studies in Family Planning*, 39(2), 105–110.

- Bongaarts, J., & Sinding, S. (2011). Population Policy in Transition in the Developing World. *Science*, 333(6042), 574–576.
- Bongaarts, J., & Sinding, S. W. (2009). A Response to Critics of Family Planning Programs. *International Perspectives on Sexual and Reproductive Health*, 35(01), 039–044.
- Bongaarts, J., & Watkins, S. C. (1996). Social Interactions and Contemporary Fertility Transitions. *Population and Development Review*, 22(4), 639–682.  
doi:10.2307/2137804
- Boserup, E. (1965). *The Conditions of Agricultural Growth: The Economics of Agrarian Change Under Population Pressure*. Chicago: Aldine Publishers.
- Bosworth, B., & Collins, S. M. (2008). Accounting for Growth: Comparing China and India. *Journal of Economic Perspectives*, 22(1), 45–66.
- Boyer, G., & Smith, R. (2001). The Development of the Neoclassical Tradition in Labor Economics. *Industrial and Labor Relations Review*, 54(2), 199–223.
- Brewster, K. L., & Rindfuss, R. R. (2000). Fertility and Women's Employment in Industrialized Nations. *Annual Review of Sociology*, 26(1), 271–296.
- Browning, M. (1992). Children and Household Economic Behavior. *Journal of Economic Literature*, 30(3), 1434–1475.
- Bulatao, R. A. (2001). Introduction. *Population and Development Review*, 27(Supplement: Global Fertility Transition), 1–14.
- Burch, T. K. (1996). Icons, straw men, and precision: Reflections on demographic theories of fertility decline. *Sociological Quarterly*, 37(1), 59–81.
- Cáceres-Delpiano, J. (2012). Can we still learn something from the relationship between fertility and mother's employment? Evidence from developing countries. *Demography*, 49(1), 151–174.
- Cahuc, P., & Zylberberg, A. (2004). *Labor economics*. Cambridge, MA: MIT Press.
- Caldwell, J. C. (1976). Toward A Restatement of Demographic Transition Theory. *Population and Development Review*, 2(3/4), 321–366.
- Caldwell, J. C. (1997). The Global Fertility Transition: The Need for a Unifying Theory. *Population and Development Review*, 23(4), 803–812.

- Caldwell, J. C., & Caldwell, P. (2001). Regional paths to fertility transition. *Journal of Population Research*, 18(2), 91–117.
- Canning, D. (2011). The causes and consequences of demographic transition. *Population Studies*, 65(3).
- Canning, D., & Finlay, J. (2012). The Relationship between Fertility and Female Labor Force Participation in Low- to Middle-Income Countries: Uncovering the Heterogeneity Across and Within Countries. In *Human Capital and Reaping the Demographic Dividend in Sub-Saharan Africa*. Presented at the 2012 Annual Meeting of the Population Association of America, San Francisco, CA. Retrieved from <http://paa2012.princeton.edu/abstracts/122950>
- Carter, A. T. (2001). Social Processes and Fertility Change: Anthropological Perspectives. In J. B. Casterline (Ed.), *Diffusion Processes and Fertility Transition: Selected Perspectives* (pp. 138–178). Washington DC: National Research Council, National Academy Press.
- Cascio, E. U. (2009). Maternal Labor Supply and the Introduction of Kindergartens into American Public Schools. *Journal of Human Resources*, 44(1).
- Case, A. (1992). Neighborhood influence and technological change. *Regional Science and Urban Economics*, 22(3), 491–508.
- Case, A. C., Rosen, H. S., & Hines, J. J. (1993). Budget spillovers and fiscal policy interdependence : Evidence from the states. *Journal of Public Economics*, 52(3), 285–307.
- Casterline, J. B. (2001b). Diffusion Processes and Fertility Transition: Introduction. In John B. Casterline (Ed.), *Diffusion Processes and Fertility Transition: Selected Perspectives* (pp. 1–38). Washington DC: National Research Council, National Academy Press.
- Casterline, J.B. (2001a). The pace of fertility transition: national patterns in the second half of the twentieth century, 27(Supplement: Global Fertility Transition), 17–52.
- Central Government Staff News. (2008). Special Allowance for child care for women. Retrieved January 1, 2013, from <http://cgstaffnews.com/?p=459>
- Chakrabarti, S. (2009). *Gender Dimensions of the Informal Sector and Informal Employment in India*. Paper presented at the Global Forum on Gender Statistics, Accra, Ghana.
- Chakraborty, M., & Guilmoto, C. Z. (2005). An Analysis of the Determinants of Fertility

- Behavior in South India at the Village Level. In Christophe Z. Guilmoto & S. I. Rajan (Eds.), *Fertility Transition in South India* (pp. 324–356). New Delhi: SAGE Publications.
- Chandra, S. M. (2001). *Population Policy at National and State Level (A case)*. Presented at the Presentation at the University of Pittsburg, Pittsburg.
- Chao, D. N. W. (2005). *Family Planning in Egypt Is a Sound Financial Investment*. Washington DC: The Futures Group International.
- Clark, C. C. (1940). *The Conditions of Economic Progress*. London, England: Macmillan and co., limited.
- Cleland, J. B. (2001). The Effects of Improved Survival on Fertility: A Reassessment. *Population and Development Review*, 27(Supplement: Global Fertility Transition), 60–92.
- Cleland, J. B., Baschieri, A., Bailey, C., & Falkingham, J. (2009). *The women “work-fertility” link in Africa: a re-assessment of recent evidence* (Working Paper). The William and Flora Hewlett Foundation.
- Cleland J., & Rodríguez G. (1988). The Effect of Parental Education on Marital Fertility in Developing Countries. *Population Studies*, 42(3), 419–442.
- Cleland, J., & Wilson, C. (1987). Demand Theories of the Fertility Transition: An Iconoclastic View. *Population Studies*, 41(1), 5–30.  
doi:10.1080/0032472031000142516
- Coale, A. J., & Hoover, E. M. (1958). *Population Growth and Economic Development in Low-income Countries*. Princeton: Princeton University Press.
- Coale, A. J., & Treadway, R. (1986). A Summary of the Changing Distribution of Overall Fertility, and the Proportion Married in the Provinces of Europe. In A. J. Coale & S. C. Watkins (Eds.), *The Decline of Fertility in Europe* (pp. 31–181). Princeton, N.J: Princeton University Press.
- Coale, A. J., & Watkins, S. C. (1986). *The Decline of Fertility in Europe*. Princeton, N.J: Princeton University Press.
- Cohen, S. P. (2001). *India: emerging power*. Washington DC: Brookings Institution Press.
- Connelly, M. (2006). Population Control in India: Prologue to the Emergency Period. *Population and Development Review*, 32(4), 629–667.

- Connelly, R., DeGraff, D., Levison, D., & McCall, B. (2006). Tackling The Endogeneity Of Fertility In The Study Of Women'S Employment In Developing Countries: Alternative Estimation Strategies Using Data From Urban Brazil. *Feminist Economics*, 12(4), 561–597.
- Corbridge, S., Harriss, J., & Jeffrey, C. (2012). *India today: economy, politics & society*. Cambridge, UK: Polity Press. Retrieved from <http://www.politybooks.com/>
- Crabtree, S., & Pugliese, A. (2012). China Outpaces India for Women in the Workforce; One in six college-educated Indian women works full time for an employer. *Gallup Poll News Service*. Washington DC.
- Crenshaw, E. M., Ameen, A. Z., & Christenson, M. (1997). Population Dynamics and Economic Development: Age-Specific Population Growth Rates and Economic Growth in Developing Countries, 1965 to 1990. *American Sociological Review*, 62(6), 974–984.
- Cruces, G., & Galiani, S. (2007). Fertility and female labor supply in Latin America: New causal evidence. *Labour Economics*, 14(3), 565–573.
- Das Gupta, M. (1995). Fertility decline in Punjab, India: parallels with historical Europe. *Population studies*, 49(3), 481–500.
- Das Gupta, M. (2001). Synthesizing Diverse Interpretations of Reproductive Change in India. In J. F. Phillips & Z. A. Sathar (Eds.), *Fertility transition in South Asia*. New York: Oxford University Press.
- Das, M. (2000). Women Entrepreneurs from India: Problems, Motivations and Success Factors. *Journal of Small Business & Entrepreneurship*, 15(4), 67–81.
- Das, M. B. (2006). *Do Traditional Axes of Exclusion Affect Labor Market Outcomes in India?* (No. 97). Washington DC: World Bank Publications.
- Das, N. P., & Dey, D. (2000). *Demographic Transition in Gujarat* (No. 2). Ahmedabad: Lakdawala Memorial Trust.
- Datta, V. (2003). Child care in India: Emerging issues and challenges for the 21st century. In *The Proceedings of the 7th Early Childhood Convention* (Vol. 2). Nelson: New Zealand.
- Davis, K. (1937). Reproductive Institutions and the Pressure for Population. *The Sociological Review*, 29(3), 289–306.
- Davis, K., & Blake, J. (1956). Social Structure and Fertility: An Analytic Framework.

*Economic Development and Cultural Change*, 4(3), 211–235.

De Bruijn, B. J. (1999). *Foundations of Demographic Theory: Choice, Process, Context*. Indiana: Purdue University Press.

De Tray, D. N. (1973). Child Quality and the Demand for Children. *Journal of Political Economy*, 81(2), S70–S95.

Del Boca, D. (2002). The Effect of Childcare and Part-Time on Participation and Fertility of Italian Women. *Journal of Population Economics*, 15(3), 549–573.

Del Boca, D., Aaberge, R., Colombino, U., Ermisch, J., Francesconi, M., Pasqua, S., & Strøm, S. (2005). Labour Market Participation of Women and Fertility: the Effect of Social Policies. In T. Boeri, D. Del Boca, & C. Pissarides (Eds.), *Women at Work: An Economic Perspective*. Oxford: Oxford University Press.

Del Boca, D., & Wetzels, C. (2008). *Social Policies, Labour Markets and Motherhood. A Comparative Analysis of European Countries*. Cambridge, UK: Cambridge University Press.

DeLong, J. B. (2003). India Since Independence: An analytic growth narrative. In D. Rodrik (Ed.), *In search of prosperity: analytic narratives on economic growth*. Princeton: Princeton University Press.

Diamond-Smith, N., & Potts, M. (2010). Are the population policies of India and China responsible for the fertility decline? *International Journal of Environmental Studies*, 67(3), 291–301.

Donaldson, P. J., & McNicoll, G. (2012). Repositioning Population Research and Policy in Asia: New Issues and New Opportunities. *Asia Pacific Population Journal*, 27(1), 119–136.

Dossani, R. (2008). *India Arriving: How this Economic Powerhouse is Redefining Global Business*. New York: AMACOM / American Management Association.

Dráeze, J., & Sen, A. (2002). *India, Development and Participation*. Oxford and New Delhi: Oxford University Press.

Drèze, J., & Murthi, M. (2001). Fertility, Education, and Development: Evidence from India. *Population and Development Review*, 27(1), 33–63.

Drèze, J., & Sen, A. (1995). *India, Economic Development and Social opportunity*. Oxford and New Delhi: Oxford University Press.

- Drukker, D. M., Egger, P., & Prucha, I. R. (2011). *On two-step estimation of a spatial autoregressive model with autoregressive disturbances and endogenous regressors* (Technical report) (pp. 1–55). Department of Economics, University of Maryland.
- Drukker, D. M., Prucha, I. R., & Raciborski, R. (2011). A command for estimating spatial-autoregressive models with spatial autoregressive disturbances and additional endogenous variables. *The Stata Journal*, 1(1), 1–13.
- Dyson, T., Cassen, R., & Visaria, L. (2004). *Twenty-first Century India: Population, Economy, Human Development, And the Environment*. New Delhi: Oxford University Press.
- Dyson, T.R. (2006). A Personal View of Research on Population Impacts on Economic Development. Presented at the The First Annual Research Conference on Population Impacts on Economic Development, November 1-3, 2006, London, England.
- Dyson, T.R. (2010). *Population and Development: The Demographic Transition*. London and New York:: Zed Books.
- Dyson, Timothy R., & Moore, M. (1983). On kinship structure, female autonomy, and demographic behavior in India. *Population and Development Review*, 9(1), 35–60.
- Eapen, M. (1992). Fertility and Female Labour Force Participation in Kerala. *Economic and Political Weekly*, 27(40), 2179–2188.
- Easterlin, R. A. (1978). The Economics and Sociology of Fertility: A Synthesis. In C. Tilly & L. K. Berkner (Eds.), *Historical Studies of Changing Fertility*. Princeton, N.J: Princeton University Press.
- Easterlin, R. A., & Crimmins, E. M. (1985). *The Fertility Revolution: A Supply-Demand Analysis*. Chicago: University of Chicago Press.
- Economic Commission for Latin America and the Caribbean (ECLAC). (2009). The Demographic Dividend: An opportunity to improve coverage and progression rates in secondary education. In *Social Panorama of Latin America*. Washington DC: United Nations Publications.
- Ehrlich, P. R. (1968). *The population bomb*. New York, NY: Ballantine Books.
- Esteve-Volart, B. (2004). *Gender Discrimination and Growth: Theory and Evidence from India* (STICERD Development Economics Papers No. 42). London, England:



London School of Economics.

- Falcão, B. L. S., & Soares, R. R. (2008). The Demographic Transition and the Sexual Division of Labor. *Journal of Political Economy*, 116(6), 1058–1104.
- Field, E., Jayachandran, S., & Pande, R. (2010). Do Traditional Institutions Constrain Female Entrepreneurship? A Field Experiment on Business Training in India. *American Economic Review*, 100(2), 125–129.
- Fogli, A., Marcassa, S., & Veldkamp, L. (2007). *The Spatial Diffusion of Female Labor Force Participation: Evidence from US Counties*. Unpublished manuscript, New York University. Retrieved from [http://pages.stern.nyu.edu/~lveldkam/pdfs/geography\\_slides.pdf](http://pages.stern.nyu.edu/~lveldkam/pdfs/geography_slides.pdf)
- Fogli, A., & Veldkamp, L. (2011). Nature or Nurture? Learning and the Geography of Female Labor Force Participation. *Econometrica*, 79(4), 1103–1138.
- Frank, O., & McNicoll, G. (1987). An Interpretation of Fertility and Population Policy in Kenya. *Population and Development Review*, 13(2), 209–244. doi:10.2307/1973192
- Freedman, R. (1962). American Studies of Family Planning and Fertility: A Review of Major Trends and Issues. In C. V. Kiser (Ed.), *Research in Family Planning* (pp. 211–227). Princeton: Princeton University Press.
- Freedman, R., & Berelson, B. (1976). The Record of Family Planning Programs. *Studies in Family Planning*, 7(1), 1–40. doi:10.2307/1965290
- Garenne, M. L. (2011). Testing for fertility stalls in demographic and health surveys. *Population Health Metrics*, 9(1), 59.
- Gates, M. (2012). *Let's put birth control back on the agenda*. Presented at the The TED Summit, April 2012, Germany.
- Gayen, K., & Raeside, R. (2006). Communication and contraception in rural Bangladesh. *Healthcare quarterly (Toronto, Ont.)*, 9(4), 110–122.
- Gelbach, J. B. (2002). Public Schooling for Young Children and Maternal Labor Supply. *American Economic Review*, 92(1), 307–322.
- Ghani, E., Kerr, W., & O'Connell, S. (2012). *What Explains Gender Disparities in India? What Can Be Done?* (Policy Research Working Paper, Economic Policy and Debt Department, Poverty Reduction and Economic Management Network No. 6228). Washington DC: World Bank.

- Goldin, C. D. (1990). *Understanding the Gender Gap: An Economic History of American Woman*. New York: Oxford University Press.
- Goldstein, S. (1972). The influence of labor force participation and education on fertility in Thailand, 26(November), 419–436.
- Goldstone, J. A. (2010). The New Population Bomb. *Foreign Affairs*, (January/February 2010).
- Goldstone, J. A., Kaufmann, E. P., & Toft, M. D. (2012). *Political Demography: How Population Changes Are Reshaping International Security and National Politics*. USA: Oxford University Press.
- Government of India (GOI). (2008). The All India Services (House Rent Allowance) Rules, 1977: Annexure to O.M. no. 2(13)/2008-E.II(B) dated 29th August, 2008. GOI. Retrieved from [http://persmin.gov.in/DOPT/Acts\\_Rules/AIS\\_Rules/Revised\\_AIS\\_Rules\\_Vol\\_I\\_Updated\\_Upto\\_31Oct2011/Revised\\_AIS\\_Rule\\_Vol\\_I\\_Rule\\_22.pdf](http://persmin.gov.in/DOPT/Acts_Rules/AIS_Rules/Revised_AIS_Rules_Vol_I_Updated_Upto_31Oct2011/Revised_AIS_Rule_Vol_I_Rule_22.pdf)
- Guillard, A. (1855). *Elements de Statistique Humaine ou Demographie Comparee*. Paris: Guillaumin et Cie Libraries.
- Guilmoto, Christophe Z. (2008). Economic, social and spatial dimensions of India's excess child masculinity. *Population (english edition)*, 63(1), 91–117.
- Guilmoto, Christophe Z., & Rajan, S. I. (2001). Spatial Patterns of Fertility Transition in Indian Districts. *Population and Development Review*, 27(4), 713–738.
- Guilmoto, Cristophe Z. (2005). Fertility Decline in India: Maps, Models and Hypotheses. In Christophe Z. Guilmoto & S. I. Rajan (Eds.), *Fertility Transition in South India* (pp. 385–435). New Delhi: SAGE Publications.
- Guilmoto, Cristophe Z., & Rajan, S. I. (2002). District Level Estimates of Fertility from India's 2001 Census. *Economic and Political Weekly*, 37(7), 665–672.
- Gupta, S. (2009). *Borrowing and Lending Patterns in Indian Cities*. India: Assocham Research Bureau. Retrieved from <http://www.assochem.org/arb/aep/Indian-cities-credit-deposit.pdf>
- Gustafsson, S., & Stafford, F. (1992). Child Care Subsidies and Labor Supply in Sweden. *Journal of Human Resources*, 27(1), 204–230.
- Haub, C. (2002). Decline in India's Birth Rate Slows - Population Reference Bureau. Retrieved December 15, 2012, from

- <http://www.prb.org/Articles/2002/DeclineinIndia8217sBirthRateSlows.aspx>
- Haub, C., & Gribble, J. (2011). The World at 7 Billion. *Population Bulletin*, 66(2), 1–12.
- Hirschman, C. (1994). Why fertility changes. *Annual review of sociology*, 20, 203–233.
- Hirschman, C. (2001). Comment: Globalization and theories of fertility decline. *Population and Development Review*, 27(Supplement: Global Fertility Transition), 116–125.
- Hornik, R., & McAnany, E. (2001). Mass Media and Fertility Change. In J.B. Casterline (Ed.), *Diffusion Processes and Fertility Transition: Selected Perspectives* (pp. 208–239). Washington DC: National Research Council, National Academy Press.
- International Institute for Population Sciences (IIPS). (2006). *District Level Household and Facility Survey, 2002-04*. Mumbai: IIPS.
- International Institute for Population Sciences (IIPS) and Macro International. (2007). *National Family Health Survey (NFHS-3), 2005–06: India: Volume I*. Mumbai: IIPS.
- International Institute for Population Sciences (IIPS) and Macro International. (2008). *National Family Health Survey (NFHS-3), India, 2005-06: Bihar*. Mumbai: IIPS.
- International Labor Organization (ILO). (2010a). Main statistics (annual): Table 1A -- Total and Economically Active Population, by Age-group (\*). *Welcome to LABORSTA Internet!* International Labour Office database on labour statistics operated by the ILO Department of Statistics. Retrieved from <http://laborsta.ilo.org/>
- International Labor Organization (ILO). (2010b). *Women in labour markets: Measuring progress and identifying challenges*. Geneva: International Labor Office.
- International Labor Organization (ILO). (2013a). *Global Employment Trends 2013: Recovering from a second jobs dip* (Report). Geneva: International Labor Office, ILO. Retrieved from [http://www.ilo.org/global/research/global-reports/global-employment-trends/2013/WCMS\\_202326/lang--en/index.htm](http://www.ilo.org/global/research/global-reports/global-employment-trends/2013/WCMS_202326/lang--en/index.htm)
- International Labor Organization (ILO). (2013b). *ILO's Global Employment Trends 2013 report: Recovering from a second jobs dip*. Geneva: International Labor Office.
- Iyer, S. (2002). *Demography And Religion In India*. Oxford: Oxford University Press.
- Jaffe, A. J., & Azumi, K. (1960). The birth rate and cottage industries in underdeveloped

- countries. *Economic Development and Cultural Change*, 9(1), 52–63.
- Jain, A. K., & Adlakha, A. L. (1982). Preliminary Estimates of Fertility Decline in India During the 1970s. *Population and Development Review*, 8(3), 589–606.  
doi:10.2307/1972381
- Jain, A. K., & Jain, A. (2010). *Family Planning and Fertility in India*. Draft Report presented at the UNFPA - ICOMP Regional Consultation: Family Planning in Asia and the Pacific – Addressing the Challenges, Bangkok, Thailand.
- Jakobi, L., & Bocquet-Appel, J.-P. (1998). Evidence for a spatial diffusion of contraception at the onset of the fertility transition in victorian Britain. *Population*, 10(1), 181–204.
- James, K. S., & Subramaniam, S. V. (2005). Decline in Fertility in Andhra Pradesh: A Re-examination of Conflicting Arguments. In Christophe Z. Guilmoto & S. I. Rajan (Eds.), *Fertility Transition in South India* (pp. 357–384). New Delhi: SAGE Publications.
- Jeanty, P. W. (2010). *SPMLREG: Stata module to estimate the spatial lag, the spatial error, the spatial durbin, and the general spatial models by maximum likelihood*. Boston: Boston College Department of Economics.
- Jeffrey, P., & Jeffrey, R. (1996). What's the benefit of being educated? Women's Autonomy and Fertility Outcomes in Bijnor. In R. Jeffery & A. M. Basu (Eds.), *Girls' schooling, women's autonomy, and fertility change in South Asia* (pp. 150–183). New Delhi: Sage Publications.
- Jensen, R. (2012). Do Labor Market Opportunities Affect Young Women's Work and Family Decisions? Experimental Evidence from India. *The Quarterly Journal of Economics*, 127(2), 753–792.
- Jensen, R. T. (2010). *Economic Opportunities and Gender Differences in Human Capital: Experimental Evidence for India* (NBER Working Paper No. 16021). Washington DC: National Bureau of Economic Research.
- Joshi, S., & Schultz, T. P. (2007). *Family Planning as an Investment in Development: Evaluation of a Program's Consequences in Matlab, Bangladesh* (Yale University Economic Growth Center Discussion Paper No. 951). New Haven, CT: Yale University.
- Kabubo-Mariara, J., Ndeng'e, G. K., & Mwabu, D. K. (2009). The Consequences of Fertility for Child Health in Kenya: Endogeneity, Heterogeneity and Application of the Control Function approach. Presented at the 2009 CSAE Conference on

Economic Development in Africa, St Catherine's College, Oxford: CSAE.

- Kalwij, A. S. (2000). The effects of female employment status on the presence and number of children. *Journal of Population Economics*, 13(2), 221–239.
- Kantner, A., & He, S. (2001). Levels and Trends in Fertility and Mortality in South Asia: A Review of Recent Evidence. In Z. A. Sathar & J. F. Phillips (Eds.), *Fertility transition in South Asia*. New York: Oxford University Press.
- Kelejian, H. H., & Prucha, I. R. (1998). A Generalized Spatial Two-Stage Least Squares Procedure for Estimating a Spatial Autoregressive Model with Autoregressive Disturbances. *The Journal of Real Estate Finance and Economics*, 17(1), 99–121.
- Kelejian, H. H., & Prucha, I. R. (1999). A Generalized Moments Estimator for the Autoregressive Parameter in a Spatial Model. *International Economic Review*, 40(2), 509–533.
- Kelejian, H. H., & Prucha, I. R. (2004). Estimation of simultaneous systems of spatially interrelated cross sectional equations. *Journal of Econometrics*, 118(1-2), 27–50.
- Kelejian, H. H., & Prucha, I. R. (2007). The relative efficiencies of various predictors in spatial econometric models containing spatial lags. *Regional Science and Urban Economics*, 37(3), 363–374.
- Kelejian, H. H., & Prucha, I. R. (2010). Specification and Estimation of Spatial Autoregressive Models with Autoregressive and Heteroskedastic Disturbances. *Journal of Econometrics*, 157(1), 53–67.
- Kelley, A. C. (1985). Population and development: controversy and reconciliation. *The Journal of Economic Education*, 16(3), 177–188.
- Kelley, A., & Schmidt, R. (2005). Evolution of recent economic-demographic modeling: A synthesis. *Journal of Population Economics*, 18(2), 275–300.
- Killingsworth, M. R., & Heckman, J. J. (1987). *Female labor supply: A survey* (Handbook of Labor Economics) (pp. 103–204). Elsevier.
- Kim, J., & Aassve, A. (2006). *Fertility and its Consequence on Family Labour Supply* (IZA Discussion Paper No. 2162). Bonn, Germany: Institute for the Study of Labor (IZA).
- Klasen, S., & Lamanna, F. (2009). The Impact of Gender Inequality in Education and Employment on Economic Growth: New Evidence for a Panel of Countries. *Feminist Economics*, 15(3), 91–132.

- Klasen, S., & Pieters, J. (2012). *Push or Pull? Drivers of Female Labor Force Participation during India's Economic Boom* (IZA Discussion Paper No. 6395). Institute for the Study of Labor (IZA).
- Kögel, T. (2004). Did the association between fertility and female employment within OECD countries really change its sign? *Journal of Population Economics*, 17(1), 45–65.
- Kohler, H.-P. (2012). *Copenhagen Consensus 2012: Challenge Paper on "Population Growth* (No. PSC 12-03).
- Krishnan, T. N. (1998). Social Development and Fertility Reduction in Kerala. In G. Martine, M. Das Gupta, & L. C. Chen (Eds.), *Reproductive change in India and Brazil* (pp. 37–64). Delhi ; New York: Oxford University Press.
- Kumar, S. (1997). Women's work status and fertility: macro and micro level analysis in India and its selected states. *Demography India*, 26(1), 63–78.
- Kuznets, S. (1968). *Toward a Theory of Economic Growth: With Reflections on the Economic Growth of Modern Nations*. New York: W W NORTON & Company.
- Lam, D. (2011). How the world survived the population bomb: lessons from 50 years of extraordinary demographic history. *Demography*, 48(4), 1231–1262.
- Land, K., & Deane, G. (1992). On the Large-Sample Estimation of Regression Models with Spatial- Or Network-Effects Terms: A Two-Stage Least Squares Approach. *Sociological Methodology*, 22, 221–248.
- Lee, R. (1983). Economic consequences of population size, structure and growth. *International Union for the Scientific Study of Population, Newsletter*(17), 43–59.
- Lee, R., & Mason, A. (2006). What Is the Demographic Dividend? *Finance and Development*, 43(3), 16–17.
- Lehrer, E., & Nerlove, M. (1986). Female labor force behavior and fertility in the United States. *Annual review of sociology*, 12, 181–204.
- LeSage, J., & Pace, R. K. (2010). *Introduction to Spatial Econometrics*. CRC Press.
- Lesthaeghe, R. (1980). On the Social Control of Human Reproduction. *Population and Development Review*, 6(4), 527–548.
- Lesthaeghe, R. (1983). A Century of Demographic Change in Western Europe: An Explosion of Underlying Dimensions. *Population and Development Review*, 9,

411–435.

- Lesthaeghe, R., & Surkyn, J. (1988). Cultural Dynamics and Economic Theories of Fertility Change. *Population and Development Review*, 14(1), 1.
- Lesthaeghe, R., & Vanderhoeft, C. (2001). Ready, Willing, and Able: A Conceptualization of Transitions to New Behavioral Forms. In *Diffusion Processes and Fertility Transition: Selected Perspectives* (pp. 240–264). Washington DC: National Research Council, National Academy Press.
- Lesthaeghe, R., & Wilson, C. (1986). Modes of Production, Secularization and the Pace of Fertility Decline in Western Europe, 1870-1930. In A. J. Coale & S. C. Watkins (Eds.), *The Decline of Fertility in Europe*. Princeton, N.J: Princeton University Press.
- Lim, L. L. (2002). Female Labor Force Participation. In *Completing the Fertility Transition* (pp. 195–212). New York: United Nations Publications.
- Lloyd, C. B. (1991). The contribution of the World Fertility Surveys to an understanding of the relationship between women's work and fertility. *Studies in family planning*, 22(3), 144–161.
- Lokshin, M. M., Glinskaya, E., & Garcia, M. (2000). *The Effect of Early Childhood Development Programs on Women's Labor Force Participation and Older Children's Schooling in Kenya* (World Bank Policy Research Working Paper No. 2376). Washington DC: World Bank Publications.
- Lundberg, S., & Rose, E. (2002). The Effects of Sons and Daughters on Mens' Labour Supply and Wages. *The Review of Economics and Statistics*, 84(2), 251–268.
- Malhotra, A., Vanneman, R., & Kishor, S. (1995). Fertility, Patriarchy and Development in India. *Population and Development Review*, 21(2), 281–305.
- Mammen, K., & Paxson, C. (2000). Women's work and economic development. *The journal of Economic Perspectives*, 14(4), 141–164.
- Manski, C. F. (1993). Identification of Endogenous Social Effects: The Reflection Problem. *The Review of Economic Studies*, 60(3), 531–542.
- Markham, V. (2012). Wanted: New Champions for Family Planning. *Impatient Optimists*. Retrieved March 18, 2013, from <http://www.impatientoptimists.org/Posts/2012/10/New-Champions-for-Family-Planning>

- Mason, K. O. (1987). The impact of women's social position on fertility in developing countries. *Sociological Forum*, 2(4), 718–745.
- Mason, K. O. (1992). Culture and the fertility transition: thoughts on theories of fertility decline. *Genus*, 48(3/4), 1–14.
- Mason, K. O. (1997). Explaining Fertility Transitions. *Demography*, 34(4), 443–454.
- Mason, K. O., & Palan, V. T. (1981). Female employment and fertility in Peninsular Malaysia: The maternal role incompatibility hypothesis reconsidered. *Demography*, 18(4), 549–575.
- Mathur, A. (1994). Work participation, gender and economic development: A quantitative anatomy of the Indian scenario. *Journal of Development Studies*, 30(2), 466–504.
- May, J. F. (2012a). Internationalization of Population Issues. In *World Population Policies - Their Origin, Evolution, and Impact* (pp. 91–127). Dordrecht, New York: Springer Publishers.
- May, J. F. (2012b). *World Population Policies - Their Origin, Evolution, and Impact*. Dordrecht, New York: Springer Publishers.
- Mazumdar, I., & Neetha, N. (2011). *Gender Dimensions: Employment Trends in India, 1993-94 to 2009-10* (Occasional Paper No. 56). New Delhi: Centre for Women's Development Studies.
- Mazumdar, S., & Guruswami, M. (2006). Female labour Force Participation in Kerala: Problems and Prospects. Presented at the Annual Meeting Program of the Population Association of America, Los Angeles, CA.
- McDonald, P. (2000). Gender Equity in Theories of Fertility Transition. *Population and Development Review*, 26(3), 427–439.
- McNay, K., Arokiasamy, P., & Cassen, R. H. (2003). Why Are Uneducated Women in India Using Contraception? A Multilevel Analysis. *Population Studies*, 57(1), 21–40.
- McNicoll, G. (1980). Institutional Determinants of Fertility Change. *Population and Development Review*, 6(3), 441–462.
- McNicoll, G. (1983). *Notes on the Local Context of Demographic Change*. New York: Population Council.



- McNicoll, G. (2001). Government and fertility in transitional and post-transitional societies. *Population and Development Review*, 27(Supplement: Global Fertility Transition), 129–159.
- Mincer, J. (1962). Labor Force Participation of Married Women: A Study of Labor Supply. In *Aspects of Labor Economics* (pp. 63–106). Princeton, N.J: Princeton University Press.
- Ministry of Health and Family Welfare. (2012). Shri Ghulam Nabi Azad Launches Compendium of Population Stabilization Reports. *Press Information Bureau, Government of India, November 11, 2012*. Retrieved January 1, 2013, from <http://pib.nic.in/newsite/erelease.aspx?relid=89006>
- Ministry of Health and Family Welfare (MOHFW). (2000). National Population Policy 2000. MOHFW, Government of India, New Delhi.
- Montgomery, K. (2006). The Demographic Transition. Retrieved May 30, 2013, from <http://www.uwmc.uwc.edu/geography/demotrans/demtran.htm>
- Montgomery, M. R., & Casterline, J. B. (1993). The diffusion of fertility control in Taiwan: evidence from pooled cross-section time-series models. *Population studies*, 47(3), 457–479.
- Montgomery, M. R., & Casterline, J. B. (1998). *Social Networks and the Diffusion of Fertility Control* (No. 119). New York: Population Council.
- Munshi, K., & Myaux, J. (1998). *Social Effects in the Demographic Transition: Evidence from Matlab, Bangladesh* (Unpublished paper). Boston: Department of Economics, Boston University.
- Murthi, M., Guio, A.-C., & Drèze, J. (1995). Mortality, Fertility, and Gender Bias in India: A District-Level Analysis. *Population and Development Review*, 21(4), 745–782.
- Myrdal, G. (1968). Problems of Population Size. In *Asian Drama An Inquiry into the Poverty of Nations* (Vol. III). UK: Penguin Publishers.
- Nallari, R., Griffith, B., & Yusuf, S. (2012). *Geography of Growth: Spatial Economics and Competitiveness*. Washington DC: World Bank Publications.
- Narayana, G., & Kantner, J. F. (1992). *Doing the Needful: The Dilemma of India's Population Policy*. Boulder, CO: Westview Press.
- Notestein, F. W. (1945). Population: The Long View. In T. W. Schultz (Ed.), *Food for*

- the World* (pp. 36–57). Chicago: University of Chicago Press.
- Olsen, W., & Mehta, S. (2006). Female Labour Participation in Rural and Urban India: Does Housewives' Work Count? *Radical Statistics*, 93, 57–90.
- Oster, E. (2009). Proximate Sources of Population Sex Imbalance in India. *Demography*, 46(2), 325–339.
- Owen, R., Ntoko, A., Zhang, D., & Dong, J. (2002). Public Policy and Diffusion of Innovation. *Social Indicators Research*, 60(1-3), 179–190.
- Palloni, A. (2001). Diffusion in Sociological Analysis. In J.B. Casterline (Ed.), *Diffusion Processes and Fertility Transition: Selected Perspectives* (pp. 6–114). Washington DC: National Research Council, National Academy Press.
- Plosky, W. D., & Winfrey, B. (2009). *Family-Friendly Workplace: A Model for Estimating the Cost Savings of Implementing Family-friendly Policies*. Washington DC: USAID.
- Pool, I. (2007). *Demographic Dividends. Determinants of development or merely windows of opportunity?* (No. 7) (pp. 28–35). Oxford: Oxford Institute of Ageing.
- Pop-Eleches, C. (2006). The Impact of an Abortion Ban on Socioeconomic Outcomes of Children: Evidence from Romania. *Journal of Political Economy*, 114(4), 744–773.
- Population matters: demographic change, economic growth, and poverty in the developing world*. (2001). New York: Oxford University Press.
- Posel, D., & van der Stoep, G. (2008). Co-resident and Absent mothers: Motherhood and Labour Force Participation in South Africa. Presented at the Conference on Income Distribution and the Family, Kiel, Germany.
- Presser, H. B., & Baldwin, W. (1980). Child care as a constraint on employment: prevalence, correlates, and bearing on the work and fertility nexus. *American Journal of Sociology*, 85(5), 1202–1213.
- Preston, S. H., & Bhat, P. N. M. (1984). New Evidence on Fertility and Mortality Trends in India. *Population and Development Review*, 10(3), 481–503.
- Priebe, J. (2010). *Child Costs and the Causal Effect of Fertility on Female Labor Supply: An investigation for Indonesia 1993-2008* (Courant Research Centre: Poverty, Equity and Growth - Discussion Paper No. 45). Courant Research Centre PEG.

- Qian, N. (2009). *Quantity-Quality and the One Child Policy: The Only-Child Disadvantage in School Enrollment in Rural China* (NBER Working Paper No. 14973). Cambridge, MA: National Bureau of Economic Research.
- Rakaseta, V. L. (1995). Women's work and fertility in Fiji. *Pacific Health Dialog*, 2(1), 17–24.
- Ram, F., & Sekhar, C. (2006). *Ranking and Mapping of Districts based on Socio-economic and Demographic Indicators*. Mumbai: International Institute of Population Sciences.
- Ramasundaram, S. (1995). Causes for the rapid fertility decline in Tamil Nadu: a policy planner's perspective. *Demography India*, 24(1).
- Rao, B. N., Kulkarni, P. M., & Ryappa, P. H. (1986). *Determinants of Fertility Decline*. New Delhi: South Asian Publishers.
- Rao, M. (2004). *From Population Control to Reproductive Health: Malthusian Arithmetic*. New Delhi: Sage Publications.
- Ray, K. (2009). Azad's population control mantra: Watch late night TV. *Deccan Herald*. New Delhi, India. Retrieved from <http://www.deccanherald.com/content/13278/azads-population-control-mantra-watch.html>
- Reardon, S. F., & O'Sullivan, D. (2004). Measures of Spatial Segregation. *Sociological Methodology*, 34(1), 121–162.
- Registrar General of India (RGI). (1999). *Compendium of Fertility and Mortality Indicators 1971-1997*. New Delhi: Office of the Registrar General.
- Registrar General of India (RGI). (2006). *Population Projection for India and States 2001-2026*. New Delhi: Office of the Registrar General and Census Commissioner. Retrieved from [http://nrhm-mis.nic.in/UI/Public%20Periodic/Population\\_Projection\\_Report\\_2006.pdf](http://nrhm-mis.nic.in/UI/Public%20Periodic/Population_Projection_Report_2006.pdf)
- Registrar General of India (RGI). (2011). *Sample Registration System (SRS): Maternal & Child Mortality and Total Fertility Rates*. New Delhi, India: Office of the Registrar General. Retrieved from [http://censusindia.gov.in/vital\\_statistics/SRS\\_Bulletins/MMR\\_release\\_070711.pdf](http://censusindia.gov.in/vital_statistics/SRS_Bulletins/MMR_release_070711.pdf)
- Retherford, R. D., & Roy, T. K. (2003). *Factors Affecting Sex-selective Abortion in India and 17 Major States* (National family health survey subject reports No. 21).

Mumbai and Honolulu: International Institute of Population Sciences; East-West Center.

- Richards, L. (1996). Controlling China's Baby Boom. *Contemporary Review*, 268(1560), 5.
- Rindfuss, R. R. (1991). The Young Adult Years: Diversity, Structural Change, and Fertility. *Demography*, 28(4), 493–512.
- Rindfuss, R. R., Guilkey, D. K., Morgan, S. P., & Kravdal, Ø. (2010). Child-care availability and fertility in Norway. *Population and Development Review*, 36(4), 725–748.
- Robinson, W. C. (1997). The economic theory of fertility over three decades. *Population studies*, 51(1), 63–74.
- Robinson, W. C., & Cleland, J. B. (1992). The Influence of Contraceptive Cost on the Demand for Children. In J. F. Phillips & J. A. Ross (Eds.), *Family planning programmes and fertility* (pp. 106–122). Oxford: Clarendon Press.
- Rosero-Bixby, L., & Casterline, J. B. (1993). Modeling Diffusion Effects in Fertility Transition. *Population Studies*, 47(1), 147–167.
- Rosero-Bixby, L., & Casterline, J. B. (1994). Interaction Diffusion and Fertility Transition in Costa Rica. *Social Forces*, 73(2), 435–462.
- Ross, J. (2004). *Understanding Demographic Dividend* (Policy Project General Report). Washington DC: Policy Project. Retrieved from [http://www.policyproject.com/pubs/generalreport/Demo\\_Div.pdf](http://www.policyproject.com/pubs/generalreport/Demo_Div.pdf)
- Roychowdhury, A., Chandrasekhar, C. P., & Ghosh, J. (2006). The “Demographic Dividend” and Young India's Economic Future. *Economic and Political Weekly*, 41(49), 5055–5064.
- Ryder, N. B. (1983). Fertility and Family Structure. *Population Bulletin of the United Nations*, 15, 15–33.
- Sachs, J. D., Bajpai, N., & Ramiah, A. (2002). Understanding Regional Economic Growth in India. *Asian Economic Papers*, 1(3), 32–62.
- Sankhe, S., Vittal, I., Dobbs, R., Mohan, A., Gulati, A., Ablett, J., ... Sethy, G. (2010). *India's urban awakening: building inclusive cities, sustaining economic growth*. Mumbai: McKinsey Global Institute, McKinsey & Company.

- Santhya, K. G. (2003). *Changing Family Planning Scenario in India: An Overview of Recent Evidence*. New Delhi, India: South & East Asia--Regional Office, Population Council.
- Saqib, A. (2008). *Need assessment report: Creche (day care centers) for children of working women*. Islamabad: International Labor Organization.
- Sathar, Z. A., & Phillips, J. F. (2001a). *Fertility transition in South Asia*. New York: Oxford University Press.
- Sathar, Z. A., & Phillips, J. F. (2001b). Introduction. In Z. A. Sathar & J. F. Philips (Eds.), *Fertility transition in South Asia*. New York: Oxford University Press.
- Schoumaker, B. (2009). Stalls in fertility transitions in sub-Saharan Africa: real or spurious. *Document de travail*, 30. Retrieved from [http://www.academia.edu/1773825/Stalls\\_in\\_fertility\\_transitions\\_in\\_sub-Saharan\\_Africa\\_real\\_or\\_spurious](http://www.academia.edu/1773825/Stalls_in_fertility_transitions_in_sub-Saharan_Africa_real_or_spurious)
- Schultz, T. P. (1995). The U-Shaped Female Labor Force Function in Economic Development and Economic History. In *Investment in Women's Human Capital*. Chicago: University of Chicago Press.
- Schultz, T. P. (2008). *Population Policies, Fertility, Women's Human Capital, and Child Quality* (Handbook of Development Economics). Amsterdam, Holland: Elsevier. Retrieved from <http://econpapers.repec.org/bookchap/eedevhes/5.htm>
- Sen, A. (1997). Population policy: Authoritarianism versus cooperation. *Journal of Population Economics*, 10(1), 3–22.
- Sen, C., & Sen, G. (1985). Women s Domestic Work and Economic Activity-Results from National Sample Survey. *Economic and Political Weekly*, 20(17), WS49–WS56.
- Shapiro, D. A., Kreider, A., Varner, C., & Sinha, M. (2010). Stalling of fertility transitions and socioeconomic change in the developing world: evidence from the demographic and health surveys. Presented at the The 36th Chaire Quetelet, Louvain la Neuve.
- Shapiro, D., & Tambashe, B. O. (1997). Education, employment, and fertility in Kinshasa and prospects for changes in reproductive behavior. *Population Research and Policy Review*, 16(3), 259–287.
- Sharma, M. (1985). Caste, class, and gender: Production and reproduction in North India. *Journal of Peasant Studies*, 12(4), 57–88. doi:10.1080/03066158508438275

- Simon, J. L. (1977). *The economics of population growth*. Princeton, N.J: Princeton University Press.
- Simon, J. L. (1981). *The Ultimate Resource*. Princeton: Princeton University Press.
- Sinding, S. W. (2000). The great population debates: how relevant are they for the 21st century? *American Journal of Public Health*, 90(12), 1841–1845.
- Skolnik, R. (2008). *Essentials of Global Health*. Massachusetts: Jones & Bartlett Learning.
- Srinivasan, K. (1995). Lessons from Goa, Kerala and Tamil Nadu: the three successful fertility transition states in India. *Demography India*, 24(2).
- Srinivasan, T., & Kumar, S. (2005). Significance of Medical and Paramedical Personnel in Demographic Transition: An Empirical Analysis. In Christophe Z. Guilmoto & S. I. Rajan (Eds.), *Fertility Transition in India* (pp. 309–323). New Delhi: Sage Publications.
- Stycos, J. M., & Weller, R. H. (1967). Female working roles and fertility. *Demography*, 4(1), 210–217.
- Sudarshan, R. M., & Bhattacharya, S. (2009). Through the Magnifying Glass: Women's Work and Labor Force Participation in Urban Delhi. *Economic and Political Weekly*, 44(48), 59–66.
- Sunil, T. S., Pillai, V. K., & Pandey, A. (1999). Do incentives matter? – Evaluation of a family planning program in India. *Population Research and Policy Review*, 18(6), 563–577.
- Szreter, S. (1993). The Idea of Demographic Transition and the Study of Fertility Change: A Critical Intellectual History. *Population and Development Review*, 19(4), 659–701.
- The Demographic challenge: a study of four large Indian states*. (1991). Mumbai, Oxford: Oxford University Press.
- The Economist. (2012). A new science of population: The digressions of people power. *The Economist*, (May 19th, 2012). Retrieved from <http://www.economist.com/node/21555533>
- Thompson, W. S. (1929). Population. *American Journal of Sociology*, 34(6), 959–1075.
- Tolany, S. E. (1995). The spatial diffusion of fertility: a cross-sectional analysis of

- counties in the American South, 1940. *American Sociological Review*, 60(2), 299–308.
- Tolany, S. E., & Rodeheaver, D. G. (1988). The Effects of Family Planning Effort and Development of Fertility: An Intervening Variables Framework. *Studies in Comparative International Development*, 23(3), 28–50.
- Tsui, A. O. (2001). Population policies, family planning programs, and fertility: the record. *Population and Development Review*, 27(Supplement: Global Fertility Transition), 184–204.
- United Nations Population Division (UN). (2002). *Completing the Fertility Transition* (Vol. Special Issue Nos. 48/49). New York: Department of Economic and Social Affairs, Population Division.
- United Nations Population Division (UN). (2008). Millennium Development Goals Indicators: The official United Nations site for the MDG Indicators. United Nations Statistics Division. Retrieved April 15, 2013, from <http://mdgs.un.org/unsd/mdg/host.aspx?Content=indicators/officiallist.htm>
- United Nations Population Division (UN). (2011). World Population Prospects, the 2010 revision. *On-line Database*. Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. Retrieved February 15, 2013, from <http://esa.un.org/unpd/wpp/>
- United States Agency for International Development (USAID). (2009). *Focus on India: The Family-Friendly Workplace Model Helping Companies Analyze the Benefits of Family-Friendly Policies. The Health Policy Initiative* (Policy Brief). Washington DC: USAID.
- US Bureau of Labor Statistics (BLS). (2012). *Labor Market* (No. Section 2) (pp. 14–28). Washington DC: BLS.
- Visaria, L. (1996). Regional Variations in Female Autonomy and Fertility and Conception in India. In R. Jeffery & A. M. Basu (Eds.), *Girls' schooling, women's autonomy, and fertility change in South Asia* (pp. 235–260). New Delhi: Sage Publications.
- Wang, P., Lawler, J. J., Shi, K., Walumbwa, F., & Piao, M. (2008). Family-friendly employment practices: Importance and effects in India, Kenya, and China. In J. J. Lawler & G. S. Hundley (Eds.), *The Global Diffusion of Human Resource Practices: Institutional and Cultural Limits* (pp. 235–265). United Kingdom: Emerald Group Publishing.

- Watkins, S. C. (1986). Conclusions. In A. J. Coale & S. C. Watkins (Eds.), *The Decline of Fertility in Europe*. Princeton, N.J: Princeton University Press.
- Watkins, S. C. (1987). The fertility transition: Europe and the Third World compared. *Sociological Forum*, 2(4), 645–673.
- Weeks, J. R. (2005). *Population: An Introduction to Concepts and Issues*. Belmont, CA: Wadsworth Press.
- Weller, R. H. (1968). The Employment of Wives: Role Incompatibility and Fertility: A Study among Lower- and Middle-Class Residents of San Juan, Puerto Rico. *The Milbank Memorial Fund Quarterly*, 46(4), 507–526.
- Willis, R. J. (1973). A New Approach to the Economic Theory of Fertility Behavior. *Journal of Political Economy*, 81(2), S14–64.
- Winters, A., & Yusuf, S. (2007). *Dancing with giants: China, India, and the global economy*. Washington DC: World Bank Publications.
- Wong, R., & Levine, R. E. (1992). The Effect of Household Structure on Women's Economic Activity and Fertility: Evidence from Recent Mothers in Urban Mexico. *Economic Development and Cultural Change*, 41(1), 89–102.
- Wooldridge, J. M. (2009). Chapter 15: Instrumental Variables Estimation and Two-stage Least Squares. In *Introductory econometrics: a modern approach* (pp. 461–500). Ohio: Cengage Learning.
- World Bank. (2010). *Determinants and Consequences of High Fertility: A Synopsis of the Evidence* (Case study). Washington DC: World Bank.
- World Bank. (2011a). *Getting to Equal: Promoting Gender Equality through Human Development*. Washington DC: World Bank Publications.
- World Bank. (2011b). The World Development Indicators. *Data*. Retrieved from <http://data.worldbank.org/indicator>
- World Bank. (2013). The World Development Indicators 2012. Retrieved January 1, 2013, from <http://data.worldbank.org/data-catalog/world-development-indicators>
- Yardley, J. (2010). India Tries Using Cash Bonuses to Slow Birthrates. *The New York Times*, p. A6.
- Younger, S. D. (2006). *Labor Market Activities and Fertility* (Prepared for the African Economic Research Consortium No. ISSN 1936-5071). Nairobi, Kenya: African



Economic Research Consortium.

Zodgekar, A. V. (1996). Family welfare programme and population stabilization strategies in India. *Asia-Pacific population journal / United Nations*, 11(1), 3–24.

## **BIOGRAPHY**

Debasree Das Gupta has a Master in City & Regional Planning from Clemson University, SC. She worked as a Research Associate at the Strom Thurmond Institute of Government and Public Affairs at Clemson University for a year before joining the Ph.D. Program in Public Policy at George Mason University. Debasree is interested in studying disparities in social and health outcomes, and inter-linkages between health, development and gender in developing countries and specializes in spatial statistical, econometric and GIS modeling.