University of Reading

Empowering Women Through Employment: Determinants and Impacts

Doctor of Philosophy

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Declaration

‘Declaration: I confirm that this is my own work and the use of all material from other sources has been properly and fully acknowledged.’

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Abstract

This thesis comprises three empirical papers examining the determinants and consequences of women's employment in the Middle East and North Africa (MENA) region, with a specific focus on Egypt and Saudi Arabia. Using large-scale nationally representative datasets and robust econometric methods, the thesis explores how early childbirth, maternal employment, and legal reforms shape women's labour force participation, sectoral integration, and family wellbeing outcomes.

The first paper investigates how the age at first birth influences women's employment outcomes in Egypt. Using data from the 2008 and 2014 Egypt Demographic and Health Surveys (EDHS), the chapter employs Propensity Score Matching (PSM), logistic and multinomial logit models, and a Two-Stage Residual Inclusion (2SRI) approach to address endogeneity. Results indicate that early motherhood (before age 20) significantly reduces the employment, particularly in wage jobs. Delaying childbirth increase employment, and higher education levels moderate the negative effects of early childbirth, although the penalties persist even among educated women.

The second paper examines the impact of maternal employment on child health in Egypt, using pooled EDHS data from 2005, 2008, and 2014. Applying an instrumental variable approach (2SLS), the chapter finds that maternal employment increases the likelihood of child stunting by 12.6%. The effects are more pronounced among children under two and vary across maternal occupations: employment in service jobs is associated with reduced stunting but higher rates of wasting, while physically demanding jobs show no significant associations. These findings highlight trade-offs between income and caregiving time, particularly during early childhood.

The third paper evaluates the impact of Saudi Arabia's 2019 legal reforms—removing male guardianship restrictions, improving travel and work rights, and introducing anti-discrimination measures—on female labour force participation. Using Labour Force Survey data from 2019 and 2022, the chapter applies a before-and-after framework and Propensity Score Matching. The results show that women's employment increased by 10.5% following the reforms, with notable gains in male-dominated sectors such as construction and trade. Although the reforms primarily targeted women, a small positive spillover effect is observed on male employment. The findings are framed within feminist legal theory and human capital theory, illustrating the interplay between legal reforms and labour market structures.

Dedication

First and foremost, I am deeply grateful to **Allah** for giving me the strength, patience, and courage to complete this PhD journey.

To my beloved father, ***Duhaim Marzouq Alotaibi***, who is no longer with us but will always remain in my heart. You were my greatest inspiration, always encouraging me to pursue education and follow my dreams. I will never forget the tears in your eyes as you watched me walk across the stage at my master's graduation. This PhD was your dream for me, and as I submit this thesis today, I know I have made you proud.

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To my husband and best friend, ***Mohamad AboEgal***, who believed in me when I doubted myself and supported me when I needed it the most. You have always been my biggest cheerleader, celebrating every little success and reminding me to keep going. Your love and encouragement have made this journey so much easier, and I am forever thankful for you.

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This thesis is dedicated to all of you, with love and gratitude.

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Finally, I want to thank myself. For believing in my abilities, for pushing through the hard times, and for never giving up.

Acronyms

ATE- Average Treatment Effect
ATET- Average Treatment Effect on the Treated
CIA- Conditional Independence Assumption
DHS- Demographic and Health Survey
DiD- Difference in Difference
FLFP - Female Labour Force Participation
GASTAT- General Authority for Statistics
HH- Household
IR- Individual Recode
IV- Instrument Variable
KM- Kernel Matching
KR- Children Recode
LFS- Labour Force Surveys
NNM- Nearest Neighbour Matching
OLS - Ordinary Least Squares
PCA- Principal Component Analysis
PSM- Propensity Score Matching
PSU- Primary Sample Units
RCT- Randomized control trials
RM- Radius Matching
SDG- Sustainable Development Goals
SMD- Standardized Mean Difference
SUTVA- Stable Unit Treatment Value Assumption
WHO - World Health Organization
2SLS- Two Stage Least Squares
2SRI- Two-Stage Residual Inclusion

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Chapter 1

Introduction to Thesis

1.1 Introduction

Women across the globe have historically faced significant barriers to economic participation, including limited access to resources, restricted education, and fewer employment opportunities. These challenges are particularly pronounced in the Middle East and North Africa (MENA) region, where patriarchal norms and structural inequalities have constrained women's roles in society (Assaad & Barsoum, 2019; Moghadam, 1990). Despite progress in educational attainment, women's participation in the labour force remains disproportionately low—a phenomenon often referred to as the "MENA paradox" (Assaad et al., 2020). Social norms, caregiving responsibilities, and economic inequalities further complicate these challenges, influencing women's employment opportunities and household well-being (Lufumpa et al., 2021).

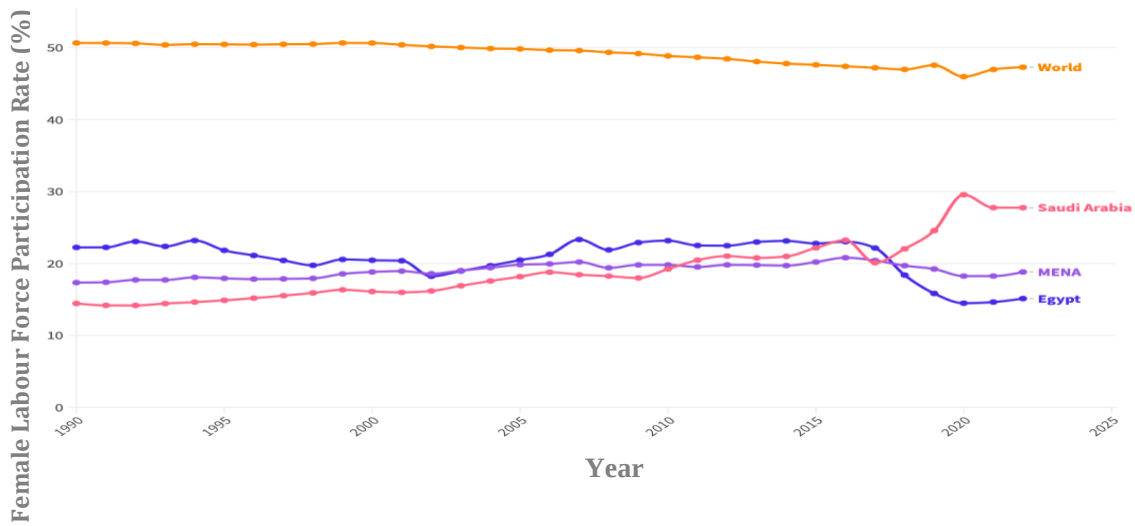
In *Egypt*, although women have achieved significant progress in education, their employment remains limited by societal expectations surrounding marriage and motherhood, wage discrimination, and restricted job opportunities (Krafft et al., 2019). In contrast, *Saudi Arabia* has seen notable changes in recent years, with female labour force participation increasing from 20% in 2018 to 35% in 2022 (GASTAT, 2022). This progress is largely attributed to Vision 2030 reforms, including the 2019 reform which removed the male guardian requirements for employment, travel, and other activities, aimed at enhancing women's autonomy and economic empowerment (The Embassy of the Kingdom of Saudi Arabia, 2019).

Despite these advancements, significant challenges remain. Women in both countries continue to be underrepresented in leadership roles, and deeply rooted social norms still act as barriers to their full economic inclusion. This thesis explores the factors influencing women's employment in Egypt and Saudi Arabia, focusing on the timing of life-cycle events, such as early motherhood, the impact of maternal employment on child health, and the role of legal reforms. By examining these issues, this thesis aims to contribute to a deeper understanding of how education, employment, and policy reforms can empower women and promote greater economic participation.

1.2 Contextual Background: Status of Women in Saudi Arabia and Egypt

The status of women in the labour markets of Saudi Arabia and Egypt offers a valuable perspective on the broader socio-economic dynamics within the Middle East and North Africa (MENA) region. While both countries share strong cultural norms that traditionally limit women's roles in public life, their economic policies and legal frameworks have led to different outcomes in female labour force participation (FLFP). **Figure 1.1** illustrates the trends in FLFP from 1990 to 2022 in Saudi Arabia and Egypt, alongside regional (MENA) and global averages. The graph reveals how both countries have faced the challenge of low FLFP, yet their responses have differed markedly. In Saudi Arabia, FLFP has seen a significant rise, particularly after the introduction of Vision 2030 in 2016. This national strategy prioritised economic diversification and included specific measures to increase women's participation in the workforce. As a result, Saudi Arabia has made notable progress, gradually closing the gap with the regional average. In contrast, Egypt's FLFP has remained relatively stagnant, with a slight decline in recent years. Despite policy efforts and international interventions, such as those linked to the International Monetary Fund's (IMF) stabilisation programmes, the entrenched social norms and the economic restructuring have hindered substantial improvements in women's participation in the labour market.

Figure 0.1 *Female Labour Force Participation in Saudi Arabia, Egypt, MENA, and World*



Source: Data from World Development Indicators (ILO estimate). Aggregation method: Weighted average. Labour Force Participation Rate, Female (% of Female Population Ages 15-64).

Table 1.1 provides a more detailed breakdown of key labour market and educational indicators for Egypt and Saudi Arabia from 2001 to 2022. It includes data on labour force participation rates, unemployment rates, literacy rates, and school enrolment rates for both men

and women. In Egypt (***Panel A***), female labour force participation stood at 21.88% in 2001, increasing to 24.08% in 2011, before slightly rising to 24.65% in 2016. However, after 2016, there was a significant decline, with female participation dropping to 16.99% in 2019 and further to 17.49% in 2022. Although the female unemployment rate fell from 21.79% in 2001 to 18.06% in 2022, this decline in unemployment did not correspond with an increase in employment, suggesting that many women may have exited the labour force. This trend could be linked to the reduction of government jobs under the IMF stabilisation programmes, as women in Egypt traditionally prefer government employment due to its stability and benefits, as discussed in Chapter 2. When government jobs are scarce, women may turn to informal employment or continue their education, enhancing their qualifications in the hope of securing a government job in the future (Assaad & Barsoum, 2019). Male participation rates in Egypt have remained relatively stable, fluctuating from 71.82% in 2001 to 74.45% in 2022. The rise in female tertiary school enrolment, from 24.98% in 2001 to 38.03% in 2022, indicates improvements in educational attainment. However, these gains in education have not yet fully translated into higher employment levels.

Table 0.1 *Labour Market and Education Indicators by Gender in Saudi Arabia and Egypt*

Panel A	**Egypt**																	
	Female						**Male**						**Total**					
	2001	**2005**	**2011**	**2016**	**2019**	**2022**	**2001**	**2005**	**2011**	**2016**	**2019**	**2022**	**2001**	**2005**	**2011**	**2016**	**2019**	**2022**
Labour Force Participation Rate	21.88	22.04	24.08	24.65	16.99	17.49	71.82	73.90	77.47	72.45	71.17	74.45	47.25	48.43	51.27	49.00	44.57	46.47
Unemployment Rate	21.79	24.59	22.34	23.55	21.35	18.06	5.60	7.21	8.73	8.85	4.76	4.93	9.26	11.05	11.85	12.45	7.85	7.34
Literacy Rate	..	56.12	63.52	65.51	..	68.95	..	77.91	80.27	..	..	79.99	..	67.33	72.05	71.17	..	74.50
Secondary School Enrollment	78.49	77.57	73.41	77.63	80.16	84.02	82.97	81.17	73.60	79.47	82.14	87.10	80.79	79.42	73.51	78.57	81.17	85.59
Tertiary School Enrollment	24.98	26.36	24.78	32.58	38.75	38.03	31.22	31.11	26.90	31.31	37.50	37.61	28.20	28.80	25.87	31.93	..	37.82
Panel B	**Saudi Arabia**																	
	Female						**Male**						**Total**					
	2001	**2005**	**2011**	**2016**	**2019**	**2022**	**2001**	**2005**	**2011**	**2016**	**2019**	**2022**	**2001**	**2005**	**2011**	**2016**	**2019**	**2022**
Labour Force Participation Rate	16.73	19.00	21.15	24.19	25.48	35.70	75.48	77.63	78.38	81.41	81.53	81.19	52.70	54.58	55.41	58.81	59.66	63.07
Unemployment Rate	9.36	14.46	19.25	21.48	21.35	15.65	3.97	4.73	3.36	2.55	2.51	2.69	4.62	6.05	5.77	5.60	5.64	5.59
Literacy Rate	69.29	76.34	91.37	92.71	96.05	..	87.06	87.53	96.53	97.10	98.62	..	79.35	82.86	94.43	95.33	97.59	..
Secondary School Enrollment	..	87.60	89.93	106.12	103.95	119.61	..	99.65	95.83	104.08	104.93	120.31	..	93.48	92.89	105.05	104.45	119.97
Tertiary School Enrollment	25.17	38.10	40.72	73.71	84.75	78.45	15.68	24.92	22.19	57.86	75.09	69.54	19.77	31.17	28.94	64.66	79.61	73.75

Source: Own construction using data from World Development Indicators (WDI) Database. Note: Labour force participation rate, (% of population ages 15-64) (modelled ILO estimate), Unemployment, (% of labour force) (modelled ILO estimate), Literacy rate, adult female (% of females ages 15 and above), School enrolment, secondary, (% gross)[1] , and School enrolment, tertiary, (% gross).

[1] The gross enrolment ratio includes students of all ages enrolled at a specific level of education, not just those within the official age group. This measure accounts for late enrolment, early enrolment, and grade repetition, which can result in total enrolment exceeding the population of the age group officially

In Saudi Arabia (***Panel B***), female labour force participation has steadily increased over the years. It was 16.73% in 2001, rising to 21.15% in 2011, then 24.19% in 2016, before accelerating sharply to 35.70% in 2022. This rise reflects the impact of major legal reforms and policy initiatives aimed at increasing women's workforce participation, particularly after 2019. These reforms are discussed in Chapter 4. Male participation rates in Saudi Arabia have remained relatively high, ranging from 75.48% in 2001 to 81.19% in 2022, suggesting that the growth in female employment has not significantly displaced male workers. The female unemployment rate decreased from 21.48% in 2016 to 15.65% in 2022, further highlighting the positive impact of recent policy changes. Additionally, tertiary enrolment among Saudi women increased from 25.17% in 2001 to 78.45% in 2022, reflecting substantial progress in female higher education.

These figures highlight both the shared challenges and the differing responses of Saudi Arabia and Egypt in addressing low FLFP. While both countries contend with strong cultural norms that restrict women's participation in the workforce, Saudi Arabia has taken more proactive steps through legal reforms to alter these norms and improve women's employment outcomes. In contrast, Egypt's efforts have been less aggressive, resulting in stagnant or declining FLFP. This comparison underscores the critical role of government policy and legal frameworks in shaping labour market outcomes for women in the MENA region.

1.3 Structure of Thesis

This thesis comprises three individual papers, (Chapters 2–4), each exploring different dimensions of women's employment and its broader implications. The central aim across all papers is to investigate the factors that influence women's participation in the labour force and the consequent impacts on their lives and their families. Chapters 2 and 3 are under preparation for submission. Chapter 4 have been submitted to "*Development Studies Research"*, and currently "under-review." **Table 1.2** summarises the status of each article. In addition, I have submitted a paper titled *"Measuring the Invisible: Developing a Patriarchy Index for Egypt"* to *"Australian Feminist Studies*." While this paper is not included in the thesis, it was produced during the course of my PhD, and its development was directly informed by the research undertaken in Chapters 2 and 3. This illustrates the broader academic progression that has arisen from this body of work.

corresponding to the educational level. Consequently, gross enrolment ratios can exceed 100%. https://datahelpdesk.worldbank.org/knowledgebase/articles/114955-how-can-gross-school-enrollment-ratios-be-over-100

Table 0.2 *Overview of the Papers*

Chapter	Title	Journal/Status	Impact Factor/Q
2	Exploring How Age at First Birth Shapes Women's Employment Paths in Egypt	**Under preparation for submission**	
3	Maternal Employment and Child Health Outcomes in Egypt		
4	Legal reforms and Women Employment: Evidence from Saudi Arabia	**Under-review** at *Development Studies Research*	2.5/ Q2
Not Included	Measuring the Invisible: Developing a Patriarchy Index for Egypt	**Under-review** at *Australian Feminist Studies*	1.3/ Q2

The first paper (Chapter 2) investigates the relationship between the age at which women have their first child and their subsequent labour market outcomes in Egypt. The chapter is guided by three central research questions: (1) What is the impact of early childbirth on women's employment in Egypt? (2) How does this impact vary across different types of employment? (3) To what extent does educational attainment mitigate the adverse effects of early childbirth on employment outcomes? The paper employs data from the 2008 and 2014 rounds of the Demographic and Health Surveys (DHS) in Egypt. Methodologically, it applies a robust econometric framework that includes Propensity Score Matching (PSM) to control for selection bias, logistic and multinomial logistic regression models to capture the heterogeneity of employment types, and the Two-Stage Residual Inclusion (2SRI) method to address endogeneity, specifically; unobserved confounders and omitted variable bias.

The second empirical paper (Chapter 3) shifts focus to the interplay between maternal employment and child health outcomes in Egypt, an issue that is vital for understanding the broader socio-economic impacts of female labour force participation. The chapter poses three key research questions: (1) How does maternal employment influence child health outcomes? (2) How do these effects vary based on the age of the child? (3) How does the type of maternal occupation affect child health outcomes? This paper utilizes pooled data from the 2005, 2008, and 2014 DHS surveys and applies a two-stage least squares (2SLS) instrumental variable (IV) approach to address endogeneity issues related to maternal employment. The cluster average of women's employment status is used as an instrument to estimate causal effects. This cluster-level is designed to capture the conditions of the local labour market and labour demand, which

are exogenous factors affecting local economic conditions and external to the women and their households.

The third paper (Chapter 4) explores the impact of the 2019 legal reforms in Saudi Arabia, which were part of the Vision 2030 initiative aimed at enhancing women's economic participation. This chapter addresses two main research questions: (1) How have the 2019 legal reforms influenced women's participation in the labour force? (2) Which economic sectors have experienced the most significant changes in women's labour force participation as a result of these reforms? This paper aims to fill a gap in the literature by providing an empirical analysis that goes beyond specific interventions, such as the lifting of the driving ban, to assess the broader sectoral impacts of these comprehensive legal changes. Utilizing data from the 2019 and 2022 Labour Force Surveys (LFS) conducted by the General Authority for Statistics (GASTAT), the paper employs Before and After Analysis and Propensity Score Matching (PSM) to mitigate selection bias and ensure robust estimates of the reforms' impact.

Chapter 2

Timing Motherhood: Exploring How Age at First Birth Shapes Women's Employment Paths in Egypt

Abstract

This chapter investigates the impact of a mother's age at first birth on her employment probability across different types of work (family, wage, and self-employment) in Egypt and assesses whether education mitigates the negative effects of early childbirth on employment outcomes. Using data from the 2008 and 2014 Demographic and Health Surveys (DHS), this chapter applies a comprehensive methodological approach, including Propensity Score Matching (PSM), logistic and multinomial logistic regression models, and the Two-Stage Residual Inclusion (2SRI) method to address potential endogeneity. The findings indicate that delaying childbirth significantly increases employment, with the most pronounced effects observed in wage employment. The impacts on family and self-employment are comparatively modest. Additionally, higher educational attainment offsets the negative effects of early childbirth, enhancing employment prospects across all employment types. These results highlight the need for policy interventions that promote delayed childbirth and expand educational opportunities to improve women's labour market participation and advance gender equality in Egypt.

Keywords: *Early Childbirth, Delayed Childbirth, Women's Employment, Logistic Regression, Multinomial Logistic Regression, Two-Stage Residual Inclusion (2SRI), Propensity Score Matching (PSM), Demographic and Health Surveys (DHS), Egypt.*

2.1 Introduction

Peter Drucker said, "The best way to predict your future is to create it." However, in Egyptian society, where societal norms and cultural expectations heavily influence individual decisions, significantly impacting women's career trajectory and economic independence. Traditional gender ideologies persist in Arab societies, often discouraging women from advancing their careers due to societal constraints (Kaufman & Williams, 2010; McRae, 2003; Williams et al., 2019). This dynamic often discourages women from pursuing career advancement, as societal constraints frequently position domestic responsibilities in conflict with professional aspirations. In Egypt, adult roles—including independent living, socially sanctioned sexual relations, and childbearing—are typically confined to marriage. Women are expected to marry to complete their transition to adulthood, and this expectation is reflected in societal norms and language, where a female is referred to as a girl until she is married (Sadiqi, 2002; Singerman, 2007). The normative role of the husband is that of the breadwinner, providing income for the family and assuming minimal responsibility within the home. Conversely, the normative role of the wife is that of the homemaker, raising children and assuming almost full responsibility for the domestic sphere (Hoodfar, 1997).

For women, marriage and childbirth often signifies a transition that adds a substantial domestic work burden, making it difficult for them to engage in market work (Assaad & El Hamidi, 2009; Assaad & El-Hamidi, 2001; Assaad et al., 2017; Assaad & Krafft, 2014; Hendy, 2010; Hoodfar, 1997). The difficulty in reconciling domestic responsibilities with the type of work available in Egyptian labour markets is a major contributor to the low rates of female labour force participation in the region (Zeitoun et al., 2023), Therefore, a nuanced understanding of the challenges women face in balancing work outside the home with motherhood is necessary to enhance women's economic opportunities and more fully utilize the region's human potential for development.

Extensive research has underscored the critical importance of delaying early marriage to improve women's socioeconomic status (Assaad et al., 2022; Batyra & Pesando, 2021; Dahl, 2010; Knox, 2017; Yount et al., 2016). Early marriage is often linked to disruptions in education, limited skill acquisition, and reduced labour market engagement, thereby perpetuating cycles of economic dependency and gender inequality. However, while the timing of marriage has been widely studied, a significant gap remains in understanding the specific relationship between the timing of childbearing and women's employment in Egypt. Childbearing introduces additional challenges that may affect women's ability to remain in or re-enter the labour market, particularly in a socio-cultural context that prioritises domestic roles

for women over professional ones. Accordingly, this chapter investigates the impact of early childbirth on women's employment and examines the employment characteristics and factors that may facilitate or hinder women's continued labour-force participation following childbirth.

2.1.1 Research Questions

This chapter is organized around three research questions:

1) What is the impact of early childbirth on women's employment in Egypt?
2) How does this impact vary across different types of employment?
3) To what extent does education mitigate the effects of early childbirth on the employment outcomes of Egyptian women?

The empirical analysis is grounded in a theoretical framework that considers how individuals and families maximize utility within the constraints of gender roles. The economic principles of specialization related to marriage and childbirth (Becker, 1973, 1974; Shelton & John, 1996) provide a foundation for understanding the interplay between labour market participation and domestic roles. This chapter emphasizes the crucial link between the timing of motherhood and female labour force participation (FLFP). Using data from the 2008 and 2014 Egypt Demographic and Health Surveys (DHS), a comprehensive econometric approach—including Propensity Score Matching (PSM), logistic and multinomial logistic regressions, and the Two-Stage Residual Inclusion (2SRI) method—is employed. Each methodology provides unique insights into the relationship between childbirth timing and employment, and ensure robustness in the results by addressing endogeneity issues, such as selection bias and unobserved confounders.

This chapter makes three significant contributions to the existing literature on women's employment in Egypt. First, it provides empirical evidence that early motherhood (defined as giving birth before the age of 20) is associated with a lower likelihood of women's employment in Egypt. The analysis reveals that early childbirth is associated with a lower probability of both overall employment and wage employment. This finding aligns with global studies by Spierings and Smits (2007) and the Population Council and Women Deliver (2019), which highlight the negative impact of early childbirth on women's labour force participation. However, this chapter uniquely contextualizes these effects within the Egyptian labour market. Additionally, in order to ensure the robustness of the results, an additional analysis was

conducted by replacing the mother's age at first birth with mother's age at first marriage[2]. As demonstrated in **Table 2.A6** in the appendices, the findings remain consistent, thereby reinforcing the reliability of the original analysis. The second major contribution is the nuanced understanding of how education interacts with the age at first birth to influence women's employment outcomes. While previous literature has established that higher educational attainment enhances women's employment prospects (Assaad et al., 2022; Ehab, 2022; Hendy, 2020; Krafft & Assaad, 2020; Nazier & Ramadan, 2016), this chapter explores the influence of educational attainment on employment outcomes for women who experience early childbirth compared to those who have their first child at a later age. The analysis reveals a significant disparity: even among women with higher education, those who have their first child before the age of 20 are less likely to be employed than those who have their first child at age 34 or older. This underscores the substantial and enduring impact of early motherhood on women's employment prospects, regardless of their educational level.

Finally, this chapter makes a methodological contribution by employing a comprehensive econometric approach to address the limitations in the current literature. Samari (2017), for example, focused on the relationship between early childbearing and women's empowerment, assessing outcomes such as decision-making, mobility, and financial autonomy using multilevel models with data from the Egypt Labour Market Panel Survey (ELMPS)[3]. While valuable, her study did not directly assess economic impacts like employment. In contrast, this chapter utilises data from the 2008 and 2014 Demographic and Health Surveys (DHS) and applies Propensity Score Matching (PSM), logistic and multinomial logistic regressions, and the Two-Stage Residual Inclusion (2SRI) method. This rigorous econometric strategy addresses potential endogeneity; selection bias, unobserved confounders, and simultaneity bias, providing robust and reliable evidence on the impact of childbirth timing on employment. By assessing both employment status and employment type (family, wage, or self-employment), this chapter adds a critical economic dimension to the understanding of early motherhood's implications in Egypt and informs policies designed to enhance female labour force participation and economic empowerment.

[2] Including both mother's age at first birth and mother's age at first marriage in the same model is not feasible due to high collinearity (correlation = 0.89, p = 0.000), which can distort coefficient estimates. The correlation matrix supporting this decision is presented in Table 2.A7.

[3] A key reason for selecting DHS (2008, 2014) over ELMPS is the availability of detailed fertility and childbirth history data, which are essential for accurately measuring the timing of first birth. DHS provides rich information on reproductive history, maternal and child health, and socio-demographic characteristics, allowing for a more precise analysis of the effects of early childbirth on employment. In contrast, ELMPS does not contain the same level of detail on birth histories, which limits its ability to capture nuanced fertility-employment linkages.

The following sections present a background on comparative trends, a literature review in Section 2.3, the methodology in Section 2.4, results in Section 2.5, and discussion in Section 2.6. The chapter concludes with Section 2.7.

2.2 Background and Comparative Trends

2.2.1 Background of Women's Employment in Egypt

During the 1950s and 1960s, under President Gamal Abdel Nasser's state-centred development model, Egypt established free public education up to the tertiary level and guaranteed public sector employment for university graduates (Antoninis, 2001; Waterbury, 1983). This era witnessed rapid educational expansion, higher enrolment rates, and reduced illiteracy, with both men and women benefiting from free higher education.

The 1970s and 1980s saw a continued expansion in education, although women experienced delayed entry into the system. Public sector employment guarantees, formalized in 1964, attracted many educated individuals to government jobs, which were associated with middle-class status, stability, and benefits such as health insurance and social security (Assaad, 1997). However, this system faced challenges due to an oversupply of graduates seeking public sector employment, particularly after the 1986 decline in oil prices. In response, Egypt implemented Economic Reform and Structural Adjustment Programs (ERSAP) in 1991, which reduced the state's economic role, promoted privatization, and significantly cut public sector hiring (Assaad & Arntz, 2005). Consequently, the informal economy expanded, the private sector could not absorb the surplus labour, and real wages declined (Assaad & El Hamidi, 2009). Youth unemployment, especially among women, became a critical issue, with a notable gender gap as women continued to prefer increasingly scarce public sector jobs, while men adapted to lower-quality private sector employment (Krafft et al., 2019).

The slowdown in public sector hiring in recent years has been influenced by economic, political, and fiscal factors. Beginning in the late 1990s and early 2000s, economic reforms aimed at reducing public spending, including the wage bill, were implemented. The 2008 global financial crisis further intensified fiscal pressures, leading to cautious public sector hiring policies (Assaad & Krafft, 2015). Political and economic instability following the 2011 revolution caused fluctuations in public sector hiring, reflecting the challenges of managing the public workforce during periods of transition. In late 2016, Egypt's IMF-sponsored reform program introduced measures to curtail public spending, including restrictions on public sector hiring, to address macroeconomic imbalances and promote fiscal sustainability.

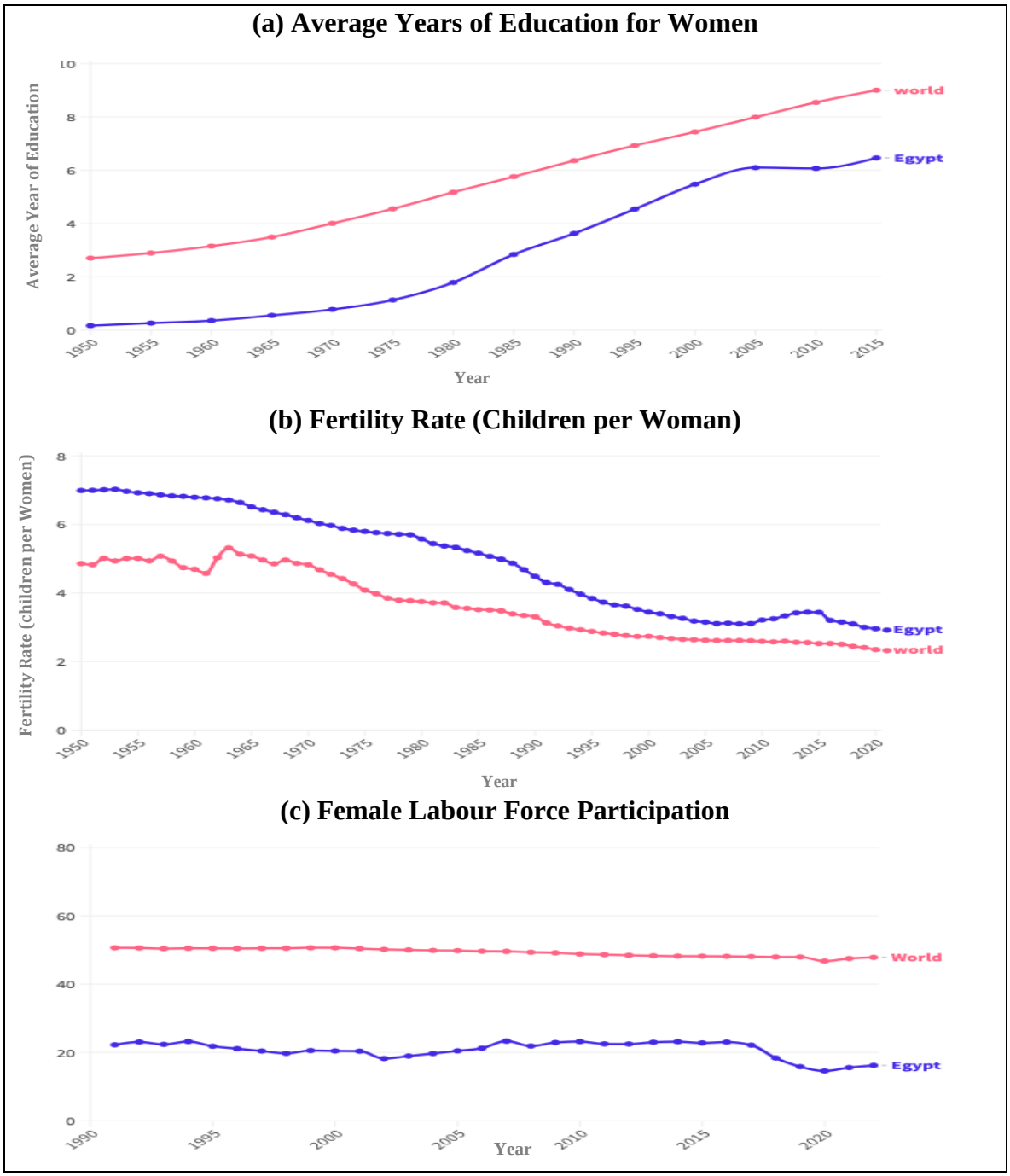
This slowdown, driven by ongoing fiscal challenges, underscores the government's struggle to balance budgetary constraints with the demand for public sector employment. Historically, Egypt's labour market dualism has been shaped by the practice of offering higher public sector wages to appease politically influential groups (Amin et al., 2012; Assaad, 2014). This has led to several outcomes: the misallocation of human capital, with many well-educated individuals seeking government positions; an emphasis on acquiring education aimed at securing government jobs rather than developing skills needed in the private sector (Salehi-Isfahani, 2012); and an inefficient queuing phenomenon among educated workers competing for limited government jobs, exacerbating youth unemployment, particularly among women (Assaad & Krafft, 2016a). This preference is influenced by several key factors. Public sector jobs are perceived to offer greater job security and a favourable work-life balance, which are particularly appealing in an unstable economic environment, (Assaad & Barsoum, 2019). Additionally, the public sector is regarded as a safer and more socially acceptable working environment for women, in contrast to the private sector, where workplace conditions and interactions may be less regulated. Moreover, women often face discrimination and limited advancement opportunities in the private sector (Amin et al., 2012), making public sector employment more desirable. As a result, many women prefer to remain unemployed or work in the informal sector rather than accept private sector positions, (Selwaness & Krafft, 2021). Some women even choose to extend their education in the hope of securing a public sector job, thereby enhancing their competitiveness for these positions, (Assaad & Barsoum, 2019). These factors collectively contribute to the strong preference for public sector employment among women in Egypt, despite the high unemployment rates associated with this sector.

2.2.2 Comparative Trends of Women's Employment in Egypt

Female labour force participation (FLFP) remains a critical socio-economic issue worldwide, particularly in the Middle East and North Africa (MENA) region. In Egypt, significant progress has been made in women’s education over recent decades, with the average years of schooling for women aged 15–65 increasing from 3.6 in 1990 to over 6 by 2015, as shown in Figure 2.1(a). This rise highlights efforts to improve access to education and promote gender equality. Fertility rates have also shifted notably over time. Figure 2.1(b) illustrates a decline from an average of seven children per woman in 1950 to three by 2008, reflecting improved access to education, family planning, and economic opportunities. However, the unexpected increase in fertility between 2009 and 2015 points to underlying socio-economic or policy factors that require deeper analysis. Despite improvements in education and fertility rates, female

participation in the labour market has not followed the same trend. Figure 2.1(c) shows that FLFP in Egypt remains low and stagnant compared to global levels, even with higher educational attainment. This discrepancy suggests that other barriers, such as social norms, limited childcare, and inflexible job markets, continue to hinder women's employment.

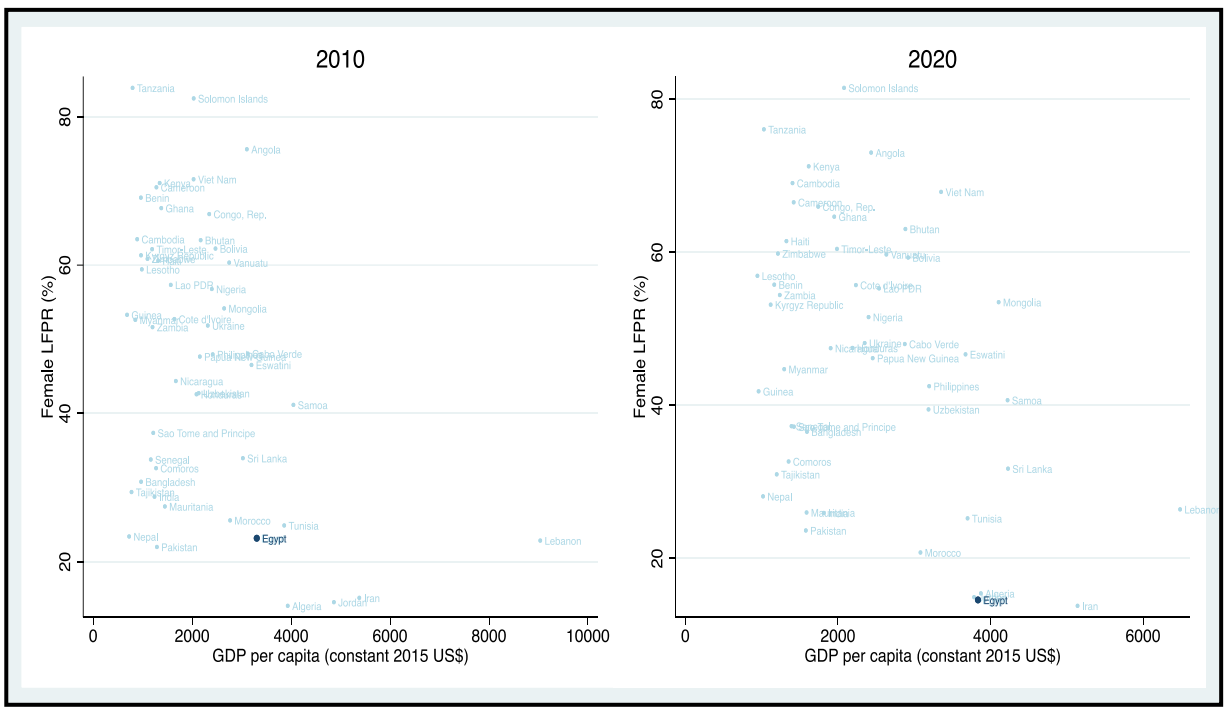
Figure 0.1 *Female Education, Fertility Rate, and Female Employment*



Source: World Development Indicators (ILO estimate). Aggregation method: Weighted average. Figure 2.1(a) depicts the Average Years of Education for Women (aged 15–65) using the Barro and Lee (2021) dataset. It was generated by calculating the population-weighted average of years of education for women across various age groups. Figure 2.1(b) Fertility Rate (Births per Woman): The total fertility rate is the number of children a woman would bear if she lived through her childbearing years, based on age-specific fertility rates of the specified year. Figure 2.1(c) Labour Force Participation Rate, Female (% of Female Population Ages 15-64).

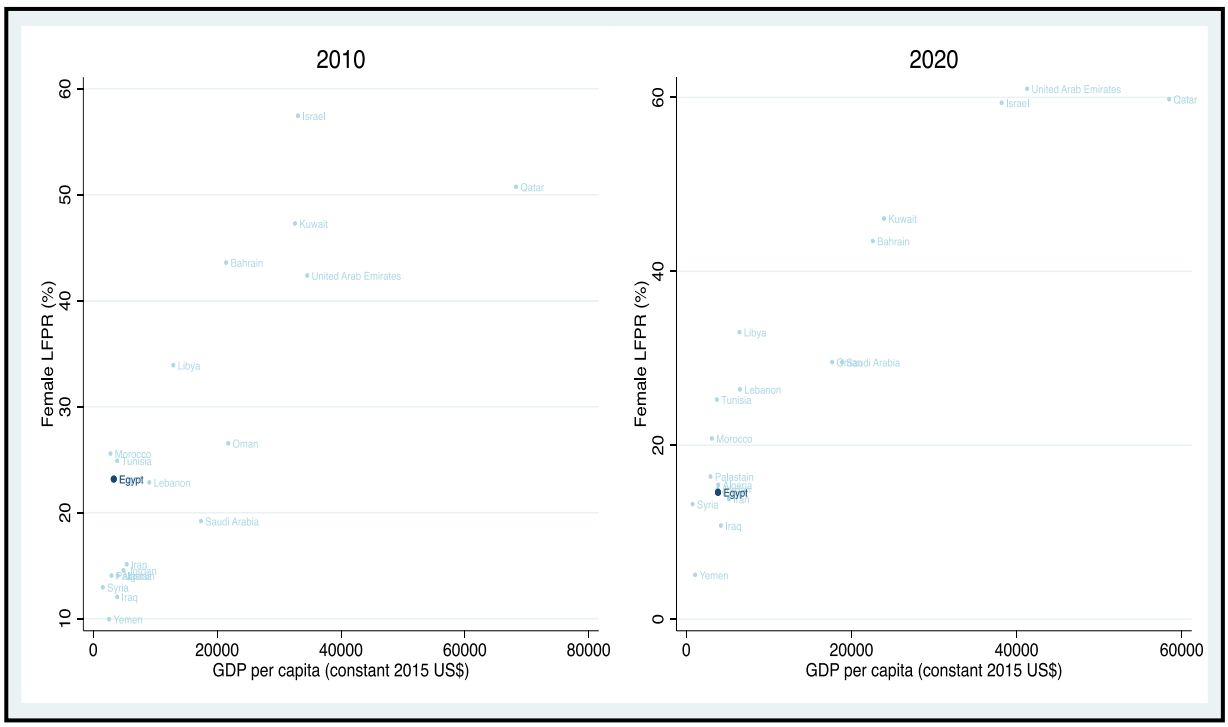
To better understand Egypt's Female Labour Force Participation (FLFP) rate, it's helpful to compare it with other Lower-Middle-Income Countries (LMICs) globally, as shown in **Figure 2.2.** Egypt has one of the lowest FLFP rates in both 2010 and 2020 within this income group, where generally higher rates of female participation are often seen. This suggests that factors beyond economic status, such as cultural and institutional barriers, may significantly limit women's participation in Egypt's labour market. When we look specifically at the Middle East and North Africa (MENA) region, Egypt's low FLFP rate is consistent with regional trends. **Figure 2.3** shows that Egypt was among the countries with the lowest FLFP rate in the MENA region in both 2010 and 2020. Interestingly, although Egypt's GDP per capita is not the lowest in the region, its FLFP rate remains low, indicating that economic growth alone has not led to greater female participation in the workforce. This lack of alignment between GDP per capita and FLFP suggests that other, non-economic factors play a large role in shaping women's employment outcomes in Egypt. The persistent low FLFP in Egypt, despite moderate GDP levels, points to the influence of structural barriers beyond economic factors. Cultural expectations, gender norms, and limited support systems for working mothers likely contribute to these low participation rates.

Figure 0.2 *Female labour force participation (FLFP) rate (%) for Lower-Middle-Income Countries (LMIC)*



Source: Own construction using data from the World Development Indicators (WDI) Database.

Figure 0.3 *Female labour force participation (FLFP) rate (%) for Middle East & North Africa (MENA)*



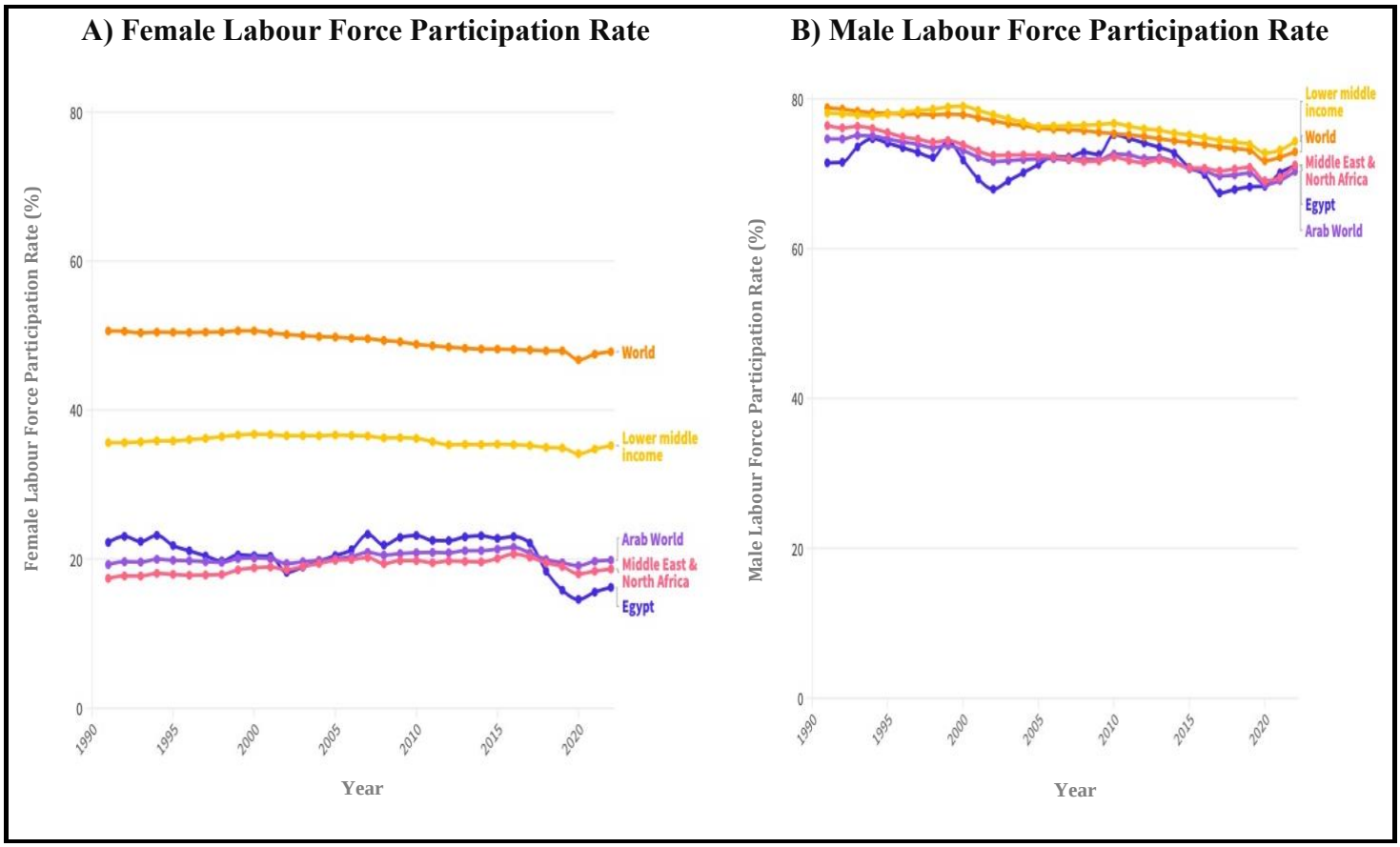
Source: Own construction using data from the World Development Indicators (WDI) Database.

2.2.3 Gender Segregation in the Egyptian Labour Market

The Egyptian labour market exhibits distinct patterns of gender segregation in employment sectors, reflecting societal norms and expectations. These patterns are closely tied to the division of domestic responsibilities and the traditional roles assigned to men and women, (Assaad et al., 2020). **Figure 2.4** utilizing World Bank data from 1990 to 2022, provides a visual representation of labour force participation rates for Egypt, the Arab World, Middle East & North Africa, the global average, and lower-middle-income countries. The female labour force participation (FLFP) rate has been persistently low and declining since the 1990s. The left panel displays data for women, while the right panel presents data for men, offering a comparative analysis within Egypt and against other regions. During the 1990s, female employment rates stagnated at an average of 23.5%. Despite robust economic growth from 2002 to 2007, female employment showed inconsistencies, initially falling from 22% in 2000 to 19.6% in 2002, before recovering to 24.9% by 2007. The 2008–2009 global financial crisis and the 2011 revolution posed significant economic challenges. In response, the Egyptian government launched a stabilization program in 2016 with IMF support, addressing fiscal and balance-of-payments deficits. However, FLFP responded minimally, rising modestly from 23.4% in 2008 to 24.7% by 2016. The IMF program's emphasis on public spending cuts and

public sector downsizing—sectors traditionally favoured by women—precipitated a sharp decline in FLFP to 16.9% by 2019.

Figure 0.4 *Labour Force Participation Rate by Gender*

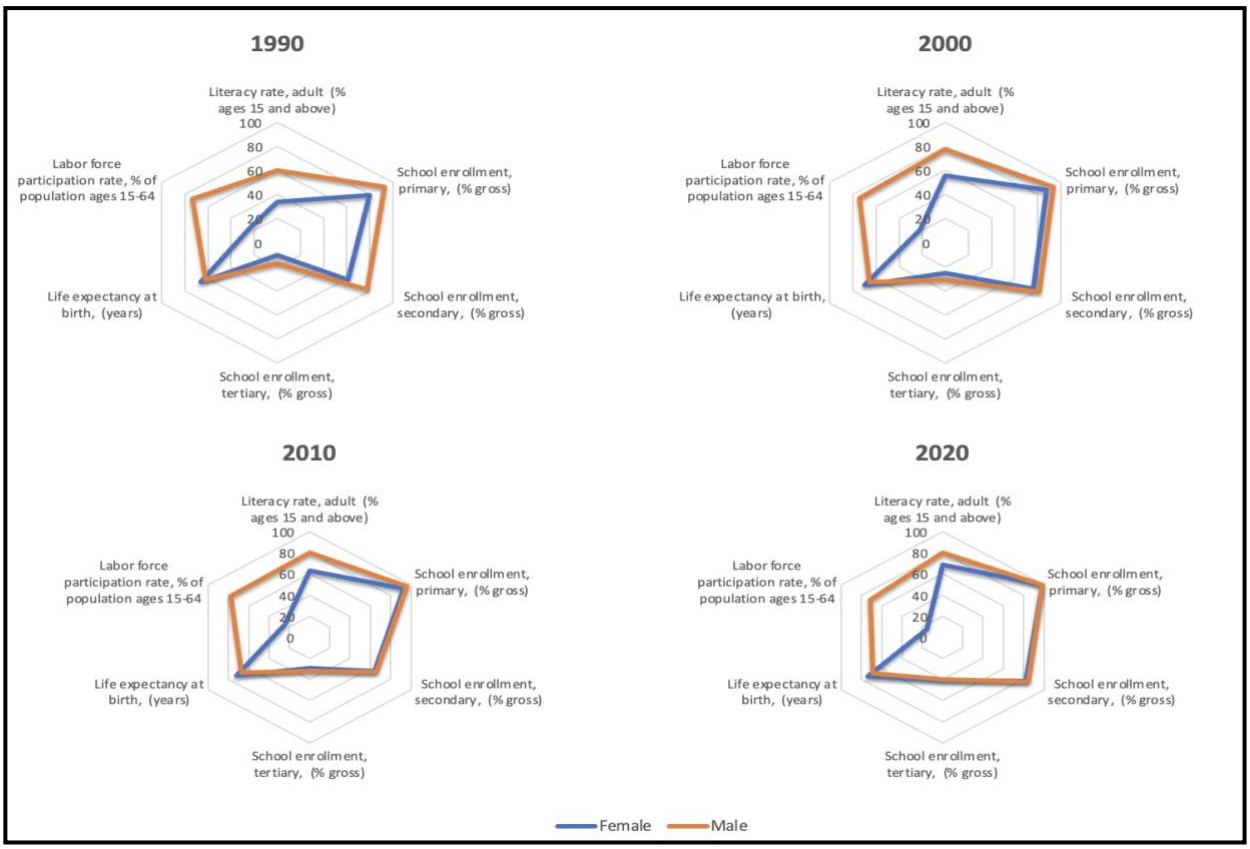


Source: Data from World Development Indicators (ILO estimate). Aggregation method: Weighted average. A) Labour Force Participation Rate, Female (% of Female Population Ages 15-64). B) Labour Force Participation Rate, Male (% of Male Population Ages 15-64).

Additionally, The COVID-19 pandemic further exacerbated this decline, with FLFP decreasing from 17% in 2019 to 15.6% by 2020, as reported by the ILO. This recent drop underscores the precarious situation of women in the workforce during economic shocks and highlights the urgent need for comprehensive policies to mitigate such impacts. The figure illustrates that the gender gap in Egypt's labour force participation is more pronounced than in other regions, suggesting significant gender-specific factors influencing labour market engagement in Egypt. Building on the examination of gender inequality, **Figure 2.5** illustrate a radar chart to show the gender gap in education and various social indicators over the past three decades in Egypt. It has been seen significant improvements in educational attainment and literacy rates for both males and females. However, the labour force participation rate for women has remained considerably lower compared to men. The radar charts from 1990 to 2020 vividly depict this persistent disparity. While male labour force participation remains relatively

high and stable, female participation lags significantly, with only minor fluctuations. This enduring gender gap necessitates a thorough investigation into the reasons behind low female employment. This chapter rigorously examines the effects of early motherhood on women's employment, highlighting the substantial consequences of this pivotal life event on their professional and economic outcomes.

Figure 0.5 *Social Indicators 1990-2020*



Source: Own construction using data from the World Development Indicators (WDI) Database.

2.3 Literature Review

2.3.1 Theoretical Framework

This chapter utilizes two primary theoretical frameworks, which are Becker's theory of the family and the life course theory. Both theories explore the relationship between the timing of childbirth and women's employment outcomes. Firstly, Becker's theory provides foundational insights into how family-related decisions, such as marriage and childbirth, affect labour market participation. Specifically, his theory of marriage (1973, 1974) posits that within households, individuals tend to specialize in tasks where they hold a comparative advantage, often leading to a gendered division of labour. Typically, this division sees men focusing on paid market work while women assume primary responsibility for household duties, a dynamic that is expected to negatively impact women's occupational status post-marriage. Further,

Becker's human capital theory (1964, 1985) highlights the critical role of education and work experience in enhancing productivity and earning potential in the labour market. Early childbirth, within this framework, can disrupt the accumulation of human capital by necessitating work interruptions or hindering further educational attainment. These disruptions contribute to reduced labour market participation and slower career progression—a phenomenon often described as the "motherhood penalty[4]." The interruptions in women's careers due to early motherhood not only limit immediate earnings but also have long-term effects on occupational advancement. Moreover, Becker's theory of time allocation (1965) elaborates on the economic constraints that influence women's engagement in the labour market. Within this framework, household decisions regarding time use and labour supply are made based on comparative advantage, with the lower-earning partner—often the woman—taking on a greater share of household labour. This distribution results in women having less time and energy for market work, especially when faced with additional demands such as extended commuting times or increased childcare responsibilities. Consequently, women's labour supply tends to decrease under these pressures, further limiting their opportunities for occupational mobility.

Complementing Becker (1973, 1974) framework, life course theory offers a critical perspective on the timing and sequencing of life events and their long-term implications. As articulated by Giele and Elder (1998), life course theory examines how life transitions—such as moving from education to employment or becoming a parent—are influenced by societal norms, institutional contexts, and individual decision-making processes. The timing of key life events, like childbirth, can significantly disrupt normative life stages, particularly those related to career development. This disruption often leads to deviations from standard career trajectories with enduring effects on women's employment opportunities. In contexts where early marriage and childbearing are prevalent, these disruptions are further reinforced by traditional gender roles. Integrating these theoretical perspectives provides a robust analytical framework for examining the impact of early childbirth on women's employment outcomes, particularly in settings where societal expectations and norms heavily influence labour market participation.

[4] The human capital theory suggests that the "motherhood penalty" occurs because mothers often have reduced work experience due to time spent out of the labour force for child-rearing (Becker, 1985). Shorter maternity leaves may mitigate this by encouraging a quicker return to work, while longer leaves can lead to extended interruptions and lower work experience.

2.3.2The Impact of Early Marriage on Women Employment

Marriage is an essential element of life in Egypt that not only involves the union of two individuals, but also defines and determines how society is structured, (K. M. Yount et al., 2018). In this context, marriage marks people's journey into adulthood in which they come to bear new responsibilities, including sexual relationships, childbearing, and independent living (El-Feki, 2013; Hoodfar, 1997; Singerman & Ibrahim, 2003). Moreover, by society's standards, girls in Egypt do not become women until they are married (Sadiqi, 2002; Singerman, 2007). However, the financial burden required by most Egyptians to secure a marriage means that the commitment to marry involves the substantial allocation of resources, which often exceeds other inter-generational transfers like inheritances (Singerman & Ibrahim, 2003). In this context, understanding how Egyptian people transition through marriage leads to the comprehension of the marriage-employment connection in the context of Egypt. Egyptian women often find difficulties in maintaining a positive work-life balance, due to strong social norm that impact women life and choices. (Assaad & El Hamidi, 2009; Hoodfar, 1997).

Previous research has shown that countries with low female labour force participation, such as those in the MENA region, tend to adhere to more traditional social norms around the role of women compared to other countries (Alexander & Welzel, 2011; Inglehart & Norris, 2002). It may be difficult for married women to juggle work and home duties because traditional gender roles in the Middle East and North Africa (MENA) region frequently assign males to be breadwinners and women to be homemakers (Hoodfar, 1997) . Gender social norms refer to the obligations and expectations that society assigns to people based on their gender. They also apply to the division of domestic work, which is the term used to describe the unpaid tasks, such as chores and caring responsibilities, that are necessary to maintain the household and family members, (Hendy, 2010). Within the literature, domestic work is divided into two primary categories: "housework" and "childcare." Housework refers to a wide range of tasks, including farming, raising chickens, making dairy products like butter and cheese, cooking, cleaning dishes, laundry, housekeeping, gathering firewood and water, helping with construction projects, tending to the sick and elderly, and grocery shopping. Child care refers to the time and energy spent caring for children (Hendy, 2010). Indeed, the literature emphasizes how women's employment is impacted by these gender norms, with marriage being a major barrier to women's participation in the labour force, frequently resulting in them taking on more domestic responsibilities (Assaad et al., 2022; Hoodfar, 1997; Krafft & Assaad,

2020). This is particularly compounded in a context where social norms support the idea that women should put their family and marriage before their careers (Bursztyn et al., 2018).

Several studies have investigated the effects of marriage on women's employment in Egypt (Assaad & El-Hamidi, 2001; Assaad & Hendy, 2013; Assaad & Krafft, 2016b; Assaad et al., 2022; Ehab, 2022; Hendy, 2010; Hoodfar, 1997; Krafft & Assaad, 2020; Selwaness & Krafft, 2021). The findings consistently indicate that women employed in the public sector are more likely to maintain their employment following marriage and childbirth. Conversely, women working in the private sector often experience different trajectories. Private sector employees are more likely to exit their jobs during or after marriage and childbirth, with some transitioning to non-wage labour (Selwaness & Krafft, 2021). This divergence is largely attributed to the more favourable working conditions in public sector positions, which typically offer shorter working hours and extensive maternity leave, in contrast to private sector roles that generally entail longer working hours and fewer family-friendly benefits (Hendy, 2015). Also, another reason for preferring public job is that women face another hurdle in their career pursuits, known as the "second shift" (Ehab, 2022; Hochschild, 1989). This term refers to the additional housework and caregiving responsibilities that often fall on women due to societal norms. This lead women to quit their job after marriage, (Selwaness & Krafft, 2021).

The transition from employment to exiting the job has been the focus of several studies, highlighting the complex dynamics involved in employment decisions among women. Hendy et al. (2011) explored the dynamics between women's marriage and employment decisions by applying a joint dynamic model, utilizing data from the Egyptian Labour Market and Panel Survey (ELMPS) for the years 1998 and 2006, alongside retrospective data from 1990. This paper is distinguished by its methodological approach, which categorizes employment into four distinct states: inactivity, public sector employment, private sector employment, and subsistence employment. The analysis reveals a pronounced state dependence in public sector employment compared to the private sector, with significant transitions observed among the various employment states. Notably, married women employed in the private sector exhibited a higher likelihood of transitioning to inactivity than those in the public sector, which more readily facilitates the reconciliation of family and professional responsibilities. Similarly, Selwaness and Krafft (2021) investigate the impact of marriage transitions on women’s employment trajectories. Discrete temporal hazard models and multivariate models were used in this paper to examine the dynamics of these interactions using retrospective data from labour market panel surveys in Egypt, Jordan and Tunisia. They analyse how the transition to marriage, being married, and the anticipation of marriage influence spells of non-employment

and transitions between employment sectors. Their research reveals that married women tend to shift from employment in the formal private sector to the public sector, and from the informal private sector to non-wage work. Additionally, they note that women often transition to non-employment in anticipation of marriage and following marriage, highlighting the significant impact of marital status on women's employment decisions.

Expanding on this groundwork, Ehab (2022) employed the latest wave of Egypt's data from the ELMPS-2018. This paper investigates the impact of marriage on women's transitions within the labour market, specifically focusing on the roles within public sector employment, private sector wage employment, and non-wage labour. Ehab (2022) broadens the scope of her analysis beyond previous studies by incorporating an array of job characteristics, such as commuting times, supervisory roles, and working hours. Moreover, Ehab (2022) examines the influence of women's decision-making autonomy within the household on their employment choices, assessing whether job characteristics or personal agency are more determinative. Additionally, Ehab (2022) evaluates the supportive role of other adult females within the household and their contribution to facilitating women's employment options. The findings indicate that marriage are linked to an increased likelihood of women transitioning to non-employment, and this tendency is more pronounced for women in the private sector compared to those in the public sector (Ehab, 2022).

Importantly, researchers have found that the impact of marriage on women's empowerment, including employment, is significantly shaped not merely by the act of marriage itself but by its timing, (Dahl, 2010). Early marriage—defined as marriage before the age of 18—has been identified as a crucial factor influencing women's education and employment outcomes. Studies across various contexts have demonstrated that early marriage among women leads to decreases in female literacy and educational attainment (Batyra & Pesando, 2021; Dahl, 2010; Field & Ambrus, 2008; Hicks & Hicks, 2015; Sekhri & Debnath, 2014). Batyra and Pesando (2021) investigates the impact of early marriage on women's employment and education in low- and middle-income countries (LMICs). They find waiting even a year to get married is linked to better educational results for women, including more years spent in school, lower dropout rates, and greater literacy rates. Lower levels of education associated with early marriage have further effects on employment and wages (Joshi & Schultz, 2007).

Focusing on Egypt, Kathryn M. Yount et al. (2018) examines the impact of marrying at 18 or older on women's long-term economic empowerment in Egypt. Using data from the Egypt Labour Market Panel Survey (1998–2012), they found that women who married as adults had positive associations with market work and family economic agency in 2012, even

after accounting for prior economic conditions and fertility. The findings suggest that discouraging child marriage could enhance women's long-term economic empowerment. Similarly, Assaad et al. (2022) investigate the effect of early marriage on women's employment in the Middle East and North Africa (MENA). They define early marriage according to the median age at marriage. They use data from labour market panel surveys to determine the median age for three different countries, Egypt and Jordan, and Tunisia. The median age is 22 in Egypt and Jordan, and 27 in Tunisia. They find that marriage by the median age reduces the probability of working for women by 47 percent in Jordan, 33 percent in Tunisia and 16 percent in Egypt. Much of the effect is due to a reduction in the probability of private wage work, which is reduced by 76 percent in Jordan, 57 percent in Tunisia and 40 percent in Egypt. Despite legislative changes aimed at curbing child marriage, such as Egypt's amendment of the Child Law in 2008 to raise the legal marriage age from 16 to 18, the prevalence of child marriage remains high. Approximately 29.2% of Egyptian women marry before reaching the age of 18, indicating persistent challenges in combating early marriage (Ministry of Health and Population, El-Zanaty and Associates, and ICF International, 2015).

2.3.3The Impact of Early Childbirth on Women Employment

Another challenge women in Egypt face is that after marriage women have strong pressures to prove their fertility upon marriage (Inhorn, 1996), and very few (<1%) use contraception before their first birth (El-Zanaty & Way, 2009). Consequently, fertility is concentrated in women's early reproductive years, with more than one-third of total fertility—or 1.1 births—occurring before age 25, and 10% of women having a first birth before age 20 (El-Zanaty & Way, 2009). These statistics highlight the significant issue of early childbirth among Egyptian women.

Moving to the impact of early childbirth on women employment, a report by the Population Council and Women Deliver rigorously evaluated the socioeconomic impacts associated with the timing of a mother's first birth, employing the latest DHS datasets from 43 low/middle-income countries (LMICs). The findings reveal that adolescent childbirth is linked to persistent economic disadvantages, notably reducing the likelihood of employment and participation in wage employment for women. Additionally, research conducted by Arceo-Gómez and Campos-Vazquez (2014) in Mexico found that women aged 25–64 who had given birth between ages 15 and 19 had lower educational attainment and income than their counterparts who had not given birth during adolescence. In Egypt, there is a lack of research on early childbirth, because originally women cannot have a child without marriage, making early childbirth inherently linked to early marriage. Thus, the issue begins with early marriage.

While early marriage itself impacts women's education and career paths, this impact is significantly amplified if the women have children. Therefore, the primary challenge for married women lies in childbearing. The existing literature, (Assaad et al., 2022; Batyra & Pesando, 2021; Knox, 2017; K. M. Yount et al., 2018) collectively underscore the critical importance of delaying early marriage in Egypt to enhance women's socioeconomic status. However, a significant gap remains in the literature concerning the specific relationship between the timing of childbearing and women's employment in Egypt.

The only paper examining childbirth timing in Egypt is by Samari (2017), which differs in its focus and methodology. Samari (2017) investigates how early childbearing impacts women's empowerment, including aspects such as mobility and household decision-making, without directly assessing the economic consequences. Empowerment is measured through household decision-making, mobility, and financial autonomy—factors that, while significant, do not directly capture women's employment status. Moreover, Samari (2017) analysis does not centre on the age at first birth but rather on the number of children a mother has, limiting its direct application to economic outcomes. Methodologically, Samari utilises data from the Egypt Labour Market Panel Survey (ELMPS) and applies multilevel models, including mixed-effects negative binomial regressions and ordinary least squares (OLS) models, to explore how community-level factors influence individual empowerment.

In contrast, this chapter fills this gap by focusing on the economic implications of the age at first birth on women's employment in Egypt. I use data from the 2008 and 2014 Demographic and Health Surveys (DHS) and employ a robust econometric approach. This includes Propensity Score Matching (PSM) to mitigate selection bias, followed by logistic and multinomial logistic regressions to explore different types of employment outcomes. Additionally, the Two-Stage Residual Inclusion (2SRI) method is used to address potential endogeneity, unobserved confounders and simultaneity bias. In my analysis, the "mother's age at first birth" variable is treated differently across models: as a binary variable in PSM and as a continuous variable in the logistic, multinomial, and 2SRI models. This methodological design allows for a comprehensive investigation into not only employment status but also the type of employment, including family work, wage employment, and self-employment. By directly assessing the timing of childbirth and its impact on economic participation, this chapter contributes a nuanced perspective on the socioeconomic consequences of early motherhood in Egypt. It highlights how the age at first birth can shape employment opportunities and career paths, providing critical insights for policies aimed at enhancing female labour force participation and economic empowerment.

2.4 Methodology

2.4.1 Propensity Score Matching (PSM)

When we look at the relationship between early childbirth and women's employment outcomes, there remains a concern regarding selection bias. Women who give birth early are likely to differ systematically from those who delay childbirth in terms of socio-economic status, education, and other characteristics that may simultaneously affect their employment prospects. Failing to account for these differences could result in biased estimates of the true effect of early childbirth on labour market outcomes. To address this issue, Propensity Score Matching (PSM) is employed to mitigate the selection bias inherent in non-experimental data (Rosenbaum & Rubin, 1983).

PSM is a non-parametric technique that creates a counterfactual group of individuals who did not experience early childbirth but share similar observable characteristics with those who did. This method allows for a more robust comparison by balancing the distribution of covariates between the treated and control groups, thereby reducing confounding bias (Caliendo & Kopeinig, 2008). In this chapter, the treatment group consists of women who gave birth before the age of 20, while the control group includes women who delayed childbirth.

The first step in PSM involves estimating the propensity score, which is the conditional probability of early childbirth given a set of covariates. The propensity score is estimated using a logit model:

$$P(Early\ Childbirth_{\ i} = 1|X_i) = \frac{e^{\beta_0+\beta_1 X_i}}{1+ e^{\beta_0+\beta_1 X_i}} \qquad (2.1)$$

Where:

- $P(Early\ Childbirth_{\ i} = 1|X_i)$ is the probability that individual i experienced early childbirth,
- X_i is a vector of observable covariates, including education, marital status, household size, wealth, number of children, husband characteristics, and regional factors.

Once the propensity scores are estimated, individuals from the treated group (those who experienced early childbirth) are matched with individuals from the control group (those who delayed childbirth) based on similar propensity scores. Matching techniques such as nearest neighbour matching, kernel matching, and radius matching are applied to ensure that the treated and control groups are comparable on observed characteristics. These matching algorithms are widely used in the literature to account for selection bias, as they reduce the likelihood that differences in outcomes are driven by pre-treatment characteristics (Dehejia & Wahba, 2002; Leuven & Sianesi, 2003).

To ensure the validity of the PSM estimates, it is essential to satisfy several identification assumptions. The Conditional Independence Assumption (CIA) posits that, conditional on observed covariates, early childbirth is independent of employment outcomes (Rosenbaum & Rubin, 1983). However, unobservable factors such as social norms or personal aspirations may still influence employment, limiting the causal interpretation of PSM (Heckman et al., 1998). The Common Support Condition is also addressed by visually inspecting the overlap in propensity scores between treatment and control groups (Heckman et al., 1997), while the Stable Unit Treatment Value Assumption (SUTVA) assumes no spillover effects across individuals (Rubin, 1978). For the matching algorithm, this study applies Nearest Neighbour Matching (NNM) due to its simplicity, ease of interpretation, and widespread use in applied economic evaluations (Rosenbaum & Rubin, 1983).

After matching, I estimate the Average Treatment Effect (ATE) and the Average Treatment Effect on the Treated (ATET). The ATE measures the expected difference in employment outcomes between women who gave birth early and those who delayed childbirth, while the ATET focuses on the effect of early childbirth specifically for those women who experienced it. The treatment effects are defined as follows:

$$ATE = E(y_1 - y_0) \quad (2.2)$$

$$ATET = E(y_1 - y_0 | D = 1) \quad (2.3)$$

Where:

- y_1 represents the employment outcomes (e.g., employment status or employment type) for women who gave birth early,
- y_0 represents the counterfactual employment outcomes for the same women had they delayed childbirth,
- D=1 indicates the treated group (early childbirth).

By using PSM, I attempt to control for selection on observables, thereby reducing bias in estimating the causal effect of early childbirth on labour market outcomes. The difference between the employment outcomes of the matched treated and control groups provides an unbiased estimate of the impact of early childbirth on women's employment. This method is particularly useful in addressing the non-random assignment of early childbirth in observational data and has been applied successfully in various studies to examine labour market outcomes (Heckman et al., 1997; Smith & Todd, 2005).

The matching quality is assessed by comparing the balance of covariates between the treated and control groups before and after matching. Standardized bias is calculated for each covariate, and t-test is used to verify whether the means of covariates are statistically different

between the two groups. A well-balanced sample ensures that the treatment effect is not driven by differences in covariates but by the treatment itself (Rosenbaum & Rubin, 1985). While PSM is effective in controlling for observable confounders, it is important to acknowledge its limitations. The PSM cannot account for unobserved heterogeneity, meaning that unobserved factors that influence both early childbirth and employment outcomes could still bias the results. To address this concern, Two-Stage Residual Inclusion (2SRI) is employed in subsequent analyses to control for potential endogeneity arising from unobserved factors. These methods PSM and 2SRI ensures that the estimated treatment effects are robust and reflective of causal relationships (Terza et al., 2008).

2.4.2 Logistic and Multinomial Logistic Regression

Following the PSM analysis, logistic and multinomial logistic regressions are employed to estimate the likelihood of a mother choosing to engage in the labour market. This model is expressed as follows:

$$P(y_i = 1|x_i) = \Lambda(x_i'\beta)$$

where y_i represents the probability that an individual mother i chooses to participate in employment, conditional on a set of covariates x_i. The vector β includes the coefficients for these predictors.

When examining the choice of employment sector, it is assumed that mothers who decide to work face three potential alternatives: family work, wage employment, or self-employment. To capture these alternatives, a multinomial logit model is utilised. The likelihood function for these choices is specified as:

$$f(y) = p_1^{y_1}.p_2^{y_2}.p_3^{y_3} = \Pi_{j=1}^{3} p_j^{y_i}$$

where $j = 1, \dots, J$ refers to the employment alternatives, with $j = 3$ representing the number of employment choices. The corresponding likelihood function for the model is given by:

$$L = \Pi_{i=1}^{N}\Pi_{j=1}^{3} p_{ij}^{y_{ij}} \qquad (2.4)$$

$i = 1, \dots, N$ denotes the total number of mothers in the sample, and N is the overall sample size. The analysis follows a household utility maximisation framework (Bourguignon & Browning, 1991; Gramm, 1975), assuming that mothers act rationally by selecting the employment option that maximises their utility. Specifically, mother i is expected to choose alternative j if the utility derived from that choice, U_{ij}, exceeds the utility derived from all other available alternatives $\{U_{i1}, \dots, U_{iJ}\}$. Consequently, the utility function is specified as:

$$U_{ij} = x_i'\beta_j + \epsilon_{ij} \; for \; i = 1, \dots, N \; and \; j = 1, \dots, J$$

In this specification, N is the total number of mothers in the sample, and J represents the number of employment alternatives. The latent variable U_{ij} is observed only if it exceeds the utility derived from all other options. Thus, mother i chooses alternative j if $U_{ij} > U_{is}$ for all $s \neq j$. The probability that mother i selects employment alternative j is represented as:

$$p_{ij} = P(Y_i = j) = p(max(U_{i1}, \dots, U_{ij}) = U_{ij})$$

This probability is further specified by the following equation:

$$P_{ij} = \frac{e^{x_i' \beta_j}}{\sum_{j=1}^{J} e^{x_i' \beta_j}} \qquad (2.5)$$

A key assumption underpinning the multinomial logit model is the Independence of Irrelevant Alternatives (IIA), which implies that the relative odds of choosing between any two employment types are unaffected by the inclusion or characteristics of other alternatives (McFadden, 1974). This property assumes that unobserved factors influencing one employment choice are independent of those affecting others, a condition that may not always hold in real-world settings—particularly when alternatives are similar or substitutable. For instance, if wage and self-employment are close substitutes for certain women, the IIA assumption may be violated. Violations of the IIA assumption can lead to biased and inconsistent parameter estimates (Cheng & Long, 2007). Empirical studies have shown that standard IIA tests—such as the Hausman-McFadden test and the Small-Hsiao test—often produce conflicting results and suffer from size distortions, especially in small samples or when sparse outcome categories exist (Cheng & Long, 2007). While formal testing for IIA is not undertaken in this chapter, awareness of this limitation informs the interpretation of results.

2.4.3 Two-Stage Residual Inclusion (2SRI) Approach

- ***Justification of the 2SRI Approach***

The logit and multinomial logit (mlogit) models offer valuable insights into the associations between a mother's age at first birth (mageabrth) and employment outcomes. However, these models primarily establish correlations rather than causation due to potential endogeneity issues. Addressing endogeneity is essential for ensuring that parameter estimates are consistent and unbiased. The endogeneity of "mageabrth" in this context arises from multiple sources: omitted variables, measurement error, unobserved confounders, and simultaneity bias.

One significant source of endogeneity is *omitted variables* that simultaneously influence both the age at first birth and employment outcomes. For instance, unobserved traits such as a woman's physical appearance, social skills, and family background may impact her

likelihood of marrying early, educational attainment, and subsequent employment prospects (Baizan et al., 2006). These traits, when not accounted for, introduce bias by confounding the relationship between the timing of childbirth and employment outcomes. The absence of these variables in the model means that the observed association may be influenced by factors not included in the analysis.

Endogeneity can also arise from *measurement error*, particularly in self-reported survey data. Inaccuracies in reporting the exact age at first birth or marriage can distort the true value of mageabrth, leading to biased estimates. Such errors can attenuate the relationship between childbirth timing and employment outcomes, potentially underestimating or overestimating the true effects. *Unobserved confounders* present another source of endogeneity, where factors influencing both the timing of childbirth and employment are not captured in the model. These may include socio-cultural norms, household preferences, and unmeasured personal characteristics such as ambition or extended family support. For example, women in communities with strong traditional gender roles may be more likely to marry and have children at an earlier age, consequently limiting their participation in the labour market (Baizan et al., 2006). Failure to account for these unobserved factors may result in biased parameter estimates and unreliable inferences about the effect of mageabrth on employment.

Lastly, *simultaneity bias* further complicates the analysis, as the relationship between age at first birth and employment is potentially bidirectional. While the timing of childbirth can influence a woman's likelihood of participating in the labour market, her employment status may also affect when she decides to have her first child. Duncan et al. (2018) identify reverse causality as a critical concern in such analyses, suggesting the need for instrumental variable (IV) approaches to address this issue. For instance, they utilised changes in Medicaid abortion funding restrictions as an instrument to account for endogeneity in the timing of first births. Women who are employed or pursuing job opportunities may delay childbirth to focus on their careers, highlighting the need for models that consider the simultaneous determination of these variables.

To address these issues, I adopt the Two-Stage Residual Inclusion (2SRI) method, which has been recognized as a robust solution for dealing with endogeneity in nonlinear models. Unlike traditional approaches such as Two-Stage Least Squares (2SLS), which are suited for linear models, 2SRI is specifically designed to handle nonlinear models, where endogeneity may lead to biased estimates if left uncorrected (Terza et al., 2008). The 2SRI approach effectively incorporates the residuals from the first-stage regression into the second-stage model, which allows us to control for the unobserved confounders that would otherwise

bias the estimates. The 2SRI method has been successfully applied in a variety of empirical studies, demonstrating its utility in controlling for endogeneity across a range of contexts (Başer et al., 2003; Stuart et al., 2009; Terza et al., 2008; Tesfu, 2010).

Compared to the Two-Stage Predictor Substitution (2SPS) method, the 2SRI approach is more appropriate for nonlinear models such as logit and multinomial logit. Terza et al. (2008) demonstrate that 2SPS yields biased estimates and incorrect standard errors in nonlinear settings because it fails to account for the correlation between the endogenous regressor and the unobserved error term in the second stage. By contrast, 2SRI introduces the first-stage residuals into the second-stage regression, effectively correcting for endogeneity. This adjustment allows for consistent estimation of treatment effects and asymptotically valid standard errors, particularly in models involving discrete outcomes such as employment categories (Başer et al., 2003; Terza et al., 2008; Tesfu, 2010).

In this chapter, I implement the 2SRI method to address the endogeneity of the mother's age at first birth (mageabrth), using the cluster-level average age at first birth (excluding the individual's own value) at the governorate level as an instrumental variable. This instrument captures localized reproductive norms and socio-economic conditions that shape childbirth timing but are unlikely to directly affect individual employment outcomes once covariates are controlled for (Angrist & Pischke, 2009). While exclusion restrictions cannot be tested directly, the inclusion of regional and urban-rural fixed effects helps mitigate concerns that contextual factors—such as religious norms or institutional influences—would simultaneously affect both the cluster-level instrument and individual labour market outcomes. Similar instruments have been used in fertility and labour market research (Baizan et al., 2006; Rashad & Sharaf, 2019), supporting its validity in this context. The instrument demonstrates strong relevance, confirmed by a high F-statistic in the first stage, and improves identification by controlling for unobserved confounders and simultaneity bias, thus strengthening the causal interpretation of the relationship between childbirth timing and employment trajectories (Terza et al., 2008).

- ***Stage 1: Instrumental Variable Estimation***

In the first stage of the 2SRI approach, I regress the endogenous variable mageabrth on the instrumental variable[5], which is the cluster average of age at first birth at the governorate level, along with other exogenous covariates. The first-stage equation is specified as:

[5] I attempted to use a second instrument as an indicator of social norms for the mother's age at first birth by constructing a Patriarchy Index for Egypt. This index was developed following the methodology of Gruber and Szołtysek (2016) for Europe and Singh et al. (2022) for India, incorporating five key dimensions of patriarchy: male domination, generational hierarchy, patrilocality, son preference, and socio-economic

$$\text{mageabrth}_i = \alpha_0 + \alpha_1 \, Cluster_{gov\,(rural,urban)} + \alpha_2 \, X_i + \varepsilon_i \quad (2.6)$$

Where:

- mageabrth_i is the mother age at first birth for individual i,
- $Cluster_{gov\,(rural,urban)}$ is the cluster-level average mother age at first birth at the governorates level across rural/urban classification.
- X_i is a vector of control variables, including education, marital status, household characteristics, and regional controls,
- and ε_i is the error term, capturing unobserved individual-level factors.

- ***Stage 2: Multinomial Logit with Residual Inclusion***

In the second stage, I include the residuals from the first-stage regression in the multinomial logit model, along with the endogenous variable mageabrth and other exogenous covariates. The multinomial logit model estimates the probability of selecting one of four employment outcomes: family work, wage employment, self-employment, or not employed. The second-stage model is specified as follows:

$$P(Y_i = j) = \frac{e^{\beta_{j1} magebirth_i + \beta_{j2} residuals\_magebirth_i + \beta_j X_i}}{\sum_{K=1}^{K} e^{\beta_{K1} magebirth_i + \beta_{K2} residuals\_magebirth_i + \beta_K X_i}} \quad (2.7)$$

Where:

- $P(Y_i = j)$ is the probability that individual i selects employment outcome j,
- $magebirth_i$ is the endogenous explanatory variable (mother's age at first birth),
- $residuals\_magebirth_i$ are the residuals from the first-stage regression, which correct for endogeneity,
- X_i represents the vector of control variables,
- and β_i are the estimated coefficients for each employment outcome.

This approach corrects for the bias introduced by the endogeneity of mother age at first birth, ensuring that the estimates of its effect on employment outcomes are consistent and unbiased.

- ***Marginal Effects***

Following the estimation of the multinomial logit model, I calculate the marginal effects to interpret the impact of mageabrth on the probability of each employment outcome. Marginal effects allow us to quantify how changes in mageabrth influence the likelihood of being engaged in family work, wage employment, self-employment, or being out of the labour force. For the continuous endogenous variable mageabrth, the marginal effects are calculated as:

domination. However, the instrument did not pass the validity tests for use as an instrumental variable (IV), and thus, it was not utilised in this chapter. It is worth noting that the chapter detailing the construction of the Patriarchy Index is currently under review for publication in *Australian Feminist Studies*.

$$\frac{\partial P(Y_i=j)}{\partial magebirth_i} = P(Y_i = j)(1 - P(Y_i = j))\beta_{j1} \quad (2.8)$$

Where $P(Y_i = j)$ is the predicted probability of selecting employment outcome j, and β_{j1} is the coefficient for mageabrth. The marginal effect estimates provide valuable insights into how changes in the timing of childbirth affect the probabilities of different employment outcomes. For example, the marginal effects can reveal whether delaying childbirth increases the likelihood of wage employment or decreases the likelihood of family work.

2.4.4 Data and Variables

This chapter uses the 2008 and 2014 waves of the Egypt Demographic and Health Surveys (EDHS). In the 2008 EDHS survey, 16,527 households were successfully interviewed while in the 2014 EDHS, a total 21,762 were interviewed. Drawing on this data, this chapter focuses only on mothers with at least one child under the age of five, resulting in a sample of 18, 223 mothers (7,484 mothers from the 2008 survey and 10,736 mothers from the 2014 survey). The STATA statistical software, specifically version 17, was used to extract, clean, code, and analyse the data. This was done to avoid any bias in the coefficients from the over-sampled population and to adjust the standard errors for the survey clustering effect (Deaton, 1997). Moreover, all the regression analyses have corrected for the survey design, i.e. the sampling weight, the cluster, and the strata were all considered.

- ***Measurement of Variables***

This chapter examines two aspects of maternal employment outcomes: participation in employment and employment type. For employment participation, the dependent variable is binary, set to 1 if the mother is employed and 0 otherwise. For employment type, mothers who reported working in the last 12 months were classified as follows: *family work* (unpaid work on a family farm or business), *wage employment* (paid work for someone else, including off-farm labour), or *self-employment* (running a personal business or selling goods). This approach captures both the employment decision and type of work among mothers.

The main independent variable in this chapter is the mother's age at first birth, defined differently across models to capture its impact on employment. In the Propensity Score Matching (PSM) model, mother's age at first birth is a binary variable: coded as 1 for early motherhood (birth before age 20) and 0 otherwise. This binary classification is used because matching on a continuous variable, such as each year of age, would result in too many matches, potentially reducing the precision and reliability of the estimates. It also provides an initial estimate of how early childbirth affects employment. In the logistic, multinomial logistic, and Two-Stage Residual Inclusion (2SRI) models, mother's age at first birth is treated as a

continuous variable, allowing us to examine the effect of each additional year of delay in childbirth on employment outcomes. This approach provides a more detailed view of how delayed motherhood influences employment opportunities. Using these different approaches across models improves the chapter's robustness, with the PSM addressing selection bias and the 2SRI tackling unobserved confounders and simultaneity bias. Together, they give a clearer picture of how the timing of motherhood shapes women's employment in Egypt.

The control variables in this analysis account for characteristics of the mother, household, husband, and region, each influencing women's employment outcomes in distinct ways. For the mother's characteristics, controls include age, educational level, and fertility (measured by the number of children under age five). Educational attainment is controlled for by using dummies for primary education, secondary education, and higher education. The reference category is having no education. It is expected that higher educational attainment is associated with an increase in the probability of finding a job in the labour market and having higher wages; thus, it is positively related to women employment (Kennedy & Hedley, 2003). Higher education also increases the self-esteem of women, which helps them resist the pressure of cultural patterns. Higher education also enhances women's self-esteem, which can empower them to challenge restrictive cultural norms. However, this does not imply that educated women are entirely free from the influence of these norms. As Varol (2017) notes, many women with higher education still opt not to participate in the labour market after marriage or childbirth, often due to prevailing gender expectations or social pressures within the household. In some cases, educated women may choose to prioritise domestic responsibilities or conform to their husbands' preferences, illustrating that cultural norms continue to shape women's employment decisions regardless of their educational attainment. The lifecycle stage is also controlled for, proxied by age and age squared. This is because female labour force participation varies based on whether women are in their childrearing years or approaching retirement. The impact of age on women employment is therefore ambiguous. As women age (i.e., move away from their childrearing years), participation in the labour force becomes easier. However, other problems arise as people age, such as health problems, which negatively affect employment choices. Varol (2017) found that the age of a woman has a positive impact until she reaches her mid-30s; it has negative effects after her mid-30s. The number of children under five is included because the presence of younger children restricts women from job seeking, primarily because of their role as caregivers. The presence of young children in a household is thus expected to have a negative impact on women employment (Assaad & El Hamidi, 2009).

I also control for household characteristics and husbands' characteristics, such as the number of children under age five, husbands' age, husbands' education, and husbands' occupation. The variable of the number of children under age five can be thought of as a constraint for women's mobility based on the sexual division of labour in the household. Household size might affect women's decision to work either negatively through a higher need for household care or positively through the need for more income. Husbands' characteristics, which include education, and occupation, add to account for the restrictions they might impose on women. Furthermore, to control for unobserved heterogeneity over time and across regions, I include year fixed effects (time dummies) for the survey years (2008 and 2014) and governorate fixed effects in the analysis. Year fixed effects help account for time-specific factors such as economic conditions, policy changes, or social trends that could influence women's employment decisions. Governorate fixed effects control for region-specific characteristics that remain constant over time but vary across regions, such as cultural norms, local labour market conditions, or regional policies. These fixed effects ensure the analysis accurately isolates the impact of household and individual characteristics on women's employment outcomes." The 2008 and 2014 Demographic and Health Surveys (DHS) in Egypt used a consistent framework of six major administrative regions for subnational estimates: Urban Governorates (Cairo, Alexandria, Port Said, Suez), Lower Egypt (Damietta, Dakahlia, Sharkia, Salyubia, Kafr el-Sheikh, Gharbia, Menoufia, Behera, Ismailia), Upper Egypt (Giza, Beni Suef, Fayoum, Menya, Assuit, Souhag, Qena, Aswan, Luxor), and Frontier Governorates (Red Sea, New Valley, Matrouh, North Sinai, South Sinai). Lower and Upper Egypt are further divided into urban and rural areas to capture demographic diversity. North and South Sinai were not surveyed in 2014 due to security concerns, which minimally impacted national estimates but should be considered when comparing data from previous surveys.

2.5Results

2.5.1 Descriptive Statistics

Table 2.1 presents descriptive statistics on background characteristics across employment statuses (employed vs. not employed) for Egyptian women, based on data from the 2008 and 2014 Egyptian Demographic and Health Surveys (DHS). The table reports means, standard deviations, and T-test results comparing the two groups. Employed women had a mean age at first birth of 23.13 years, while non-employed women had a mean of 20.91 years, with 2.22 significant difference. These results suggest that women who delay childbirth are more likely to be employed, highlighting the significant association between maternal age at first birth and women employment. Additionally, the data reveal that employed mothers are, on average, older than non-employed mothers. The average age of employed mothers was 36.85 years compared to 32.40 years for non-employed mothers, a significant difference of 4.45 years. These patterns suggest that older mothers may have better employment opportunities, potentially due to higher educational attainment or the ability to re-enter the workforce once their children are older. Educational attainment is another critical factor, directly addressing the second research question on whether education can mitigate the negative impact of early motherhood on employment outcomes. The data show that women with higher levels of education are significantly more likely to be employed. 32% of employed women had higher education compared to only 8% of non-employed women, a significant difference of 24 percentage points. These findings underscore the crucial role of education in enhancing employment prospects, suggesting that educational attainment can help offset some of the disadvantages associated with early motherhood.

The data highlight significant differences in employment status across urban and rural areas. Among the employed, 53% reside in urban areas and 47% in rural areas. In contrast, among the non-employed, only 39% live in urban areas, while 61% reside in rural areas. This statistically significant difference (14 percentage points) suggests that women residing in rural areas are less likely to be employed than their urban counterparts. These disparities may reflect differences in access to job opportunities, transportation, childcare services, and cultural norms across geographic contexts. Such regional gaps highlight the importance of considering place-based constraints in strategies to enhance female employment.

Table 0.1 *Descriptive Statistics (T-test across Employment Status)*

Variables	Not Employed		Employed		T-test
	Mean	SD	Mean	SD	Diff
Mothers' age at first birth	20.91	0 .05	23.13	0 .11	-2.22***
Mother's age in Years	32.40	0.09	36.85	0.17	-4.45***
Mother Education					
No education	0.34	0.01	0.20	0.01	0.14***
Incomplete primary	0.09	0.00	0.05	0.00	0.04***
Complete primary	0.04	0.00	0.02	0.00	0.02***
Incomplete secondary	0.12	0.00	0.03	0.00	0.09***
Complete secondary	0.32	0.01	0.37	0.01	-0.04***
Higher	0.08	0.00	0.32	0.01	-0.25***
Marital status					
Married	0.94	0.00	0.89	0.01	0.04***
Widowed	0.04	0.00	0.06	0.01	-0.02***
Divorced	0.02	0.00	0.04	0.00	-0.02***
Not living together	0.01	0.00	0.01	0.00	0.00
Household Head					
Male	0.92	0.00	0.88	0.01	0.04***
Female	0.08	0.00	0.12	0.01	-0.04***
Residence					
Urban	0.39	0.02	0.53	0.02	-0.14***
Rural	0.61	0.02	0.47	0.02	0.14***
Child's age					
Below 8 months	0.24	0.01	0.20	0.01	0.04**
9-17 months	0.21	0.01	0.17	0.01	0.04***
18-35 months	0.32	0.01	0.33	0.02	-0.01

Source: Authors' calculations using data from the EDHS, 2008 and 2014. Note: Summary statistics have been weighted using the sample weight provided by the EDHS.

Table 2.1 ***(****continued)*

Variables	Not Employed		Employed		T-test
	Mean	**SD**	**Mean**	**SD**	**Diff**
Number of children	2.85	0.02	2.89	0.04	-0.04
Number of children under five years	0.95	0.02	0.63	0.02	0.32***
Household Size	5.92	0.08	5.15	0.06	0.77***
Wealth Index					
Poorest	0.20	0.01	0.12	0.01	0.07***
Poorer	0.21	0.01	0.12	0.01	0.09***
Middle	0.21	0.01	0.17	0.01	0.04***
Richer	0.21	0.01	0.23	0.01	-0.02
Richest	0.17	0.01	0.36	0.02	-0.19***
Region					
Urban Governorates	0.17	0.01	0.21	0.02	-0.04***
Lower Egypt urban	0.11	0.01	0.16	0.02	-0.05***
Lower Egypt rural	0.35	0.02	0.33	0.02	0.02
Upper Egypt urban	0.10	0.01	0.15	0.02	-0.05***
Upper Egypt rural	0.26	0.01	0.14	0.01	0.12***
Frontier Governorates	0.01	0.00	0.02	0.00	0.00
Husband Education					
No education	0.23	0.01	0.14	0.01	0.09***
Primary education	0.18	0.00	0.12	0.01	0.07***
Secondary education	0.47	0.01	0.40	0.01	0.06***
Higher education	0.12	0.00	0.34	0.01	-0.22***
Husband Occupation					
Service	0.44	0.01	0.67	0.01	-0.23***
Agriculture	0.18	0.01	0.12	0.01	0.06***
Physical labour	0.38	0.01	0.21	0.01	0.17***

Source: Authors' calculations using data from the EDHS, 2008 and 2014. Note: Summary statistics have been weighted using the sample weight provided by the EDHS.

To understand the impact of maternal age at first birth on employment, it is crucial to first examine the prevalence of early motherhood within the sample. **Table 2.2** offers insight into this by documenting the proportion of women who experienced early motherhood based on data from the DHS 2008 and DHS 2014 surveys. Specifically, 14.5% of women in 2008 and 11.5% in 2014 reported having their first child before the age of 18. Additionally, a

significant percentage of women had their first child between the ages of 18 and 20, with 28.5% in 2008 and 27.7% in 2014. These findings underscore the persistence of early motherhood in Egypt and its prevalence within the survey samples.

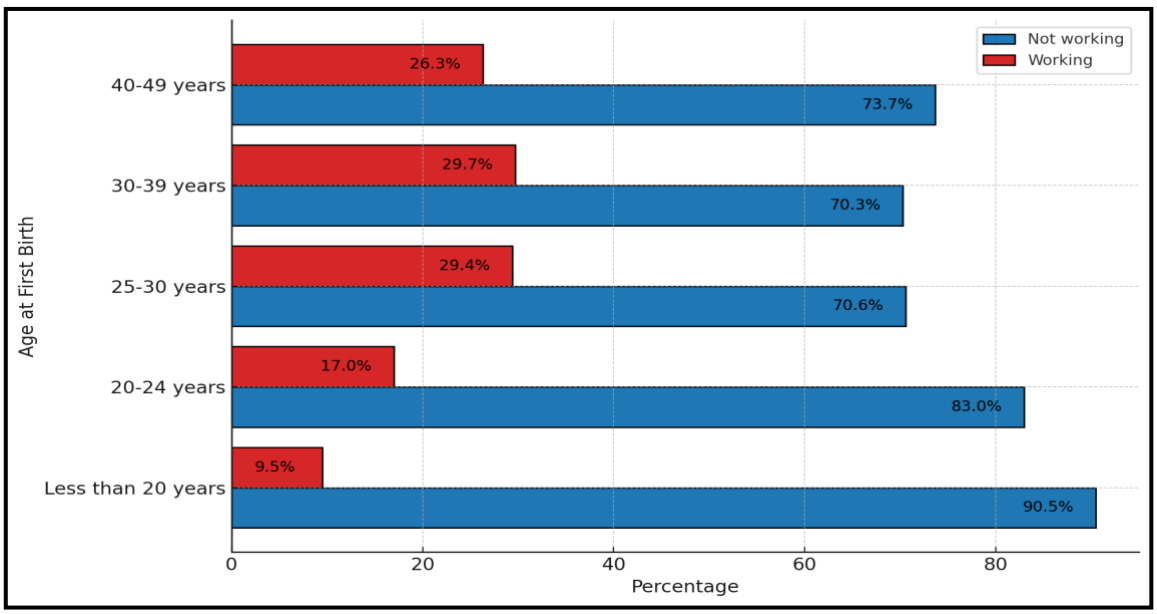
Table 0.2 *Mother Age at First Birth*

Mother Age at First Birth	Survey Year	Observation	% of Total Sample	Mean	SD	Min	Max
Under 18	2008	2,397	14.5%	15.95	1.24	11	17
	2014	2,503	11.5%	16.02	1.22	10	17
18-20	2008	4,712	28.5%	19.06	0.80	18	20
	2014	6,030	27.7%	19.08	0.80	18	20

Source: Author's own calculations based on the Demographic and Health Survey (DHS) 2008 and 2014. Note: the tabulation is weighted using the sample weight provided by the EDHS. Total sample is 16,527 for 2008 survey and 21,762 for 2014 survey.

Building on these observations, **Figure 2.6** illustrates the relationship between age at first birth and maternal employment status, revealing that nearly 90% of mothers who had their first child before the age of 20 are not employed, while only about 10% participate in the workforce. In contrast, mothers who had their first child at 25 years of age or older exhibit a more favourable employment pattern, with approximately 30% being employed. This is align with Dahl (2010) who found that in the United States a woman's likelihood of living in poverty as an older adult is 31 precent higher when she marries and have a child early in life. This could be attributed to the fact that women who become mothers at an earlier age often faced obstacles in pursuing education, which in turn affects their chances to secure employment.

Figure 0.6 *Maternal Employment and Age at First Birth*



Source: Author's own calculations based on data from EDHS 2008 and 2014.

2.5.2 Causal Inference

In addressing the causal relationship between early childbirth and women's employment outcomes in Egypt, this section begins by applying Propensity Score Matching (PSM) to mitigate selection bias and provide an initial estimation of effects. Following this, a more robust analysis is conducted using logistic, multinomial logistic, and Two-Stage Residual Inclusion (2SRI) models. This extended approach addresses issues of endogeneity, where unobserved factors may jointly influence both the timing of childbirth and employment outcomes, potentially introducing bias into the results. Additionally, it considers simultaneity, where age at first birth may both influence and be influenced by employment outcomes, thereby offering more reliable causal insights.

- ***Propensity Score Matching (PSM)***

As the first step in this causal analysis, we utilise the PSM technique[6] to estimate the impact of early childbirth on women's employment outcomes. **Table 2.3** presents a comparison of employment outcomes between women who experienced early childbirth and a matched control group who delayed childbirth, using observable socio-demographic covariates such as education, marital status, household size, wealth, number of children, husband characteristics, and regional factors to create balance between groups.

Table 0.3 *Results from Propensity Score Matching Model*

Parameters	Employed	Family Work	Wage Employment	Self-Employment
ATE	-0.0619***	-0.0013	-0.0538***	-0.0057
	(0.0089)	(0.0019)	(0.0077)	(0.0024)
ATET	-0.0272***	-0.0018	-0.0244***	-0.0029
	(0.0058)	(0.0032)	(0.0039)	(0.0031)
Observations	19,242	19,242	19,242	19,242

Source: Authors' estimation from EDHS, (2008, 2014). Note: ATE = Average Treatment Effect; ATET = Average Treatment Effect on the Treated. Standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1. observable covariates include maternal characteristics (education and age), children's characteristics (children's age) household characteristics (household headship, size, number of children, residence, region, and wealth), and husband characteristics (education and occupation).

[6] Tables 2.A1–2.A3 in the appendices assess the quality of PSM process, confirming that covariates are well-balanced between the treatment and control groups. Table A1 reports the distribution of propensity scores across both groups, showing adequate common support and balance. Table A2 further evaluates the bias reduction, with a significant decrease in covariate imbalance before and after matching, indicating that the matched sample achieves a strong balance across socio-demographic characteristics, thus enhancing the reliability of the PSM estimates. Finally, Table A3 presents summary statistics for the unmatched and matched samples, detailing measures such as Ps R^2, LR chi^2, Mean Bias, and Median Bias. The substantial reduction in bias (B = 14.4 post-matching) and the acceptable variance ratio (R = 1.34) confirm that the matching process achieved sufficient covariate balance, following the standards set by Leuven and Sianesi (2012).

The PSM results reveal that early childbirth significantly reduces overall employment likelihood, with an Average Treatment Effect (ATE) of -0.0619, indicating that early childbirth lowers the probability of employment by approximately 6.19 percentage points. Furthermore, the Average Treatment Effect on the Treated (ATET) stands at -0.0272, suggesting that women who experienced early childbirth specifically encounter a 2.72 percentage point reduction in employment probability compared to their counterparts who delayed childbearing. These findings underscore that early motherhood poses substantial barriers to labour market entry, likely due to disruptions in educational attainment and limited opportunities to accumulate work experience .

Expanding the analysis to specific employment types, PSM findings show that early childbirth has a particularly strong negative effect on wage employment. The ATE for wage employment is -0.0538, indicating a 5.38 percentage point reduction in the likelihood of participating in wage employment. This effect is further reinforced by an ATET of -0.0244, illustrating a 2.44 percentage point reduction in wage employment probability for women who had early childbirth. These results highlight the considerable challenges that early mothers face in accessing stable, formal employment, especially in roles that require higher levels of education or specific skills (Becker, 1993). The combined ATE and ATET outcomes suggest that early mothers experience consistent disadvantages in formal job markets, potentially leading to long-term economic consequences.

However, it is important to note a key limitation of the PSM approach. This method relies exclusively on observed characteristics, assuming there are no systematic differences in unobserved factors—such as personal motivation, unmeasured family support, aspirations, or prevailing gender norms—between women who had early childbirth and those who delayed it. Gender norms, in particular, are highly influential in shaping women's employment decisions and family dynamics. If such unobserved factors jointly impact both the timing of childbirth and employment outcomes, they could introduce bias into the results. While this assumption is common in PSM applications, it remains a strong one that could affect the robustness of the findings. In response to this limitation, the next section employs the Two-Stage Residual Inclusion (2SRI) method to account for potential biases from unobserved confounders, thereby aiming to provide more consistent and reliable estimates of the impact of childbirth timing on women's employment outcomes in Egypt.

- ***Regression and Causal Estimation Results (Logistic, Multinomial Logistic Regression, and 2SRI)***

Moving beyond PSM, the subsequent analysis employs logistic and multinomial logistic regressions, as presented in **Table 2.4 - *Panel A*.** Columns (2) examine the significance of age at first birth concerning overall employment outcomes, addressing the first research question. Columns (3-5) explore the second research question, assessing how early childbirth impacts different types of employment, addressing the second research question. The results highlight a strong association between the mother's age at first birth and subsequent employment outcomes, after controlling for various factors influencing maternal employment. These factors include maternal characteristics (education and age), children's characteristics (age of children), household characteristics (headship, size, number of children, residence, region, and wealth), and husband characteristics (education and occupation).

Table 0.4 *The Impact of Early Childbirth on Women's Employment*

Panel A: Logit Model & Multinominal Logit Model				
Variables	**Employed**	**Family**	**Wage**	**Self**
Mothers' age at first birth	0.10***	−0.00208	0.086***	0.014**
	(0.001)	(0.0004)	(0.0008)	(0.0006)
Controls	Yes	Yes	Yes	Yes
Governorates and Year FE	Yes	Yes	Yes	Yes
Observation	18220	18,215	18,215	18,215

Panel B: 1st Stage	
Statistic	**Value**
Coefficient	0.232***
Standard Error	(0.017)
F-statistic	647.720
R-squared	0.736

Panel C: 2SRI				
Variables	**Employed**	**Family**	**Wage**	**Self**
Mothers' age at first birth	0.0841***	-0.0223	0.0665***	0.0179
	(0.0030)	(0.0011)	(0.0024)	(0.0017)
Controls	Yes	Yes	Yes	Yes
Governorates and Year FE	Yes	Yes	Yes	Yes
Observation	18220	18,215	18,215	18,215

Note: Average Marginal Effects are reported. Standard errors are in parentheses. The sample (DHS data 2008 and 2014) includes only women aged 15–49 who have at least one child. The outcome variable is women's employment status, coded as 1 if employed and 0 otherwise. The main independent variable is the mother's age at first birth (continuous). Controls include maternal characteristics (education and age), children's characteristics (children's age) household characteristics (household headship, size, number of children, residence, region, and wealth), and husband characteristics (education and occupation). FE denotes fixed effects. Panel B showed the 1st stage regression which investigates the relationship between the instrument (cluster-level mother's age at first birth) and the endogenous variable (mother's age at first birth). The coefficient is highly significant at the 1% level (***), and the F-statistic well exceeds the conventional threshold of 10, indicating that the instrument is relevant. Panel C shows the results of the second stage of *Two-Stage Residual Inclusion (2SRI) method*, incorporating residuals from the first stage. The number of observations differs slightly between the logit and multinomial logit models due to missing values in the employment type variable. *** p<0.01, ** p<0.05, * p<0.1.

As shown in ***Panel A***, the results indicate that a one-year delay in age at first birth is associated with a 10% increase in the likelihood of employment, which is statistically significant at the 1% level. Furthermore, the multinomial logit model shows that a one-year delay in childbirth corresponds to an 8.6% higher probability of wage employment. In contrast, the association of delayed childbirth on self-employment is more modest, with a 1.4% increase for each additional year of delay, suggesting that while delayed childbirth benefits formal wage employment, its impact on entrepreneurial activities is less pronounced. Interestingly, delayed childbirth exhibits a negative association with family employment, although this relationship is not statistically significant, suggesting that factors beyond childbirth timing may play a more influential role in family work participation.

While these logistic and multinomial logit models highlight associations, they do not provide causal inference due to potential endogeneity issues. To address this, this chapter applies the Two-Stage Residual Inclusion (2SRI) method, which is particularly effective in accounting for endogeneity arising from the mother's age at first birth and its potential influence on employment outcomes. By incorporating the residuals from the first-stage regression into the multinomial logit model, the 2SRI method corrects for biases from unobserved confounders, thereby yielding more consistent estimates. The first-stage regression, as shown in **Table 2.4 - *Panel B,*** confirming the validity and strength of the instrumental variable. The instrument "cluster mother age at first birth" appears to be both reliable and relevant based on the results of the first-stage regression. To ensure exogeneity, the instrument is calculated as the average mother's age at first birth within each cluster, excluding each individual woman's own age at first birth from her cluster average. This approach reduces any direct correlation between the individual's age at first birth and the instrument, thus strengthening the validity of the relevance assumption (Rashad & Sharaf, 2019). The instrument shows a strong positive correlation with the endogenous variable (mother's age at first birth), as indicated by the statistically significant coefficient of 0.2323 with 1% significant level. Additionally, the high F-statistic of 647.72 further suggests that the instrument is not weak, meeting the conventional threshold for instrument strength. The R-squared value of 0.736 indicates that the instrument accounts for a substantial proportion of the variation in the mother's age at first birth. Since I am using only one instrument, I cannot statistically test its validity through over-identification tests like the Hansen J-test or the Sargan test, which require multiple instruments. However, from a theoretical standpoint, the instrument is likely valid, as "cluster mother age at first birth" should be exogenous to the individual-level error term, affecting the dependent variable (women employment) only

through its effect on the mother's age at first birth. Although statistical tests for validity cannot be applied in this case, the instrument's theoretical basis and strong relevance in the first stage lend confidence to its overall reliability.

The second-stage results, presented in **Table 2.4 – *Panel C***, incorporate the residuals from the first-stage regression to estimate the causal impact of delayed childbirth on overall employment and employment types. The findings causally demonstrate that delaying childbirth has a significant positive effect on both overall employment and wage employment, with a more modest effect on self-employment and no significant effect on family work. Specifically, a one-year delay in age at first birth causes an 8.41% increase in overall employment at the 1% significance level. The casual impact is particularly strong in wage employment, with a one-year delay linked to a 6.65% increase in wage employment probability. These findings suggest that women who delay childbirth are better positioned for formal employment, likely due to the opportunity to gain education and work experience before motherhood. These findings align with prior research by Spierings and Smits (2007), which suggests that delaying childbirth enhances female labour force participation. Furthermore, a report by Women Deliver and Population Council (2019) supports these results, noting that early childbirth is linked to long-term economic disadvantages, including reduced probabilities of employment and lower wage participation. Conversely, the relationship between delayed childbirth and family employment remains negative and statistically insignificant, suggesting that delayed childbirth has a limited impact on family work. This may be because early childbirth especially affects formal wage employment, where there is less flexibility to accommodate childcare demands, whereas family work, often more flexible or informal, is less impacted by the timing of motherhood. For self-employment, delayed childbirth shows a modest positive effect, with each additional year of delay causing a 1.79% increase. However, these effects are considerably smaller than those observed for wage employment, indicating that the economic benefits of delayed childbirth are more substantial in formal employment sectors than in entrepreneurial activities. A comprehensive analysis of all control variables is provided in **Table 2.A4** and **Table 2.A5** in the appendices.

2.5.3 Heterogeneity Analysis

- ***Women's Educational Level***

To explore third research question in this chapter, I analyse the interaction effects of early childbirth and educational attainment on maternal employment, using both average marginal effects (AMEs) and predictive margins. The results are presented in **Table 2.5** and **Figure 2.7**, providing complementary insights into how these factors influence employment outcomes across different years.

Table 0.5 *Heterogeneity Analysis Using Average Marginal Effects*

Model	(1)	(2)	(3)	(4)	(5)	(6)
Educational level	**No Education**			**Primary Education**		
Age at First Birth	less 20y	20-34 y	35-49 y	less 20y	20-34 y	35-49 y
Women Employed	0.001	-0.002	0.04	-0.006	0.009	0.01
	(0.02)	(0.02)	(0.11)	(0.03)	(0.032)	(0.02)
Model	(7)	(8)	(9)	(10)	(11)	(12)
Educational level	**Secondary Education**			**Higher Education**		
Age at First Birth	less 20y	20-34 y	35-49 y	less 20y	20-34 y	35-49 y
Women Employed	-0.074***	0.079***	0.275**	-0.0839***	0.0451	0.345*
	(0.011)	(0.018)	(0.109)	(0.026)	(0.0527)	(0.229)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Governorates FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18,821	18,821	18,821	18,821	18,821	18,821

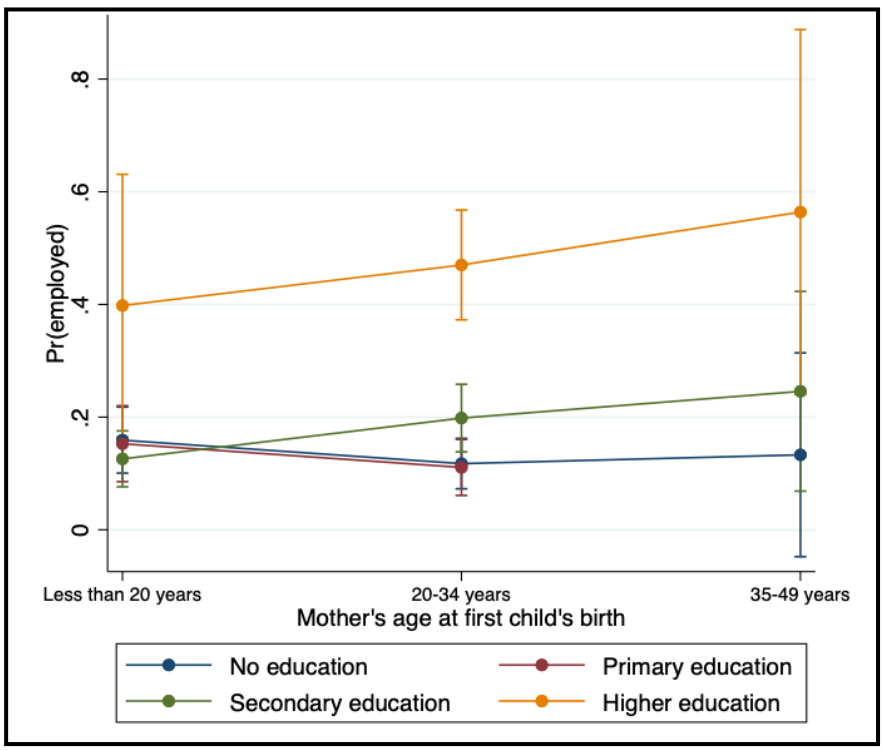
Note: Logit & Multinominal Logit Model. Average Marginal Effects are reported. Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The sample (DHS data 2008 and 2014) includes only women aged 15–49 who have at least one child. The outcome variable is women's employment status, coded as 1 if employed and 0 otherwise. The main independent variable is the mother's age at first birth. Controls include maternal characteristics (education and age), children's characteristics (children's age), household characteristics (household headship, size, number of children, residence, region, and wealth), and husband characteristics (education and occupation). FE denotes fixed effects.

Table 2.5 presents the average marginal effects, offering a detailed look at how the likelihood of employment changes based on the timing of childbirth and the mother's level of education. For women with *no education* or *primary education*, the absence of significant effects suggests that structural constraints, such as a lack of qualifications and limited access to formal employment, dominate over any potential impact of childbirth timing. Conversely, for mothers with *secondary education*, early childbirth has a markedly negative impact on employment. Specifically, women who had their first child before the age of 20 were 7.4 percentage points less likely to be employed compared to those who had children later. However, the effect of childbirth timing becomes positive for this group as the age at first birth increases. For example, having a first child between the ages of 20–34 or 35–49 is associated with an increase in employment likelihood of 7.9 and 27.5 percentage points, respectively. These results suggest that delayed motherhood allows women in this group to better navigate

both family and work commitments, enhancing their participation in the labour market. For mothers with *higher education*, the effects of childbirth timing are even more pronounced. Early childbirth (before age 20) reduces their employment likelihood by 8.4 percentage points, underscoring the substantial challenges faced by highly educated women in reconciling early motherhood with career progression. In contrast, delayed childbirth (ages 35–49) significantly increases employment probability by 34.5 percentage points. This suggests that highly educated women who postpone motherhood are better positioned to capitalise on their qualifications and establish stable careers, thereby achieving a more favourable balance between family responsibilities and labour market participation.

To complement these findings, **Figure 2.7** visually illustrates the predicted probabilities of employment based on different combinations of mother's age at first childbirth and educational attainment. The figure reveals a clear trend: higher education consistently enhances employment prospects across all age groups. Mothers with higher education who had their first child before the age of 20 had a predicted employment probability of approximately 0.3, compared to around 0.1 for those with no education. This trend continues as the mother's age at childbirth increases, with the probability reaching approximately 0.6 for those who delayed childbirth until the age of 35-49.

Figure 0.7 *Predictive Margins of Employment Probabilities*



Note: Logit & Multinominal Logit Model. The figure was created using the "marginplot" command following the logit analysis with the "asbalanced" option. This approach illustrates the interaction between Mother's Age at First Birth and Educational Level, assuming equal representation across all categories.

The differences in employment probabilities among women with higher education across different age categories are multifaceted. Firstly, women who give birth to their first child at an early age may take longer to complete their education. Consequently, when they finally graduate at an older age, their chances of finding employment may be lower compared to younger graduates. Secondly, even if women complete their education early, having a child under the age of five can significantly reduce their likelihood of being employed due to the low availability of childcare, particularly for families facing financial challenges (ERF & UNW, 2020). This often leaves many women with no other choice but to seek jobs offering flexible working conditions, which are more commonly found in the public sector7, or to turn to self-employment or family businesses (Assaad & Barsoum, 2019; Heyne & Gebel, 2016). However, the slowdown in public sector hiring has made such positions increasingly scarce (Assaad, 2014; Assaad & Barsoum, 2019; Assaad & El Hamidi, 2009; Barsoum, 2016; Nazier & Ramadan, 2016). Self-employment and family businesses, while offering flexibility, may not always provide women with stable or high-income opportunities, further compounding the economic challenges faced by early mothers. This analysis suggests that while higher education significantly enhances employment prospects, having children later in life, when women are more likely to have established careers and stable job positions, further improves these outcomes. This pattern underscores the crucial role of education in enhancing employment opportunities and mitigating some of the adverse effects of early motherhood. In conclusion, these analyses provide critical insights into how education can offset the negative impact of early childbirth on employment outcomes for Egyptian women. The distinction in numerical values between **Table 2.5** and **Figure 2.7**, resulting from the use of different estimation methods "dydx()" for AMEs and "asbalanced" for predictive margins, underscores the importance of careful interpretation[8]. This analysis supports the notion that educational policies and interventions encouraging continued education and delayed childbirth are likely to improve maternal employment outcomes in Egypt.

[7] The dataset does not include information on the type of job (public or private sector), which limits the ability to investigate this aspect further.

[8] The 'dydx()' command for calculating AMEs provides average effects across the entire sample, assuming homogeneity in marginal effects, whereas the 'asbalanced' option for predictive margins computes effects based on a balanced sample, potentially accounting for differences in sample composition. These methodological distinctions can lead to variations in coefficient magnitudes and should be considered when comparing results.

- ***Residence of Living***

Conducting a subsample analysis based on regional differences, particularly between urban and rural areas, is essential given the distinct socio-economic contexts that shape women's employment opportunities in these settings. Such an analysis allows for a more nuanced understanding of how the timing of motherhood may differentially impact employment outcomes across varying regional contexts. The heterogeneity analysis in **Table 2.6** reveals nuanced differences in how maternal age at first birth influences employment outcomes across urban and rural settings.

Specifically, the results indicate that both rural and urban regions experience similar trends regarding the impact of maternal age at first birth on employment. For example, early childbirth (before age 20) negatively affects employment in both settings, with a slightly stronger decrease in urban areas (6%) compared to rural areas (3%). However, the magnitude of this difference is relatively modest. Similarly, delayed childbirth (ages 35-49) positively influences employment outcomes in both regions, with urban areas showing a 15.8% increase and rural areas showing a 14.8% increase. While there is some variation in the effects, particularly with early childbirth being slightly more detrimental in urban areas, the overall patterns are consistent across both regions, suggesting that the timing of motherhood plays a critical role in employment outcomes irrespective of regional context.

Table 0.6 *Heterogeneity Analysis in Region*

Variables	Urban	Rural
Mothers' Age at First Birth (ref. 20 -34 years)		
Below 20 years	-0.0663***	-0.0385***
	(0.0196)	(0.0117)
35-49 years	0.158*	0.148***
	(0.0838)	(0.0528)
Controls	Yes	Yes
Governorates FE	Yes	Yes
Observations	7,180	11,036

Note: Average Marginal Effects are reported. Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The sample (DHS data 2008 and 2014) includes only women aged 15–49 who have at least one child. The outcome variable is women's employment status, coded as 1 if employed and 0 otherwise. The main independent variable is the mother's age at first birth. Controls include maternal characteristics (education and age), household characteristics (household headship, size, number of children, residence, region, and wealth), and husband characteristics (education and occupation). FE denotes fixed effects.

2.6 Discussion

The findings of this thesis provide robust empirical evidence on the significant impact of childbirth timing on women's employment outcomes in Egypt, demonstrating that early motherhood poses substantial barriers to labour market participation, particularly in formal wage employment. Using Propensity Score Matching (PSM) and the Two-Stage Residual Inclusion (2SRI) method, this chapter addresses endogeneity concerns, offering a comprehensive view of how early and delayed childbirth affect women's employment. The results suggest that early motherhood significantly decreases employment prospects, while delayed childbirth enhances women's labour market engagement, with educational attainment further amplifying these effects.

The analysis aligns closely with Becker's (1973, 1974) theory of the marriage, which argues that individuals within households tend to specialize based on comparative advantage. In the Egyptian context, this often manifests as a gendered division of labour, with men primarily engaged in market work and women assuming domestic responsibilities, especially after childbirth (Assaad et al., 2022). Early motherhood intensifies this specialization by disrupting women's educational attainment and skill development, reinforcing a "motherhood penalty" that limits career progression and access to formal wage employment. The PSM results underscore this penalty, showing that women who had their first child before age 20 are 2.72 percentage points less likely to be employed compared to those who delayed childbirth, with a pronounced effect in wage employment. This finding supports Becker's framework and highlights the long-term economic disadvantages associated with early motherhood. Life course theory, by Giele & Elder (1998), further contextualizes these findings by suggesting that the timing of key life events, such as childbirth, can disrupt normative career trajectories. In societies like Egypt, where early marriage and childbearing are common, early motherhood can lead to lasting economic setbacks. The findings of this chapter (2SRI) reinforce this notion, indicating that delaying childbirth by one year is associated with an 8.41% increase in overall employment likelihood and a 6.65% increase in wage employment. These results underscore the socio-economic benefits of delayed childbirth, allowing women to acquire more education and work experience before taking on motherhood responsibilities, thus enhancing their economic stability.

The role of education emerges as a critical factor in moderating the impact of early motherhood on employment. Higher educational attainment substantially increases employment prospects, particularly in wage employment, as corroborated by previous studies (Assaad et al., 2022; Ehab, 2022; Hendy, 2020). However, the findings reveal that education

alone does not fully offset the challenges of early motherhood. Even among women with secondary or higher education, those who became mothers before age 20 face diminished employment prospects relative to those who delayed childbirth. This underscores that structural barriers—such as limited access to childcare and entrenched societal norms regarding women's roles—continue to hinder labour market participation, even for educated women (Hoodfar, 1997; Varol, 2017). These results suggest that while education is essential, complementary structural supports are necessary to fully address the employment barriers faced by early mothers.

The heterogeneity analysis, which categorizes "mother's age at first birth" as a categorical variable (under 20 years, 20–34 years, and 35 years or older), reveals important variations in the effects of childbirth timing by educational attainment. The findings show that early childbirth has a significant negative effect on employment for mothers with lower education levels. For example, mothers with secondary education who gave birth before age 20 are 7.4 percentage points less likely to be employed compared to those who delayed childbirth. In contrast, delayed childbirth confers substantial employment advantages for highly educated women, with those having their first child at age 35 or older experiencing a 34.5 percentage point increase in employment likelihood. These results illustrate that educational attainment can partially mitigate the disadvantages of early motherhood, particularly in contexts where women are able to delay childbirth until after their educational pursuits. Regional differences further contextualize the employment impacts of early motherhood, with urban and rural areas exhibiting similar trends, albeit with slight variations in effect size. The analysis finds that early motherhood negatively impacts employment in both settings, with a 6% reduction in employment probability in urban areas compared to 3% in rural areas. Delayed motherhood, however, has a positive effect on employment in both regions, with a 15.8% increase in urban areas. These results suggest that, while early motherhood presents employment challenges across the country, the benefits of delayed childbirth are more pronounced in urban labour markets where formal employment opportunities are more readily available. This finding aligns with previous research (Selwaness & Krafft, 2021) and underscores the need for region-specific interventions to support early mothers.

These findings carry significant implications for policymakers aiming to enhance female labour force participation in Egypt. The negative impact of early motherhood on employment highlights the importance of policies promoting delayed childbirth through access to family planning and educational initiatives. As Batyra and Pesando (2021) argue, delaying

marriage and childbirth can improve educational attainment and enhance women's socio-economic status. This chapter supports this argument, showing that delayed childbirth significantly improves employment opportunities, particularly in formal wage employment. Furthermore, while education remains a key factor, existing research highlights the importance of complementary structural supports—such as affordable childcare and flexible work arrangements—in enabling women to balance family responsibilities with employment, especially in contexts where traditional gender norms prevail (Assaad & Barsoum, 2019; Hoodfar, 1997). Although the impact of such interventions varies, recent experimental and policy studies from Egypt provide important insights. For example, Caria et al. (2022) evaluated the effect of childcare subsidies and employment services on women's labour market outcomes. While the uptake of services was limited and no significant employment effects were observed, follow-up analyses emphasized that barriers such as concerns about safety, childcare quality, proximity, and entrenched gender norms played a key role in limiting effectiveness (Halim et al., 2023; Krafft & Li, 2024). These findings suggest that childcare interventions must be both multifaceted and sensitive to social norms to improve women's economic participation in the MENA region. Persistent gender norms position women as primary caregivers, restricting their economic participation post-childbirth (Assaad et al., 2022; Krafft & Assaad, 2020). The findings of this chapter shows that early motherhood leads to reduced employment probabilities for urban and rural women alike indicates that these norms remain entrenched across geographic contexts. Addressing these cultural constraints is essential for fostering gender equality in Egypt's labour market.

While this chapter provides valuable insights, it is important to note certain limitations. Firstly, the analysis primarily focuses on formal employment, omitting the informal labour market, which constitutes a significant portion of Egypt's employment landscape. Expanding the analysis to include informal employment would offer a more comprehensive understanding of the economic impacts of early motherhood. Additionally, future research could explore longitudinal data to examine how the effects of early motherhood evolve over time, providing insights into long-term labour market outcomes. Overall, this chapter underscores the importance of promoting delayed motherhood, expanding educational opportunities, and establishing structural supports for working mothers to enhance gender equality in Egypt's labour market

2.7 Conclusion

This chapter examines the impact of early childbirth on women's employment outcomes in Egypt, with a focus on variations across employment types and the moderating role of education. Using data from the 2008 and 2014 Egypt Demographic and Health Surveys (DHS), the analysis employs multiple econometric methods, including Propensity Score Matching (PSM), logistic and multinomial logistic regressions, and the Two-Stage Residual Inclusion (2SRI) method, to addresses concerns of endogeneity; selection bias and unobserved confounders. The results consistently show that early childbirth adversely affects women's employment outcomes, particularly in formal wage employment. Delaying motherhood yields significant benefits, with the 2SRI estimates indicating an 8.41% increase in overall employment likelihood per year of delay. These effects are further influenced by educational attainment and regional context: women with higher education levels and those in urban areas derive the greatest advantages from delayed childbirth, while early motherhood disproportionately impacts less-educated women and those in rural areas. The findings underscore the importance of policies that promote delayed motherhood, such as improving access to education and reproductive health services, to enhance women's economic participation. Targeted interventions are also essential to support early mothers, particularly those with limited education or restricted access to formal employment opportunities. This chapter provides valuable insights for policymakers in Egypt and contributes to a broader understanding of how childbirth timing shapes women's labour market outcomes in low- and middle-income countries.

Appendices

Table 2.A1 *Propensity Scores and Summary of Matching Assessment for Early Childbirth*

Propensity Score	Non-Early Childbirth	Early Childbirth	Total
0	5,685	125	5,730
0.05	1,567	113	1,680
0.1	1,017	122	1,139
0.15	844	150	994
0.2	570	157	727
0.25	580	168	748
0.3	461	169	630
0.35	352	187	539
0.4	371	230	601
0.45	297	223	520
0.5	239	273	512
0.55	192	355	547
0.6	183	358	541
0.65	120	352	472
0.7	101	379	480
0.75	79	433	512
0.8	63	416	479
0.85	46	541	587
0.9	59	601	660
0.95	61	662	723
Total	12,807	6,014	18,821

Source: Authors' estimation from EDHS, (2008, 2014).

Table 2.A2 *Propensity Matching and Bias Level - Further Assessment*

Variable	Unmatched/ Matched	Mean Treated	Mean Control	% Bias	% Reduct Bias	t-test	p > t
1. education	U	0.08198	0.04295	16.2	-	10.95	0.000
	M	0.08198	0.10376	-9.0	44.2	-4.12	0.000
2. education	U	0.05321	0.02928	12.1	-	8.13	0.000
	M	0.05321	0.06285	-4.9	59.7	-2.26	0.024
3. education	U	0.21433	0.09721	32.7	-	22.24	0.000
	M	0.21433	0.1859	7.9	75.7	3.90	0.000
4. education	U	0.32142	0.45795	-28.3	-	-17.88	0.000
	M	0.32142	0.28949	6.6	76.6	3.80	0.000
5. education	U	0.01463	0.21309	-65.8	-	-36.85	0.000
	M	0.01463	0.01031	1.4	97.8	2.14	0.033
mage	U	26.564	29.918	-57.1	-	-37.34	0.000
	M	26.564	30.739	-71.1	-24.5	-33.67	0.000
mage2	U	744.31	925.43	-50.9	-	-32.74	0.000
	M	744.31	998.65	-71.4	-40.4	-32.82	0.000
3. marital	U	0.00765	0.00586	2.2	-	1.43	0.151
	M	0.00765	0.00599	2.0	7.2	1.11	0.268
4. marital	U	0.00449	0.00703	-3.4	-	-2.07	0.039
	M	0.00449	0.00632	-2.4	27.9	-1.37	0.171
5. marital	U	0.00349	0.00453	-1.6	-	-1.03	0.305
	M	0.00349	0.00466	-1.8	-12.3	-1.00	0.316
2.hh_head	U	0.04523	0.04997	-2.2	-	-1.41	0.158
	M	0.04523	0.04556	-0.2	93.0	-0.09	0.930
1. residence	U	0.26804	0.46225	-41.2	-	-25.80	0.000
	M	0.26804	0.27187	-0.8	98.0	-0.47	0.637
nofchildren	U	3.1869	2.4822	42.9	-	29.01	0.000
	M	3.1869	4.3874	-73.1	-70.4	-29.30	0.000
nofchildu5	U	1.6653	1.5211	15.6	-	10.28	0.000
	M	1.6653	1.6691	-0.4	97.3	-0.21	0.836
1. childage	U	0.22032	0.22464	-1.0	-	-0.66	0.507
	M	0.22032	0.19338	6.5	-523.0	3.65	0.000
2. childage	U	0.20785	0.20879	-0.2	-	-0.15	0.882
	M	0.20785	0.17193	8.8	-3705.8	5.03	0.000
4. childage	U	0.24376	0.24518	-0.3	-	-0.21	0.833
	M	0.24376	0.3161	-16.8	-5015.8	-8.86	0.000
hhsize	U	6.3259	5.4177	29.1	-	19.32	0.000
	M	6.3259	7.2747	-30.4	-4.5	-13.75	0.000

Source: Authors' estimation from EDHS, (2008, 2014). Note: The treated group remains unchanged before and after matching; therefore, the Mean Treated values are identical in the unmatched and matched samples.

Table 2.A2 *(continued)*

Variable	Unmatched/ Matched	Mean Treated	Mean Control	% Bias	% Reduct Bias	t-test	p > t
2. wealth	U	0.2426	0.1685	18.4	-	12.08	0.000
	M	0.2426	0.26521	-5.6	69.5	-2.85	0.004
3. wealth	U	0.21633	0.19934	4.2	-	2.69	0.007
	M	0.21633	0.20818	2.0	52.0	1.09	0.275
4. wealth	U	0.16096	0.22105	-15.3	-	-9.60	0.000
	M	0.16096	0.13651	6.2	59.3	3.77	0.000
5. wealth	U	0.08497	0.2629	-48.3	-	-28.75	0.000
	M	0.08497	0.06169	6.3	86.9	4.90	0.000
2. region	U	0.05554	0.11689	-22.0	-	-13.31	0.000
	M	0.05554	0.04473	3.9	82.4	2.72	0.007
3. region	U	0.27004	0.28211	-2.7	-	-1.72	0.085
	M	0.27004	0.24559	5.5	-102.4	3.07	0.002
5. region	U	0.09894	0.13048	-9.9	-	-6.21	0.000
	M	0.09894	0.11989	-6.6	33.6	-3.68	0.000
6. region	U	0.43349	0.23698	42.6	-	28.00	0.000
	M	0.43349	0.45427	-4.5	89.4	-2.29	0.022
7. region	U	0.05969	0.06145	-0.7	-	-0.47	0.638
	M	0.05969	0.06119	-0.6	14.8	-0.34	0.731
2. husoccgroup	U	0.20635	0.11416	25.3	-	16.94	0.000
	M	0.20635	0.22963	-6.4	74.8	-3.09	0.002
3. husoccgroup	U	0.45594	0.39229	12.9	-	8.29	0.000
	M	0.45594	0.41985	7.3	43.3	3.99	0.000
1. husedu	U	0.17659	0.12329	15.0	-	9.84	0.000
	M	0.17659	0.19754	-5.9	60.7	-2.95	0.003
2. husedu	U	0.55753	0.55157	1.2	-	0.77	0.443
	M	0.55753	0.5123	9.1	-659.0	4.98	0.000
3. husedu	U	0.06485	0.21223	-43.7	-	-25.84	0.000
	M	0.06485	0.05969	1.5	96.5	1.17	0.242

Source: Authors' estimation from EDHS, (2008, 2014). Note: The treated group remains unchanged before and after matching; therefore, the Mean Treated values are identical in the unmatched and matched samples.

Table 2.A3 -*Propensity Scores and Summary Result of Matching Assessment*

Sample	Ps R^2	LR chi^2	p > chi^2	MeanBias	MedBias	B	R	% var
Unmatched	0.135	3105.59	0.000	17.8	12.4	92.7*	0.39*	100
Matched	0.004	61.10	0.000	2.1	1.2	14.4	1.34	50

Source: Authors' estimation from EDHS, (2008, 2014). Note: this table presents the unmatched sample statistics before propensity score matching (PSM) and the matched sample statistics after applying PSM. Ps R^2 shows the proportion of variance explained by the propensity score model, while LR chi^2 and p > chi^2 indicate model fit and significance. MeanBias and MedBias measure covariate imbalance, with B showing the bias reduction achieved through matching. R represents the variance ratio between treated and control groups, and % var reflects the percentage of variance explained by the matching process.

Table 2.A4. *The Impact of Delaying Childbirth on Women's Employment*

Variables	Logit Model	Multinominal Logit Model		
	Employed	Family	Wage	Self
Mothers' age at first birth	0.10***	−0.00208	0.086***	0.014**
	(0.001)	(0.0004)	(0.0008)	(0.0006)
Mother age (in years)	0.037***	0.00405**	0.0250***	0.00712**
	(0.0065)	(0.00200)	(0.00571)	(0.00328)
Mother age squared	-0.0004***	-6.61e-05**	-0.000264***	-8.61e-05*
	(9.96e-05)	(3.19e-05)	(8.76e-05)	(5.08e-05)
Mother Education (ref. No education)				
Incomplete primary	0.0136	0.00429	0.0226*	-0.0102
	(0.0149)	(0.00547)	(0.0131)	(0.00734)
Complete primary	-0.00620	-0.00579	-0.00895	0.00899
	(0.0202)	(0.00602)	(0.0117)	(0.0150)
Incomplete secondary	-0.0176	0.00139	-0.00726	-0.0111
	(0.0119)	(0.00584)	(0.00803)	(0.00686)
Complete secondary	0.0505***	-0.00116	0.0539***	-0.00240
	(0.0108)	(0.00453)	(0.00814)	(0.00656)
Higher	0.270***	-0.00552	0.217***	0.0375***
	(0.0244)	(0.00530)	(0.0207)	(0.0142)
Marital status (ref. Married)				
Widowed	0.0332	0.0122	-0.00315	0.0255
	(0.0593)	(0.0312)	(0.0429)	(0.0391)
Divorced	0.0933	-0.0127***	0.0251	0.0906*
	(0.0607)	(0.00156)	(0.0416)	(0.0547)
Not living together	0.0175	-0.0127***	-0.000554	0.0386
	(0.0783)	(0.00156)	(0.0679)	(0.0646)
	(0.0191)	(0.0149)	(0.0161)	(0.00718)
Household head (Female)	-0.00946	-0.00270	0.00648	-0.00983
	(0.0200)	(0.00695)	(0.0184)	(0.00906)
Urban	0.0892	-0.00278	0.0469	0.0289
	(0.0553)	(0.0124)	(0.0373)	(0.0364)
Child's age (ref. 18-35m)				
Below 8 months	-0.0199*	0.00301	-0.0179*	-0.00415
	(0.0109)	(0.00442)	(0.00916)	(0.00519)
9-17 months	-0.0229**	-0.00533	-0.0264***	0.00900
	(0.0107)	(0.00335)	(0.00883)	(0.00609)
36-59 months	0.0271**	-0.000687	0.0159*	0.0125**
	(0.0111)	(0.0104)	(0.00350)	(0.00940)

Note: Average Marginal effects are reported. Standard errors in parentheses *** p<0.01, ** p<0.05, * p

Table 2.A4. *(Continued)*

Variables	Logit Model Employed	Multinominal Logit Model Family	Wage	Self
Number of children	0.0235***	0.00217***	0.0136***	0.00780***
	(0.00259)	(0.000630)	(0.00240)	(0.00130)
Number of children <5y	-0.0133**	-0.0023	-0.0081	-0.0029
	(0.0064)	(0.00146)	(0.0057)	(0.0034)
Household Size	-0.00377	0.0010*	-0.00324	-0.00222
	(0.00174)	(0.000357)	(0.00162)	(0.000936)
Wealth (ref. Poorest)				
Poorer	0.00442	-0.00811	0.0306**	-0.00417
	(0.0165)	(0.00541)	(0.0138)	(0.00958)
Middle	-0.0121	-0.0101	0.0196	-0.00687
	(0.0174)	(0.00626)	(0.0141)	(0.00908)
Richer	-0.0280	-0.0157***	0.00923	-0.00686
	(0.0181)	(0.00564)	(0.0146)	(0.0103)
Richest	0.00281	-0.0121*	0.0292*	-0.00403
	(0.0208)	(0.00692)	(0.0167)	(0.0120)
Region ***(ref. Urban governorates)***				
Lower Egypt urban	0.0186	-0.000656	-0.00666	0.0246**
	(0.0124)	(0.00567)	(0.0112)	(0.00992)
Lower Egypt rural	0.110**	0.0223*	0.0336	0.0450*
	(0.0461)	(0.0126)	(0.0363)	(0.0260)
Upper Egypt urban	0.0144	0.00321	-0.00155	0.0162**
	(0.0119)	(0.00672)	(0.0106)	(0.00719)
Upper Egypt rural	0.0601	0.00134	0.0189	0.0373
	(0.0416)	(0.00780)	(0.0341)	(0.0229)
Frontier governorates	0.0591**	0.00212	0.0385	0.0224**
	(0.0237)	(0.00689)	(0.0243)	(0.00961)
Husband Education (ref. No education)				
Primary education	0.0269	0.00425	0.0235	-0.00161
	(0.0162)	(0.00433)	(0.0152)	(0.00790)
Secondary education	0.0121	0.00164	0.0217*	-0.000242
	(0.0140)	(0.00384)	(0.0123)	(0.00731)
Higher education	0.0265	-0.00254	0.0398**	-0.00159
	(0.0183)	(0.00573)	(0.0156)	(0.00985)
Husband Occupation (ref. Service)				
Agriculture	0.0176	0.0140***	-0.0119	-0.00214
	(0.0145)	(0.00516)	(0.0131)	(0.00637)
Physical labour	-0.0183*	-0.00132	-0.0190**	-0.000849
	(0.00982)	(0.00320)	(0.00843)	(0.00538)
observation	18,828	18,595	18,595	18,595

Note: Average Marginal effects are reported. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0

Table 2.A5 *The Impact of Early Childbirth on Women's Employment- Two-Stage Residual Inclusion (2SRI) Method.*

	Employed	Family	Wage	Self
Mothers' age at first birth	0.0841***	-0.0223	0.0665***	-0.0179
	(0.00300)	(0.00114)	(0.00240)	(0.00171)
Mother Education (ref. No education)				
Incomplete primary	-0.000389	0.00216	0.0124	-0.0121**
	(0.0119)	(0.00459)	(0.00946)	(0.00587)
Complete primary	-0.0151	-0.00622	-0.00539	-0.00269
	(0.0163)	(0.00465)	(0.0114)	(0.0101)
Incomplete secondary	-0.0227**	-0.00215	-0.00851	-0.0109*
	(0.0103)	(0.00404)	(0.00695)	(0.00597)
Complete secondary	0.0589***	0.000873	0.0605***	0.00165
	(0.0123)	(0.00474)	(0.00896)	(0.00712)
Higher	0.292***	0.0207	0.196***	0.0727**
	(0.0390)	(0.0220)	(0.0325)	(0.0321)
Mother age (in years)	0.0470***	0.00784	0.0272**	0.0182**
	(0.0131)	(0.00503)	(0.0107)	(0.00752)
Mother age squared	-0.000496***	-6.94e-05*	-0.000322***	-0.000151**
	(0.000108)	(3.83e-05)	(9.30e-05)	(5.94e-05)
Marital status (ref. Married)				
Widowed	0.0361	0.00390	0.0118	0.0149
	(0.0514)	(0.0175)	(0.0438)	(0.0288)
Divorced	0.157**	-0.0125***	0.0799*	0.0782
	(0.0619)	(0.00126)	(0.0459)	(0.0509)
Not living together	0.129*	0.0276	0.00311	0.0990
	(0.0776)	(0.0382)	(0.0542)	(0.0675)
Household head (Female)	0.00547	-0.000850	0.0148	-0.00552
	(0.0172)	(0.00572)	(0.0150)	(0.00863)
Urban	0.0664*	-0.00506	0.0270	0.0254
	(0.0394)	(0.0113)	(0.0316)	(0.0274)
Child's age (ref. 18-35m)				
Below 8 months	0.0108	0.0121	-0.00347	0.0110
	(0.0169)	(0.0111)	(0.0130)	(0.0117)
9-17 months	0.00150	0.000517	-0.0123	0.0185*
	(0.0134)	(0.00526)	(0.0103)	(0.0103)
36-59 months	-0.00216	-0.00394	0.00375	-0.00529
	(0.0143)	(0.00424)	(0.0123)	(0.00679)

Table 2.A5. (*Continued)*

	Employed	Family	Wage	Self
Number of children	-0.0206	-0.00839	-0.00511	-0.0185
	(0.0242)	(0.00941)	(0.0195)	(0.0140)
Number of children <5y	-0.00159	0.00141	-0.00213	0.00168
	(0.00759)	(0.00263)	(0.00629)	(0.00437)
Household Size	-0.00358**	0.000116	-0.00288*	-0.00172*
	(0.00164)	(0.000455)	(0.00149)	(0.000946)
Wealth (ref. Poorest)				
Poorer	-0.00276	-0.00913*	0.0202	-0.00442
	(0.0144)	(0.00510)	(0.0135)	(0.00744)
Middle	-0.0142	-0.0120**	0.0121	-0.00589
	(0.0156)	(0.00565)	(0.0138)	(0.00833)
Richer	-0.0276*	-0.0164***	0.00433	-0.00880
	(0.0165)	(0.00572)	(0.0142)	(0.00899)
Richest	-0.00781	-0.0118	0.0114	-0.00256
	(0.0188)	(0.00747)	(0.0155)	(0.0107)
Region *(ref. Urban governorates)*				
Lower Egypt urban	0.00875	-0.00696	-0.00932	0.0207***
	(0.0108)	(0.00977)	(0.00930)	(0.00714)
Lower Egypt rural	0.0887***	0.0121	0.0208	0.0415**
	(0.0338)	(0.0169)	(0.0311)	(0.0198)
Upper Egypt urban	0.0215**	-0.000416	0.00603	0.0179***
	(0.0107)	(0.00726)	(0.00927)	(0.00637)
Upper Egypt rural	0.0703**	-0.00317	0.0235	0.0413**
	(0.0322)	(0.0138)	(0.0313)	(0.0193)
Frontier governorates	0.0583***	-0.00295	0.0378**	0.0249***
	(0.0166)	(0.0117)	(0.0151)	(0.00863)
Husband Occupation (ref. Service)				
Agriculture	0.0276**	0.0139***	-0.000377	0.000830
	(0.0139)	(0.00453)	(0.0127)	(0.00672)
Physical labour	-0.0178*	-0.00110	-0.0168**	0.000845
	(0.00909)	(0.00267)	(0.00768)	(0.00525)
Husband Education (ref. No education)				
Primary education	0.0203	0.00251	0.0158	0.000796
	(0.0147)	(0.00362)	(0.0151)	(0.00727)
Secondary education	0.00896	0.00370	0.00477	-5.40e-05
	(0.0134)	(0.00358)	(0.0134)	(0.00688)
Higher education	0.0179	-0.000421	0.0133	0.000412
	(0.0171)	(0.00565)	(0.0156)	(0.00926)
Observations	18,455	18,266	18,266	18,266

Table 2.A6 *The Impact of Early **Marriage** on Women's Employment*

VARIABLES	2SRI Model
Mothers' Age at First Marriage (continuous)	0.102
	(0.0338)
Controls	yes
Governorates and Year FE	yes
Observations	18,220

Note: 2SRI method. Average Marginal Effects are reported. Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The sample (DHS data 2008 and 2014) includes only women aged 15–49 who have at least one child. The outcome variable is women's employment status, coded as 1 if employed and 0 otherwise. The main independent variable is the mother's age at first marriage in a continuous form. Controls include maternal characteristics (education and age), household characteristics (household headship, size, number of children, residence, region, and wealth), and husband characteristics (education and occupation). FE denotes fixed effects.

Table 2.A7 *Correlation Matrix between Mother's Age at First Marriage and Mother's Age at First Birth*

Variable	magemarried	mageabrth
magemarried (Mother's age at first marriage)	1.000	0.894
mageabrth (Mother's age at first birth)	0.894	1.000
	(0.000)	

Note: Correlation matrix between mother's age at first marriage (magemarried) and mother's age at first birth (mageabrth). The high correlation (0.89) suggests strong collinearity, justifying the exclusion of one variable in the main regression.

Table 2.A8 *The Impact of Early **Childbirth** on Women's Employment using Linear probability model (LPM)*

VARIABLES	LPM Model
Mothers' Age at First Birth (continuous)	0.0700***
	(0.000675)
Controls	yes
Governorates and Year FE	yes
Observations	18,220
R-squared	0.110

Note: Linear probability model (LPM). Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The sample (DHS data 2008 and 2014) includes only women aged 15–49 who have at least one child. The outcome variable is women's employment status, coded as 1 if employed and 0 otherwise. The main independent variable is the mother's age at first birth in a continuous form. Controls include maternal characteristics (education and age), household characteristics (household headship, size, number of children, residence, region, and wealth), and husband characteristics (education and occupation). FE denotes fixed effects.

Chapter 3

Maternal Employment and Child Health Outcomes in Egypt

Abstract

This chapter explores how maternal employment affects child health outcomes in Egypt, focusing on the differences across types of jobs and child age groups. While existing studies offer insights into this relationship, they often overlook how the type of work and the age of the child might shape the effects, leaving a gap in understanding. Using data from Egypt's Demographic and Health Surveys (DHS) from 2005, 2008, and 2014, this chapter applies an instrumental variable (IV) approach to capture the impact of maternal employment on key child health indicators: stunting, wasting, underweight, and overweight. The results show that overall, maternal employment is linked to a 12.6% increase in stunting, indicating potential long-term health impacts. For mothers in service jobs, employment appears to reduce stunting but is associated with a higher risk of wasting, suggesting that while income benefits may improve chronic nutrition, caregiving demands may challenge short-term nutrition. Physical labour, however, does not show significant associations with any of the health outcomes. Additionally, younger children, particularly those under two years, are more affected by maternal employment, especially regarding wasting, compared to older children. These findings underline the need for policies that consider the specific challenges of different job types and the varying needs of children at different ages to better support working mothers and improve child health outcomes.

Keywords: *Maternal employment, Child Malnutrition, Instrumental variable, Demographic and Health Survey (DHS), Egypt*

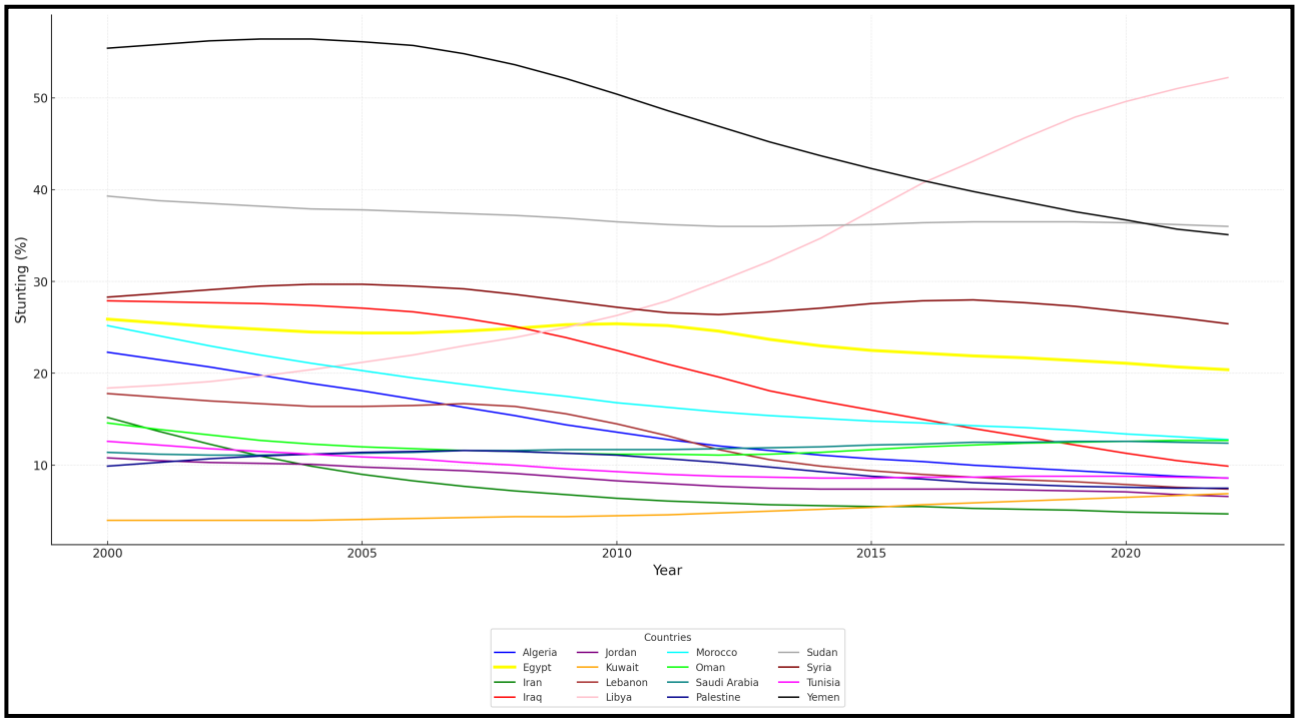
3.1 Introduction

Child health is a critical indicator of a nation's overall health and development. Malnutrition in early childhood can have lasting effects on physical and cognitive development, impacting educational outcomes and economic productivity later in life (Grantham-McGregor et al., 2007; Victora et al., 2008). Poor nutrition during the first few years of life can lead to stunted growth, impaired cognitive function, and increased susceptibility to diseases. These adverse effects not only limit the potential of individuals but also hinder the socio-economic development of entire communities and countries (Black et al., 2013). Furthermore, structural and socio-economic constraints, including household income, caregiving practices, and healthcare access, play a crucial role in shaping child health outcomes (Lufumpa et al., 2021). In the context of Egypt, understanding the factors that influence child health is essential for developing effective interventions and policies. The country's socio-economic landscape presents unique challenges and opportunities for improving child health outcomes. Despite some progress in recent years, Egypt continues to face significant issues related to child malnutrition, particularly stunting, wasting, and overweight (UNICEF, 2020). Addressing these issues requires a comprehensive understanding of the various determinants of child health, including maternal employment, household income, access to healthcare, and dietary practices (WHO, 2020).

Figure 3.1 illustrates the trends in stunting rates across various countries in the Middle East and North Africa (MENA) region from 2000 to 2022. Stunting, defined as low height for age, is a crucial indicator of chronic malnutrition and long-term health outcomes in children. The figure highlights Egypt in yellow to emphasise its specific trend within the broader regional context. Egypt's stunting rates show a modest decline over the period, indicating some progress in addressing chronic malnutrition. However, when compared to other countries in the region, Egypt's stunting rates remain relatively high, similar to countries like Iraq and Syria. Additionally, countries such as Libya and Yemen exhibit the highest stunting rates, with Libya showing a dramatic increase over the years, while Yemen experiences a notable decline. On the other hand, Gulf countries like Kuwait, Bahrain, and Qatar consistently maintain the lowest stunting rates, reflecting better nutritional outcomes and possibly more effective health policies. **Figure 3.2** provides a detailed look at the prevalence rates of stunting, wasting, underweight, and overweight in children under the age of 5 in Egypt over the period from 2005 to 2014 using the Demographic and Health Survey (DHS). The data indicate significant fluctuations in these nutritional indicators.

Stunting, which represents chronic malnutrition, increased from 22.8% in 2005 to 28.8% in 2008, followed by a decrease to 21.4% in 2014. Wasting, an indicator of acute malnutrition, rose from 4.8% in 2005 to 7.4% in 2008 and then to 8.5% in 2014. The prevalence of underweight children also showed variability, starting at 4.96% in 2005, peaking at 5.95% in 2008, and slightly declining to 5.49% in 2014. Overweight rates saw an initial increase from 13.26% in 2005 to 19.1% in 2008, before decreasing to 14.9% in 2014. These figures underscore the diverse nutritional landscape within the MENA region and highlight the significant challenges Egypt faces in improving child health outcomes. The high prevalence of stunting and the rising rates of wasting in Egypt are particularly concerning, as they reflect underlying issues of chronic malnutrition and acute malnutrition, respectively.

Figure 0.1 *Prevalence of Stunting (model-based estimates) in MENA Region (2000–2022)*

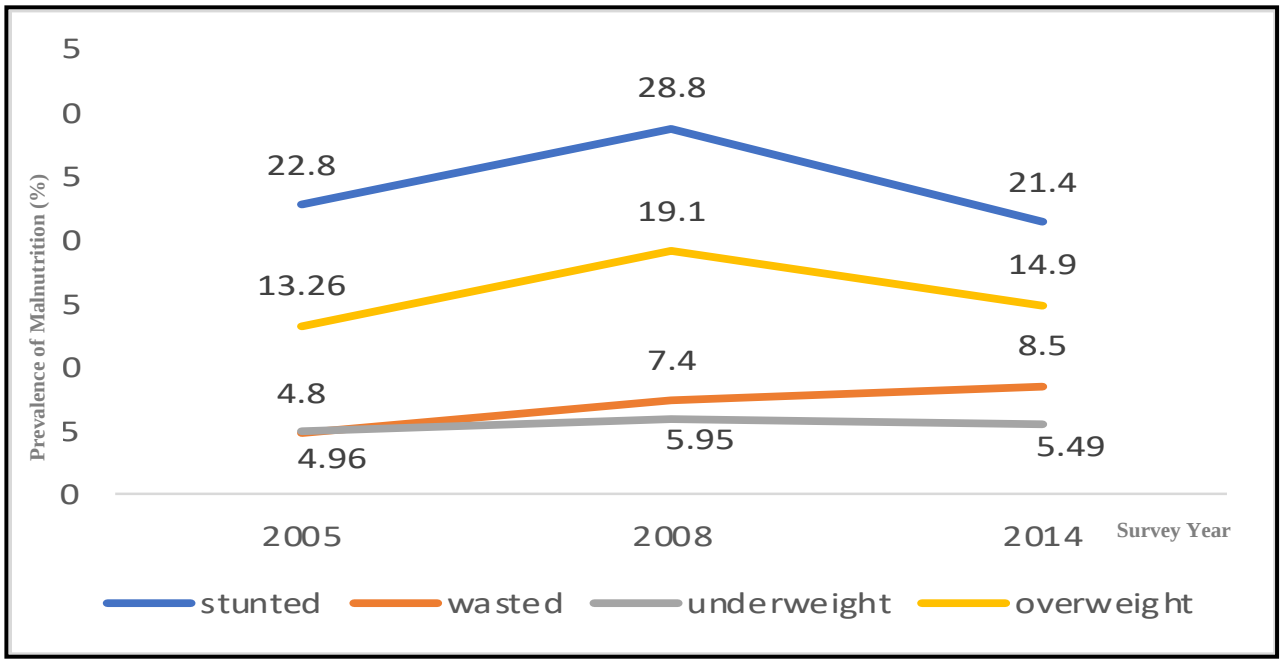


Source: Author's creation using data from UNICEF/WHO/World Bank. Joint Child Malnutrition Estimates Expanded Database: Published online May 2022. Available at: https://data.unicef.org/resources/dataset/malnutrition-data

In recent years, there has been a growing understanding of the importance of the first 1000 days of life, which include pregnancy and the first two years of a child's existence, in shaping lifetime health and development (Black et al., 2013). Maternal work status is one of the factors that can affect child nutrition during this key period since it can change food availability and

quality, caregiving habits, and access to healthcare services. However, little research has been conducted in Egypt to evaluate how the association between maternal employment and child nutrition may differ among children of various age groups. Maternal employment is a particularly important factor to consider, as it can have both positive and negative impacts on child health. On one hand, increased household income from maternal employment can improve access to nutritious food, healthcare, and education (Engle et al., 1999). On the other hand, maternal employment may reduce the time mothers can dedicate to childcare, potentially leading to less optimal feeding practices and caregiving (Ruel & Alderman, 2013). The balance between these positive and negative effects can vary significantly depending on the nature of the mother's work, the availability of support systems, and the socio-economic context (Smith et al., 2003). Understanding how maternal employment affects child health in Egypt can provide valuable insights for policymakers and help in designing interventions that support working mothers while promoting better health outcomes for their children.

Figure 0.2 *Prevalence of Stunting, Wasting, Underweight and Overweight in Egypt*



Source: Authors' calculation using data from EDHS 2005, 2008, and 2014.

3.1.1 Research Questions

This chapter is organized around three research questions:

1. How does maternal employment affect child health outcomes (stunting, wasting, underweight, and overweight) in Egypt?
2. How does the nature of a mother's work influence her child's health status?
3. How does this relationship vary among different age groups of children?

This chapter aims to investigates the link between maternal employment status and children's health outcome in Egypt, focusing on potential differences across various age groups of children and types of maternal occupation (e.g., service, physical labour, agriculture). The chapter utilises pooled data from three waves of the DHS conducted in 2005, 2008, and 2014, encompassing a total of 40,225 children, with the surveys including data on 13,505, 10,872, and 15,848 children, respectively. The analysis employs a linear probability model (LPM) to examine the relationship between maternal employment and children's nutritional outcomes. However, due to the potential endogeneity of maternal employment (caused by omitted variable bias or simultaneity bias), which are discussed in more detail in the methodology section, I address the endogeneity issue by applying a two-stage least squares (2SLS) approach with an instrumental variable (IV) to capture mothers' employment. The cluster average of women's employment status is used as the instrument.

The empirical results of this chapter, interpreted causally through the 2SLS method, indicate that maternal employment increases the likelihood of stunting by 12.6%. This suggests that the relationship between maternal employment and child stunting is not merely correlational but likely causal. However, the effects of maternal employment on the other health outcomes—wasting, underweight, and overweight—are less consistent and not statistically significant in the overall sample. This suggests that maternal employment does not have the same impact across all areas of child health. This difference can be understood by considering the distinct nature of each nutritional indicator and how they are influenced by maternal employment and household circumstances. Stunting is a measure of chronic malnutrition that develops over time due to long-standing deficiencies in nutrition and care (de Onis et al., 2012). This makes it more likely to be influenced by maternal employment, as working mothers may have less time for consistent caregiving, preparing nutritious meals, and maintaining regular health oversight (Black et al.,

2013; Ruel & Alderman, 2013). Notably, the extent to which maternal employment affects stunting may also depend on the length of employment. Longer periods of employment could exacerbate these challenges by reducing the time available for caregiving and meal preparation over an extended duration. Conversely, short-term employment may have less of an impact, as it might not significantly alter caregiving patterns or dietary practices. Unfortunately, the data used in this analysis do not allow for direct measurement of employment duration, which represents a limitation in fully understanding the nuanced relationship between maternal employment and child stunting.

Wasting, on the other hand, measures acute malnutrition, which often results from short-term nutritional stress or recent illness (Black et al., 2013). In the context of children aged 0-5 years, "short-term" typically refers to disruptions or deficiencies occurring over weeks or a few months, such as temporary food shortages, sudden economic shocks, or illnesses. Because wasting reflects more immediate health issues, it is generally influenced by these transient factors rather than the ongoing and cumulative nature of maternal employment (Victora et al., 2008). Underweight is a broader indicator that includes aspects of both chronic and acute malnutrition. This mixed nature makes it less clear how maternal employment specifically affects it, making significant findings harder to observe (WHO, 1995). Overweight is even less common in lower-income settings, where undernutrition is the main concern (Rashad & Sharaf, 2019). However, the data used in this chapter shows that approximately 15.4%[9] of children in the sample are classified as overweight, indicating that this is still a noteworthy public health issue. Despite this, the results of the 2SLS analysis do not indicate a statistically significant relationship between maternal employment and overweight status. This lack of significance could reflect a more complex set of factors influencing overweight, such as dietary composition, physical activity levels, or genetic predispositions, which may not be directly linked to maternal employment. Additionally, the chapter identifies significant heterogeneity in the relationship between maternal employment and child health outcomes, varying by both the child's age and the mother's occupation. Notably, younger children appear to be more vulnerable to the negative impacts of maternal employment, while the effects also differ substantially depending on the nature of the mother's work. These variations will be thoroughly examined in the subsequent sections of the analysis.

[9] Refer to Table 3.A3 in the Appendices for further details.

Lastly, this chapter makes significant contributions to the literature on maternal employment and child health outcomes, particularly in developing countries, with a focus on Egypt. In high-income countries, research has explored the complex interactions between maternal employment, socioeconomic conditions, and public policies, with notable contributions from scholars such as Ruhm (2008), Pilkauskas et al. (2018), and Waldfogel et al. (2002) in the United States, Chia (2008) in Canada, and Ermisch and Francesconi (2013) in the United Kingdom. In contrast, studies in developing countries, including those by Tucker and Sanjur (1988) in Panama, Rashad and Sharaf (2019) in Egypt, and Debela et al. (2021) in Tanzania, have primarily focused on nutritional deficiencies within resource-constrained settings. This chapter builds on and extends prior work, particularly Rashad and Sharaf (2019), by examining the effects of maternal employment on four child health indicators—stunting, wasting, underweight, and overweight—using a similar instrumental variable (IV) approach to address endogeneity. Like Rashad and Sharaf (2019), this chapter employs the cluster average of women's employment status as an instrument but goes further by exploring heterogeneity in effects across child age groups and maternal occupation types. This additional analysis provides a deeper understanding of how maternal employment affects child health differently depending on the child's developmental stage and the nature of the mother's work.

A further contribution of this chapter lies in its use of pooled data from three waves of Egypt's Demographic and Health Surveys (DHS) conducted in 2005, 2008, and 2014. By analysing data over time, this chapter provides a longitudinal perspective, unlike many earlier studies, including Rashad and Sharaf (2019), which rely on a single wave of cross-sectional data from 2014. This approach enables the chapter to examine trends in the relationship between maternal employment and child health, offering insights into how these dynamics have evolved over a period marked by economic and social changes in Egypt. By extending previous research and addressing these gaps, this chapter contributes to a more nuanced understanding of the relationship between maternal employment and child health outcomes. It highlights the importance of considering child age and maternal occupation type, while also incorporating a longitudinal perspective to capture trends over time.

The subsequent sections of this chapter are organised as follows: Section 3.2 reviews the relevant literature. Section 3.3 details the methodology employed in the chapter . Section 3.4 discusses results. Section 3.5 presents discussion. Finally, Section 3.6 provides the conclusion.

3.2 Literature Review

The relationship between maternal employment and child health has been a central focus of public health research, with varying dynamics observed between developed and developing countries. This literature review synthesises existing research on the impact of maternal employment on child health, exploring different theoretical and conceptual frameworks and comparing the literature across different socio-economic settings.

3.2.1 Theoretical Framework: Becker's (1965) Theory

The fundamental theoretical framework of this chapter is based on Becker (1965) time allocation theory for work and home production. This theory posits that households function as both consumers and producers, utilising resources such as time and labour to generate commodities like health, while adhering to basic microeconomic principles. Grossman (1972) expanded on this concept with a model that emphasises the commodity of "good health." Jacobson (2000) further developed Grossman's model by proposing that the family itself acts as a producer of health, where each family member contributes to their own and others' health by investing in health until the marginal consumption benefits equal the marginal net effective costs of health capital. Boserup (1970) highlighted the unique challenges faced by women in developing nations who must balance family care with earning a livelihood. According to Becker (1965), a mother's employment status impacts her family through two primary mechanisms: the income effect (IE) and the substitution effect (SE). The IE refers to the additional income a mother brings to the household, enhancing child welfare through better access to nutritious food, healthcare, and education (Tucker & Sanjur, 1988; Ulijaszek & Leighton, 1998). Conversely, the SE pertains to the reduction in time available for family care due to employment, potentially leading to negative outcomes such as decreased breastfeeding duration, lower quality and quantity of sanitary foods, and reduced time for children's cognitive development (Leslie, 1988; Ukwuani & Suchindran, 2003).

The overall impact of maternal employment on child nutrition is therefore conceptually ambiguous and depends on the relative magnitudes of these two effects (IE − SE) (Bishop, 2011). If the income gained from maternal work sufficiently compensates for the reduction in caregiving time, the net effect may be beneficial; however, if caregiving time is too compromised—especially in resource-constrained settings—the net impact may be detrimental. This trade-off is especially significant in low-income settings, where cultural and structural barriers make it challenging to balance work and caregiving. Lufumpa et al. (2021) highlight how these challenges can increase

the risk of malnutrition, particularly when caregiving responsibilities are reduced due to economic pressures. Furthermore, the type and quality of maternal employment, access to alternative childcare, and household decision-making dynamics all influence how the trade-off manifests in practice, warranting a nuanced empirical examination of this relationship.

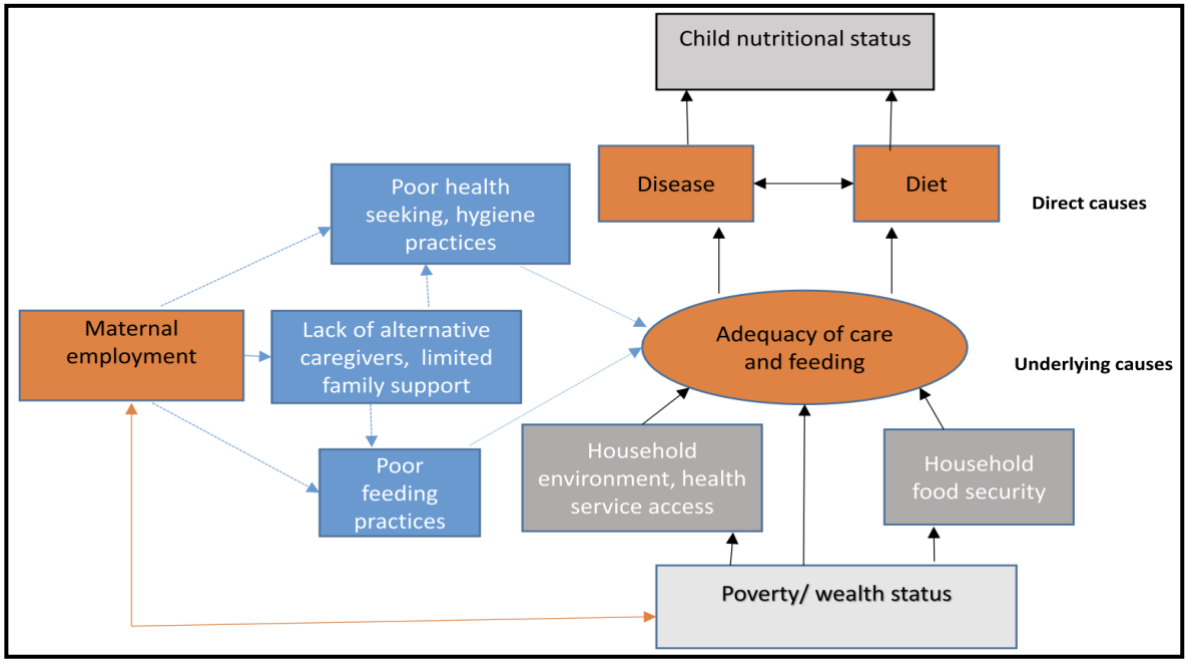
3.2.2 Conceptual Framework

Building on the theoretical foundation, the conceptual framework, shown in Figure 3.3 and adapted from Win et al. (2022) and the UNICEF framework, illustrates the presumed relationship between maternal employment and child nutritional status. Maternal employment and child health are closely linked in a bi-directional manner. On the one hand, earnings from maternal employment can lead to increased household wealth or income, resulting in positive improvements to household food security and overall living conditions. This, in turn, enhances the adequacy of childcare and feeding, referred to as the 'positive income effect' of maternal work. On the other hand, especially in contexts with limited access to formal or informal childcare support, maternal employment may reduce the time available for direct caregiving and supervision. This 'substitution effect' can lead to poorer dietary diversity, reduced feeding frequency, inadequate hygiene practices, and delayed health-seeking behaviours. These factors contribute indirectly to the underlying causes of malnutrition by lowering the adequacy of care and feeding. In turn, these pathways influence the proximate causes of malnutrition, such as disease and poor dietary intake, which directly affect child nutritional outcomes.

Figure 3.3 demonstrates these interlinked pathways. Maternal employment influences a series of intermediate factors—such as household food security, household environment, and care practices—which then affect adequacy of feeding and hygiene. This mediating node is central to the model, as it determines whether maternal employment ultimately improves or undermines child health outcomes. As shown in the diagram, these underlying mechanisms then channel into the proximate causes—diet and disease—that directly determine child nutritional status.

This framework demonstrates that the impact of maternal employment on a child's nutritional status is determined by the net effect of increased income (positive) and reduced caregiving time (potentially negative and adjustable). Due to data limitations, proximate causes such as disease and diet are not directly measured in this study. More generally, covariates are classified into child, maternal, partner, and household characteristics.

Figure 0.3 *Conceptual Framework: Maternal Employment and Child Nutritional Status*



Source: Win *et al. Archives of Public Health (2022) 80:192*

3.2.3 Maternal Employment and Child Health in Developed Countries

In developed countries, the relationship between maternal employment and child health has been extensively studied, with longitudinal data sets and robust econometric methods being utilized to unpack these dynamics. Studies in countries such as the United States, Canada, the United Kingdom, Germany, Australia, Norway, and Chile have revealed a multifaceted picture of how maternal employment impacts child health outcomes. Key researchers contributing to this body of work include Agiro and Huang (2020); Anderson et al. (2003); Aughinbaugh and Gittleman (2004); Courtemanche (2009); Datar et al. (2014); Dunifon et al. (2013); Felfe and Hsin (2012); Gennetian et al. (2010); James-Burdumy (2005); Liu et al. (2009); Mocan et al. (2015); Morrill (2011); Pilkauskas et al. (2018); Ruhm (2008); Waldfogel et al. (2002); Ziol-Guest et al. (2013) in the United States. In Canada, significant contributions have come from Chia (2008); Michael Baker et al. (2008); Phipps et al. (2006). The United Kingdom has seen important studies from Von Ermisch and Francesconi (2013); von Hinke Kessler Scholder (2008). Australia, Germany, Denmark, Norway, and Chile have also contributed to this literature through the work of Bishop (2011), Meyer (2016), Greve (2011), Haaland et al. (2013), and Reynolds et al. (2017), respectively.

Waldfogel et al. (2002), using data from the National Longitudinal Survey of Youth (NLSY), found that in the US, maternal employment during the second or third year of a child's life negatively affected reading skills at ages 5–6. Their research indicated that early maternal employment might interfere with crucial bonding and learning periods, thus impacting cognitive outcomes. This paper is significant as it underscores the crucial role that mothers play in early childhood development, highlighting the profound impact maternal factors have on shaping the health and well-being of children during these formative years. In a similar vein, Anderson et al. (2003) revealed that an additional 10 hours of maternal work per week increased the likelihood of children being overweight by 1.5 percentage points. This finding underscores the potential health risks associated with maternal employment, particularly regarding diet and physical activity. The hypothesis is that increased working hours reduce the time mothers can dedicate to preparing nutritious meals and encouraging physical activity, thereby increasing the risk of obesity. Ruhm (2008) and Courtemanche (2009) expanded on these findings by documenting significant correlations between increased maternal work hours and higher risks of childhood obesity and overweight. Ruhm (2008) utilised the Panel Study of Income Dynamics to demonstrate that children of working mothers had higher BMI scores compared to those with non-working mothers. Courtemanche (2009) used data from the Early Childhood Longitudinal Study-Kindergarten cohort to show that maternal full-time employment, especially when started within the first year of the child's life, is associated with higher rates of overweight and obesity in early childhood. Morrill (2011) reported increased probabilities of hospitalisation, asthma episodes, and injury/poisoning incidents among children aged 7–17 due to maternal employment. This paper, which utilised data from the Medical Expenditure Panel Survey, suggests that maternal employment may contribute to adverse health outcomes due to decreased supervision and potentially increased exposure to health risks. Despite these negative findings, some studies have produced mixed or insignificant results. Aughinbaugh and Gittleman (2004), for instance, found no significant impact of maternal employment on adolescent risky behaviour. Their paper, based on the NLSY, suggests that maternal employment does not necessarily correlate with increased risk-taking behaviours such as smoking, drinking, or drug use during adolescence. Similarly, Ziol-Guest et al. (2013) observed no significant effects of maternal employment on child BMI. Their research, using data from the Fragile Families and Child Wellbeing Study in the United States,

indicated that other factors, such as family structure and parental involvement, might play more substantial roles in determining child BMI than maternal employment status alone.

The divergence in findings across these studies can be attributed to several factors. First, the age of the children studied varies, which may influence the observed outcomes. For instance, younger children might be more susceptible to the negative effects of reduced maternal supervision, as seen in Morrill (2011) paper, whereas older children and adolescents, as explored by Aughinbaugh and Gittleman (2004), may have developed more independence, mitigating these risks. Second, the timing and intensity of maternal employment, such as full-time work within the first year of a child's life, could have differential impacts, as evidenced by Courtemanche (2009) findings. Additionally, the socio-economic context plays a critical role; based on data from the National Health Interview Survey in the United States, Mocan et al. (2015) highlighted the positive effects of increased household income due to maternal employment. This paper suggests that higher income levels can offset some of the negative impacts by improving access to healthcare, better nutrition, and safer living conditions. While these studies provide valuable insights into the dynamics at play in developed countries, the relationship between maternal employment and child health can differ significantly in developing countries, where socioeconomic conditions and access to resources vary widely.

3.2.4 Maternal Employment and Child Health in Developing Countries

In developing countries, research frequently focuses on under-nutrition issues such as stunting, wasting, and underweight, given the lower levels of GDP, income, education, and healthcare access. Studies conducted by Tucker and Sanjur (1988) in Panama; Abbi et al. (1991) in India; Rabiee and Geissler (1992) in rural Gilan, Iran; Glick and Sahn (1998) in Conakry, Guinea; Lamontagne et al. (1998) in Nicaragua Ulijaszek and Leighton (1998) in India; Short et al. (2002) in China; Ukwuani and Suchindran (2003) in Nigeria; Rastogi and Dwivedi (2014) in India; Afridi et al. (2016) in India; Pulok et al. (2016) in Bangladesh; Diiro et al. (2017) in rural India; Brauner-Otto et al. (2019) in Nepal; Nankinga et al. (2019) in Uganda; Rashad and Sharaf (2019) in Egypt; Shajan and Sumalatha (2022) in India; Debela et al. (2021) in Tanzania; Jakaria et al. (2022) in Bangladesh; and Hosen et al. (2023) in six South Asian countries provide valuable insights into how maternal employment can affect child health in low-resource settings.

For instance, Tucker and Sanjur (1988) in Panama and Lamontagne et al. (1998) in Nicaragua found that maternal employment was associated with improved dietary intake and

haemoglobin levels in children. These findings suggest that maternal employment can enhance child health by increasing household income, which subsequently improves access to better nutrition and healthcare. In low-resource settings, where economic constraints are significant, the additional income generated by maternal employment can be crucial for improving child health outcomes. Ulijaszek and Leighton (1998) in India reported better health outcomes for children over one year old whose mothers were employed. This finding underscores the potential benefits of maternal employment in extremely low-income households, where the additional income can significantly enhance the quality of life and health for children. Similarly, Afridi et al. (2016) in India and Diiro et al. (2017) in rural India have demonstrated that maternal employment can lead to improved child health outcomes by providing families with the necessary resources to afford better healthcare and nutrition. These studies highlight the positive impacts of maternal employment in contexts where economic challenges are severe and additional income is vital for basic survival and health improvements. However, the positive narrative does not uniformly hold across all developing countries. Abbi et al. (1991) in India and Rabiee and Geissler (1992) in Iran highlighted the adverse effects of maternal employment on child nutritional status, including increased risks of malnutrition, anaemia, and vitamin-A deficiency. These studies suggest that in some contexts, maternal employment may reduce the time available for childcare, leading to poorer health outcomes for children. This reduction in childcare time can result in less frequent feeding, inadequate nutrition, and insufficient health monitoring, all of which can contribute to poorer health outcomes for children.

Similarly, Glick and Sahn (1998) in Guinea and Short et al. (2002) in China documented negative impacts on child height and reduced maternal involvement in childcare. These findings indicate that the benefits of maternal employment are context-dependent and can vary significantly based on local economic conditions, cultural norms, and available support systems. For example, in Guinea, Glick and Sahn (1998) found that children of working mothers were more likely to suffer from stunting and other growth impairments, suggesting that the economic benefits of maternal employment were insufficient to offset the negative impacts of reduced maternal care. Similarly, Short et al. (2002) in China found that maternal employment negatively affected child height, suggesting that employment may detract from the time and attention mothers can devote to child-rearing. These mixed outcomes underscore the complexity of the relationship between maternal employment and child health in developing countries. The economic benefits of

employment may be counterbalanced by the adverse effects of reduced maternal caregiving, particularly in environments where alternative childcare support is limited or non-existent. These mixed and context-dependent results underscore the necessity for tailored interventions and policies that address the specific challenges and opportunities in each setting. While maternal employment can provide significant benefits in terms of increased household income and improved access to resources, it can also pose risks if it leads to reduced time for childcare and supervision. Lufumpa et al. (2021) provide further depth to this complexity by highlighting how structural barriers and societal norms in low-resource settings shape maternal caregiving practices and child nutritional outcomes. Their qualitative study in Zambia reveals that limited financial resources, coupled with competing economic and caregiving demands, often force mothers to prioritise employment over optimal childcare. This trade-off, exacerbated by inadequate healthcare infrastructure and cultural expectations of "good mothering," underscores the challenges faced by working mothers in resource-constrained environments. Therefore, understanding the local context is crucial for designing effective policies that support working mothers while ensuring the health and well-being of their children.

3.2.5 Heterogeneity in Child Health: The Role of Age and Maternal Occupation

- ***Child Age***

The extant literature underscores the significance of child age in modulating the impact of maternal employment on child health outcomes. Empirical studies have consistently highlighted that very young children, particularly infants, need intensive care, and maternal employment during this critical early stage can adversely affect their health. Popkin (1980), in his examination of Filipino children, found no significant difference in the overall nutritional health between children of employed and non-employed mothers. However, when differentiating between children under and over two years of age, he observed that maternal employment negatively impacted the height and weight of younger children, indicating that the deleterious effects of maternal employment are more pronounced in early childhood.

This observation is corroborated by Haggerty (1981) in Haiti and Engle and Pedersen (1989) in Guatemala, who reported that maternal employment was associated with lower nutritional status for infants under one year compared to children of non-employed mothers, but improved nutritional status for children aged one to two years. Similarly, Abbi et al. (1991) found

that maternal employment in rural Maharashtra, India, negatively affected various child health parameters more significantly for children under three years compared to those aged three to six. Glick and Sahn (1998) focusing on maternal income in Guinea, reported that children aged two to five years benefited more from the additional household income than those under two, who remained vulnerable to reduced caregiving. Furthermore, Ulijaszek and Leighton (1998) demonstrated that maternal employment in India was associated with better health outcomes for children over one year old, further highlighting how child age moderates the effects of maternal employment.

Building on this literature, this chapter directly investigates the heterogeneity in maternal employment's impact on child health by analysing two subsamples: children under 2 years and those aged 2–5 years. This approach aims to capture the differential effects of maternal employment during infancy—a period marked by greater dependence on maternal care—and early childhood, where caregiving demands begin to shift. By isolating these two age groups, the chapter provides insights into how maternal employment uniquely influences child health at different developmental stages, offering a nuanced understanding of this relationship in the Egyptian context.

- ***Occupation***

The nature of maternal occupation is a pivotal determinant of child health outcomes, as different types of employment entail varying demands, resources, and environments that can significantly affect childcare and nutrition. Nankinga et al. (2019) found that children of mothers engaged in agricultural work are more likely to be stunted. This finding suggests that the physically demanding and time-consuming nature of agricultural work may limit the time and energy mothers can dedicate to childcare, subsequently leading to poorer health outcomes for their children. Additionally, the economic returns from agricultural work are often low, potentially restricting access to nutritious food and healthcare services.

Conversely, Debela et al. (2021) reported that maternal off-farm employment is positively correlated with child height-for-age at higher levels of labour supply. This indicates that when mothers are engaged in less physically demanding jobs outside of agriculture, the additional income earned can improve children's nutritional status and access to healthcare, thereby enhancing their growth and development. However, Debela et al. (2021) also found that at lower levels of labour supply, off-farm employment had a negative correlation with child height-for-age.

This suggests that insufficient income or resources from part-time or less stable employment may not provide the same benefits and might even detract from the quality of childcare, resulting in poorer health outcomes for children. Similarly, Rastogi and Dwivedi (2014) observed that in India, children are more likely to be underweight if their mothers work in agriculture (in wealthier areas) or in services (in poorer areas). This dual finding highlights the complex interplay between the type of maternal employment, socioeconomic status, and child health. In wealthier agricultural areas, the demands of farm work combined with potentially higher economic pressures could detract from childcare. In contrast, in poorer areas, employment in the service sector might not provide sufficient income to counterbalance the negative effects of reduced maternal care time, resulting in undernutrition among children.

In conclusion, the reviewed literature demonstrates the significant heterogeneity in the impact of maternal employment on child health, shaped by the nature of maternal occupation. While prior studies highlight these dynamics in various contexts, limited research has comprehensively addressed these dimensions in Egypt. This chapter fills this gap by employing a robust econometric approach to analyse the nuanced relationship between maternal employment and multiple child health indicators in the Egyptian context. By accounting for variations across maternal occupation, this chapter provides a deeper understanding of the complex trade-offs between maternal employment and child health outcomes in resource-constrained settings.

3.3 Methodology

3.3.1 Data and Variables

In this chapter , I utilise data from the Demographic and Health Survey (DHS) conducted in Egypt during the years 2005, 2008, and 2014. The DHS is a globally recognised survey spanning over 90 countries, with the primary objective of providing comprehensive estimates on health, nutrition, and population indicators for each of Egypt's governorates. It is a nationally representative health survey conducted under the supervision of the Ministry of Health and Population. The survey employs a two-stage cluster sampling approach, with districts serving as the primary sampling units for urban areas and villages for rural regions. The target population includes women aged 15–49 who have been married, along with their children aged 0–5 years. Notably, the DHS provides anthropometric data for only one child per household when there are multiple children. According to the DHS documentation, the child selected for anthropometric measurement is typically the youngest child in the household. This sampling decision aims to capture the most recent health and nutritional status within the household, as younger children are more vulnerable to malnutrition and related health risks. The surveys from 2005, 2008, and 2014 included data for 13,505, 10,872, and 15,848 children, respectively. For this chapter , I analysed the combined sample, encompassing 40,225 children.

- ***Child Nutritional Status: The Outcome Variable***

The key outcome variable in this chapter is the nutritional status of children, assessed using four health indicators: stunting, wasting, underweight, and overweight. These indicators provide a comprehensive assessment of the different dimensions of child malnutrition, enabling a nuanced analysis of the impact of maternal employment on child health outcomes across different age groups. To measure these health indicators, three World Health Organization (WHO) anthropometric indicators are utilised: height-for-age Z-score (HAZ), weight-for-height Z-score (WHZ), and weight-for-age Z-score (WAZ). In 1993, the WHO conducted an extensive review of anthropometric references and their applications, concluding that the NCHS/WHO growth reference, which had been recommended for international use since the late 1970s, did not accurately reflect growth patterns in young children. This led to the World Health Assembly's endorsement in 1994 for the development of new growth curves. The WHO Multicentre Growth Reference Study was subsequently conducted between 1997 and 2003 to establish updated global growth and development benchmarks for children. This paper collected primary growth data and

associated information from a sample of 8,440 breastfed infants and young children who were in good health, drawn from diverse ethnic backgrounds and cultural contexts, including Brazil, Ghana, India, Norway, Oman, and the United States. The growth standards derived from this dataset provide a scientifically rigorous tool that accurately depicts the optimal pattern of physiological growth in children aged five and below. These standards illustrate typical patterns of early childhood development under ideal environmental conditions and serve as a universal reference for evaluating children, regardless of their ethnic background, socioeconomic level, or feeding practices.

The literature on child health and nutritional status predominantly employs two main measures: z-scores and binary outcomes. Z-scores provide a detailed assessment of the severity of malnutrition by indicating the degree of deviation from a reference population's mean, as seen in studies by Lamontagne et al. (1998) and Ulijaszek and Leighton (1998). These studies used z-scores to analyse deviations in height-for-age, weight-for-age, and weight-for-height, offering a nuanced understanding of nutritional status relative to well-nourished populations. In contrast, binary outcomes offer a more straightforward approach, categorising children as stunted, wasted, or underweight based on specific cut-off points. This method is particularly valuable for its simplicity and ease of interpretation, making it useful for public health surveillance and policy making, as demonstrated by Ukwuani and Suchindran (2003) in Nigeria and Rashad and Sharaf (2019) in Egypt. In this chapter, binary variables[10] are utilised to measure child health indicators. This approach not only ensures clarity and ease of interpretation but also allows for comparability with prior studies that have adopted similar methodologies.

The three anthropometric indicators, HAZ, WHZ, and WAZ, are continuous variables with a normal distribution ranging from -6 to +6 standard deviations (SD). The z-score formula, as defined by the WHO, is expressed as $Z\ score = \frac{\mathrm{X}-\mu}{SD}$, where X represents the observed value, such as height or weight, while μ and SD denote the mean and standard deviation values of the distribution associated with the reference population. Children with a HAZ less than -2 SD from the reference population median are categorised as stunted, whereas children with a WAZ less

[10] Note: To ensure the robustness of the findings, the analysis was also run using continuous Z-scores for HAZ, WAZ, and WHZ. The results remained consistent, confirming that maternal employment has a significant impact on child nutritional outcomes across both binary and continuous measures. For full details, see Appendix Table 3.A6.

than -2 SD are classified as underweight for their age. Children with a WHZ less than -2 SD are considered wasted, while those with a WHZ greater than +2 SD are considered overweight for their age[11]. These dependent variables are binary, with values of either zero or one, providing clear and straightforward measures of child nutritional health.

Each indicator assesses a distinct component of a child's nutritional health. Stunting is used as an indicator of chronic malnutrition, reflecting long-term growth issues that result from extended periods of poor nutrition and challenging living conditions (de Onis et al., 2013). It shows the cumulative impact of ongoing nutritional and health problems, often connected to socio-economic difficulties and environmental factors that limit growth (Black et al., 2013). Wasting, on the other hand, measures acute malnutrition, which means it captures short-term weight loss relative to a child's height. This indicator reflects recent nutritional issues or illnesses that cause rapid weight loss, highlighting the child's current health and nutrition status (Black et al., 2013). Underweight is a broader measure, considering a child's weight in relation to their age and showing both long-term and short-term effects of poor nutrition (WHO, 1995). Lastly, overweight is an indicator of overnutrition, showing when energy intake is higher than energy used over time (Ng et al., 2014). Although overweight is less commonly linked with developing countries, it is important to include as it captures potential changes in diet and nutrition patterns as economic conditions evolve (Popkin, 2001; Rashad & Sharaf, 2019). These different indicators provide a detailed analysis of child nutritional health, ensuring that the varied nature of malnutrition is properly represented. Understanding the unique focus of each indicator allows this chapter to examine how maternal and socio-economic factors affect child health in different ways.

- ***Maternal Employment: The Main Independent variable***

In Analysing the impact of maternal employment on child health, it is essential to consider the proxies used to measure this variable. Common proxies include maternal earnings and working hours, which reflect different aspects of employment's influence on child outcomes. Earnings capture the economic benefits that can improve child health through better access to resources, while working hours highlight the potential time constraints on activities like meal preparation

[11] I further investigate the robustness of the analysis by using alternative thresholds (-1.5 SD, -2.5 SD, +1.5 SD, +2.5 SD) in Section 3.5. These checks confirm the stability of the findings. The positive and significant association between maternal employment and stunting remains robust across all thresholds, while no significant effects are observed for other outcomes, confirming the stability of the main findings.

and physical supervision (Chia, 2008; Mocan et al., 2015; Phipps et al., 2006). However, the Egyptian Demographic and Health Survey (EDHS) lacks detailed data on these aspects, necessitating the use of binary variables indicating whether a mother is employed or not. This approach, though less nuanced, is practical for large datasets and allows for broad evaluations of employment's impact on child health. Binary variables have been effectively used in similar contexts, such as in studies by Agiro and Huang (2020) in the U.S. and Rashad and Sharaf (2019) in Egypt. Given these constraints, the primary explanatory variable in this chapter for mothers' employment is captured by a binary variable that indicates whether a mother is presently employed and has held employment within the 12 months prior to the survey.

- ***Other controls***

To account for the various factors influencing child health, this chapter incorporates a comprehensive set of covariates impacting stunting, wasting, underweight, and overweight. Child characteristics encompass several variables: child's age (in months), with the squared term included to account for the non-linear relationship between age and nutritional status; child's sex (male/female); and child's birth order, categorised into first-born, second to third-born, fourth to fifth-born, and sixth-born and higher. Breastfeeding status, indicating whether the child has never been breastfed, has been breastfed in the past, or is currently breastfeeding, is also considered. This variable is included to assess the potential influence of breastfeeding practices on child health outcomes. Additionally, twin birth is indicated if the child is part of a multiple birth, and childbirth size is categorised as larger than average, average, smaller than average, or very small.

Parental characteristics include factors that potentially affect the nutritional status of children: maternal age and age squared, recognising that higher maternal age and education are linked to improved child health due to better health and higher education levels (Barclay & Myrskylä, 2016; Sutcliffe et al., 2012). Maternal education attainment in years is considered, acknowledging that education empowers women with better bargaining power within their households, enabling informed decisions about childcare (Nussbaum, 2004). Mother's Body Mass Index (BMI) is included as maternal physical health during early child development stages can impact child growth (Hasan et al., 2016; Subramanian et al., 2010). Mother's height is presented as a categorical variable (short <152 cm, tall >152 cm), as it influences child health through genetic factors and living conditions (Addo et al., 2013; Martorell & Zongrone, 2012; Monden & Smits, 2009; Özaltin et al., 2010; Subramanian et al., 2009). Mother's current marital status (married,

widowed, or divorced) and decision-making authority over income are also included, following previous literature (Rashad & Sharaf, 2019; Hosen, 2023). Father's characteristics that could potentially affect the nutritional status of children are also controlled for, including the husband's total education attainment in years and employment status (employed or not). Parental education is utilised as a proxy for parental awareness of child health inputs, with the understanding that greater parental knowledge of health and nutrition practices leads to better child nutrition (Christiaensen & Alderman, 2004; Smith & Haddad, 2000).

Household characteristics are controlled to determine whether households are in rural or urban areas, with urban areas offering greater access to food that contributes to higher energy and fat content (Popkin, 1999). The number of eligible adult women in the household serves as a substitute for childcare, and the number of children in the family is included as a control, recognising that mothers' time allocation may be constrained with more children (Bernal, 2008; Ejrnæs & Pörtner, 2004). The wealth index, based on asset ownership and household features, is included to control for household economic position. This index is divided into quintiles, with the top 20th percentile representing the wealthiest families and the bottom 20th percentile indicating the poorest households. Wealth index inclusion may somewhat offset the income effects of maternal employment, as maternal employment can boost household wealth. Therefore, including the wealth index in the chapter might lead to a smaller maternal employment coefficient. Lastly, an interaction term combining mother’s occupation and household wealth is included to assess whether the relationship between the type of the mother’s occupation (e.g., service, physical labour, agriculture) and child health outcomes varies depending on household wealth status. This interaction term helps explore how different resources or access to healthcare in wealthier households might moderate the effect of occupation type on child health. Furthermore, all descriptive and multivariate analyses in this chapter are corrected for population weighting using sample weights from the EDHS data, and standard errors are adjusted for clustering effects.

3.3.2 Estimation Strategy

It is difficult to establish a causal relationship between a mother's employment position and her children's nutritional health. Omitted variable bias, the endogeneity problem caused by accessible work possibilities for mothers, and the possibility of reverse causation, in which a mother's career decision influences her child's nutrition, can all contribute to biased and inconsistent findings (further discussion on endogeneity is provided in Section II). To address these challenges, this chapter begins with a baseline regression to explore the association between maternal employment and child health outcomes. However, recognizing the limitations of this approach in identifying causality, advanced econometric techniques are subsequently employed to mitigate bias and inconsistency. Specifically, the analysis uses a two-stage least squares (2SLS) approach with an instrumental variable (IV) to address endogeneity and provide more robust causal estimates.

I. Linear Probability Model (LPM)

To examine the relationship between maternal employment and child health outcomes, this chapter employs the linear probability model (LPM). The LPM is chosen for its simplicity and interpretability, particularly when dealing with binary dependent variables. Unlike logit or probit models, which provide estimated probabilities on a non-linear scale, the LPM offers coefficients that can be directly interpreted as changes in probability, making it easier to understand the marginal effects of maternal employment on child health indicators such as stunting, wasting, underweight, and overweight. The primary equation for this analysis is structured as follows:

$$Y_{ij} = \beta_0 + \beta_1 ME_i + \beta_2 X_{ij} + e_{ij} \qquad (3.1)$$

In this model, Y represents the child's anthropometric indicators (stunting, wasting, underweight, and overweight) *for child i born to mother j*, ME denotes the mother's employment status, and X includes control variables accounting for observed characteristics of the child (e.g., age, sex, birth order, singleton or twin status, number of children in the household, length of breastfeeding), mother (e.g., age, education, marital status), husband or partner (e.g., education, occupation), and household (e.g., type of residence, wealth index, division, number of eligible women in the household). Fixed effects for survey year and governorates are also included. The error term e captures unexplained variation. The primary goal is to determine the extent to which maternal employment, indicated by the coefficient β1, impacts a child's nutritional health.

II. Instrumental Variable (IV)

- **Justification of the Instrumental Variable (IV) Approach**

In this chapter, a critical empirical challenge is identifying the causal effects of maternal employment on child health outcomes while addressing potential endogeneity concerns. Endogeneity can arise due to factors such as omitted variables that influence both maternal employment and child health, where unobserved factors such as maternal aptitude, skills, or preferences may influence both maternal employment and child health outcomes (Bishop, 2011; Morrill, 2011). Additionally, reverse causality, where a mother's decision to enter the workforce might be influenced by her child's health status. For instance, a mother with an ill child might choose to stay home to provide care or, alternatively, she might work more hours to cover the costs of medicine and nutritious food (Hope et al., 2017; London et al., 2022; Morrill, 2011; Zan & Scharff, 2018). These issues can create a correlation between the error term and the explanatory variable in ordinary least squares (LPM) estimation, resulting in biased and inconsistent estimates (Wooldridge, 2006).

A robust approach to addressing this issue is the use of an Instrumental Variable (IV) methodology, specifically via two-stage least squares (2SLS) estimation. The IV method requires the selection of a valid instrument that is correlated with the endogenous regressor (in this case, maternal employment) but uncorrelated with the error term in the equation for the outcome variable (child health outcomes). This is known as the exclusion restriction. Additionally, the chosen instrument must influence the endogenous variable without exerting any direct effect on the outcome variable except through the endogenous variable. In this chapter, the cluster average of women's employment status is employed as the IV. A "cluster" refers to a geographically defined area termed a "Governorate". Each governorate[12], except for the four Urban Governorates[13], is further divided into urban and rural areas to capture demographic diversity (e.g., Aswan Urban and Aswan Rural). This cluster-level measure is a valid instrument designed to

[12] This classification includes the following:

- **Urban Governorates**: Cairo, Alexandria, Port Said, and Suez.
- **Lower Egypt**: Damietta, Dakahlia, Sharkia, Qalyubia, Kafr el-Sheikh, Gharbia, Menoufia, Beheira, and Ismailia.
- **Upper Egypt**: Giza, Beni Suef, Fayoum, Minya, Assiut, Sohag, Qena, Aswan, and Luxor.
- **Frontier Governorates**: Red Sea, New Valley, Matrouh, North Sinai, and South Sinai.

[13] No rural area in Urban Governorates.

capture the conditions of the local labour market and labour demand, which are exogenous factors affecting local economic conditions and external to the women and their households. Importantly, the IV is not expected to directly impact child health outcomes except through its effect on maternal employment. The 2SLS regression model used in this chapter involves two stages. In the first stage, (equation 3.2), the endogenous variable (maternal employment) is regressed on the IV (cluster average of women's employment status). The predicted values from this stage are then used in the second stage, (equation 3.3), to estimate the impact on child health outcomes. This ensures that the variation in maternal employment is driven by exogenous factors, leading to more accurate causal estimates.

- **2SLS IV Regression Model**

As discussed earlier, this chapter examines the causal effect of maternal employment on child health outcomes using a 2SLS IV approach and ordinary least squares regression. The 2SLS model estimates maternal employment using the cluster average of women's employment status as an instrument. The following 2SLS model is estimated using equations (3.2) and (3.3).

- The first stage of the 2SLS estimation involves regressing maternal employment on the IV and other control variables:

$$ME = \alpha_o + \alpha_1 Z_1 + \alpha_2 X + \upsilon \qquad (3.2)$$

,where ME denotes maternal employment status, Z_1 represents the IV (cluster average of women's employment status at the governorates level and each governorate is further divided into urban and rural,), X includes control variables (such as child, maternal, paternal, and household characteristics), and ν is the error term.

- The second stage uses the values of maternal employment from the first stage to estimate the impact on child health outcomes:

$$\mathrm{Y} = b_0 + b_1 ME + b_2 X + e \qquad (3.3)$$

, where Y represents child health outcomes, ME denotes the maternal employment status from the first stage, X includes the control variables, and e is the error term. Hence, the IV exhibits a strong association with the endogenous variable (ME), indicated by a significant coefficient ($\alpha_1 \neq 0$) in the first-stage regression, confirming its relevance. However, instrument validity also requires the exclusion restriction—that is, the instrument must not be correlated with the unobserved determinants of child health outcomes, conditional on the included controls. The cluster average of women's employment status, calculated at the governorate-urban/rural level, captures

prevailing local labour market conditions and socio-economic norms that influence maternal employment but are unlikely to directly affect child health once individual, household, and partner characteristics are controlled for. Moreover, to mitigate the risk that the instrument reflects broader regional economic prosperity—which could directly influence child health through improved infrastructure or service access—the models include fixed effects for survey year and governorates. These absorb unobserved regional heterogeneity, allowing the variation in the instrument to reflect local labour market conditions rather than general economic development. This identification strategy aligns with existing literature (Lenze & Klasen, 2017; Rashad & Sharaf, 2019), where local averages of female employment are used as valid instruments for individual-level employment. These studies argue that the local labour demand and social norms embedded in the cluster-level average are exogenously determined and influence individual employment probabilities without directly affecting child nutritional outcomes. All regression models were corrected for the survey design, including the sampling weight, cluster, and strata, in order to eliminate bias in the coefficients due to the oversampled population and to modify the standard errors for the survey clustering effect (Deaton, 1997).

3.4 Results

3.4.1 Descriptive Statistics

This section provides a comprehensive overview of the socio-economic and demographic characteristics of the sample used in this chapter, highlighting the relationships between child malnutrition, maternal employment, and various socio-economic factors.

Table 3.1 offers a detailed examination of child malnutrition indicators—stunting, wasting, underweight, and overweight—across various socio-economic characteristics in Egypt based on data from the Egypt Demographic and Health Surveys (EDHS) conducted in 2005, 2008, and 2014. Regarding the children's sex, the data reveal that the prevalence of stunting among male children is higher at 25.48% compared to 22.27% among female children. Additionally, 7.22% of male children are wasted, while the figure for female children is 6.51%. Regarding underweight prevalence, 6.25% of males and 4.64% of females are affected. Notably, overweight is slightly more prevalent among females (15.64%) than males (15.19%). These findings suggest that male children are more susceptible to stunting and underweight, whereas overweight is more common among female children. One potential explanation could be the influence of Z-scores, which are based on Western norms that might impose stricter standards for male children (Cortinom et al., 1996). This raises the possibility that the observed gender differences in stunting and underweight may be partly attributable to the application of these norms. Alternatively, it could suggest that female children in Egypt are genuinely less stunted and underweight than their male counterparts (Kavle et al., 2015; UNFPA, 2010), potentially due to biological, cultural, and socioeconomic factors that favour female health outcomes in early childhood. Evidence supporting the higher prevalence of stunting among male children is consistent with findings from the UNFPA analysis of EDHS 2008 data, which reported stunting rates of 31% among male children compared to 27% among female children in Egypt. Furthermore, broader literature reinforces these patterns. A meta-analysis of 16 DHS datasets from 10 African countries found that the prevalence of stunting was consistently higher in boys than girls in all datasets analysed, with statistically significant differences in 11 out of 16 datasets (Wamani et al., 2007). The same study observed lower mean z-scores for boys compared to girls across all datasets, with statistically significant differences in 12 out of 16 datasets. These findings align with other research conducted in Africa, which consistently shows that male children are more at risk of developing stunting than their female counterparts (Espo et al., 2002; Ukwuani & Suchindran, 2003; Wamani et al., 2004; Zere &

McIntyre, 2003). The convergence of these findings highlights the need to consider gender-specific vulnerabilities in child nutrition. While the exact mechanisms remain an area for further research, potential explanations include biological differences that make male children more vulnerable to malnutrition during critical periods, as well as cultural practices and resource allocation within households that may disadvantage male children in certain contexts.

Table 0.1 *Child Malnutrition by Socio-Economic Characteristics*

Characteristics	Stunted	Wasted	Underweight	Overweight
Child's Gender				
Male	25.48%	7.22%	6.25%	15.19%
Female	22.27%	6.51%	4.64%	15.64%
Maternal Education				
No education or primary	27.24%	6.4%	6.42%	13.86%
Secondary or higher	22.08%	7.13%	4.94%	16.25%
Region				
Urban	23.38%	7.65%	5.46%	16.28%
Rural	24.17%	6.47%	5.46%	14.96%
Governorates				
Urban Governorates	20.45%	9.2%	5.32%	16.55%
Lower Egypt – urban	24.96%	6.16%	4.28%	19.5%
Lower Egypt – rural	21.26%	6.52%	4.33%	17.6%
Upper Egypt – urban	25.48%	7.17%	6.62 %	13.43%
Upper Egypt – rural	27.48%	6.35%	6.71%	12.08%
Frontier governorates	19.41%	8.79%	4.63%	14.27%
Wealth				
poorest	27.85%	6.52%	6.31%	14.4%
poor	25.4%	6.43%	5.67%	13.71%
Middle	21.86%	6.9%	5.34%	15.18%
Rich	22.13%	6.74%	4.93%	16.21%
Richest	22.45%	7.92%	5.03%	17.91%

Source: Authors' calculation using data from EDHS 2005, 2008 and 2014

Maternal education also plays a significant role in child malnutrition. Among children of mothers with no education or only primary education, 27.24% are stunted. In contrast, 22.08% of children whose mothers have secondary or higher education are stunted. Wasting is observed in 6.4% of children with less educated mothers, whereas it is slightly higher (7.13%) in children of more educated mothers. The percentage of underweight children is higher (6.42%) for those with less educated mothers compared to those with more educated mothers (4.94%). Overweight prevalence is higher in children of mothers with secondary or higher education (16.25%) compared to those with less education (13.86%). These data highlight the positive impact of maternal

education on reducing stunting and underweight while paradoxically increasing overweight prevalence. Regional disparities are evident in the data. Urban areas have a stunting prevalence of 23.38%, whereas rural areas report 24.17%. Wasting is more prevalent in urban areas (7.65%) compared to rural areas (6.47%). Both urban and rural regions report the same percentage of underweight children (5.46%). Overweight is more prevalent in urban areas (16.28%) compared to rural areas (14.96%). These regional differences underscore the need for tailored nutritional interventions that consider the distinct challenges faced by urban and rural populations.

Table 3.1 also reveals significant geographical and socio-economic disparities in child malnutrition across Egypt. Notably, stunting emerges as the most critical issue, particularly in Upper Egypt's rural areas, where it reaches 27.48%, compared to the national average of 24.3%. This indicates that chronic undernutrition remains a severe challenge in these regions. In contrast, the prevalence of wasting is notably higher in urban (9.2%) and frontier governorates (8.79%), suggesting acute malnutrition is more of an issue in these areas. Underweight, while less prevalent overall, is highest in Upper Egypt's rural areas (6.71%), further emphasising the severe nutritional challenges in these regions. Conversely, overweight is most prevalent in Lower Egypt's urban areas (19.5%) and least prevalent in Upper Egypt's rural areas (12.08%), highlighting that overnutrition in wealthier, urbanised areas is a growing concern. The wealth disparities in malnutrition are also stark: the poorest households experience the highest levels of stunting (27.85%), while the wealthiest are more prone to overweight (17.91%). This complex relationship between wealth and malnutrition underscores the dual burden of undernutrition and overnutrition in Egypt. Overall, these results indicate significant variations in child malnutrition across different socio-economic groups in Egypt. Male children, children of less educated mothers, and those in rural and poorer households are more vulnerable to malnutrition. Conversely, children in urban areas and from wealthier families show higher rates of overweight.

Building on the insights from **Table 3.1**, which highlights the prevalence of child malnutrition across various socio-economic characteristics, **Table 3.2** shifts the focus to explore the distribution of maternal employment across similar socio-economic factors. The table categorises the percentage of working women according to age, region of residence, education level, household wealth, and marital status, offering valuable insights into the socio-economic factors influencing maternal employment in Egypt. Firstly, analysing the data by age reveals that the highest employment rate is observed among women aged 35–49, with 21.9% engaged in

employment. This is followed by the 25–34 age group at 15.86% and the 15–24 age group, which has the lowest employment rate at 6.44%. This trend suggests that maternal employment tends to increase with age, potentially reflecting by this age family size is determined, women are less likely to have very young children, and greater stability in employment over time. Moreover, this pattern may imply that women are more likely to enter or re-enter the workforce after marriage and childbearing, aligning with life-course considerations and family dynamics.

Secondly, examining the region of residence reveals that the percentage of working women is slightly higher in urban areas (15.94%) compared to rural areas (13.43%). While this difference is relatively small, it may reflect the marginally greater availability of employment opportunities and better access to labour markets in urban regions. However, the minimal gap suggests that structural barriers to women's employment persist in both settings, potentially limiting the overall participation of women in the labour force regardless of their location. In terms of maternal education, women with secondary or higher education exhibit a higher employment rate (16%) compared to those with no education or only primary education (11.12%).

While this suggests a potential positive association between educational attainment and labour force participation, it is important to recognise that both education and employment may also be influenced by underlying socio-economic factors, such as class. Consequently, the observed differences in employment rates could reflect broader socio-economic advantages rather than a direct effect of education alone on employment outcomes. Household wealth also plays a significant role in maternal employment. The highest employment rate is found among women from the wealthiest households (21.81%), followed by those from rich (14.68%), middle (12.01%), the poorest (13.36%), and poor households (11.03%). This pattern indicates that women in wealthier households may have better access to job opportunities and resources that facilitate their employment. Lastly, marital status further highlights differences in employment rates, with widowed, divorced, or separated women showing a significantly higher employment rate (22.94%) compared to those who are married or living together (14.16%). This discrepancy could be due to the increased necessity for single mothers to work to support their households. Overall, these findings underscore the significant impact of socio-economic factors on maternal employment in Egypt, illustrating the complex interplay between age, education, wealth, and marital status in shaping women's participation in the labour force.

Table 0.2 *Maternal Employment by Socio-Economic Characteristics*

Characteristics	% of Working Women
Mothers' age	
Age (15–49)	14.3%
Age (15–24)	6.44%
Age (25–34)	15.86%
Age (35–49)	21.9%
Region of Residence	
Urban	15.94%
Rural	13.43%
Maternal education level	
No education or primary education	11.12%
Secondary or higher education	16%
Household's wealth	
Poorest	13.36%
Poor	11.03%
Middle	12.01%
Rich	14.68%
Richest	21.81%
Marital status	
Married or living together	14.16%
Widowed, divorced, separated	22.94%

Source: Authors' calculation using data from EDHS 2005, 2008 and 2014.

Expanding on the analysis of maternal employment patterns, **Table 3.3** provides a detailed examination of the distribution of mothers across various occupational categories by socio-economic background, using data from the EDHS (2005, 2008, and 2014). In urban areas, a higher proportion of mothers are employed in professional and managerial roles (60.24%) compared to rural areas (37.78%). Conversely, rural areas have more mothers working in agriculture, with 16.26% as agricultural employees and 18.03% as self-employed. This indicates a clear urban-rural divide in employment types. Maternal education significantly influences employment types. Mothers with secondary or higher education are predominantly in professional roles (62.82%), whereas those with no or primary education are more involved in agriculture (32.17% self-employed). This highlights the impact of education on access to diverse job opportunities. The wealth index further shows disparities. Mothers from the wealthiest households are mainly in professional roles (74.23%), while those from the poorest households are more likely in physical

labour (35.86% in agriculture self-employed). This illustrates the strong correlation between household wealth and maternal employment types. Further analysis reveals that working mothers are disproportionately concentrated in wealthier households, as shown in **Figure 3.A2**. Among working mothers, 47.2% come from the richest households, while only 33.63% come from the poorest households. This aligns with the expectation that wealthier households provide greater access to education and professional opportunities for mothers. **Figure 3.A1** in the appendices, further reveals that the distribution of the weight-for-height z-score (WHZ) is skewed differently for children based on their mothers' employment status. WHZ distribution for children of non-working mothers is skewed more to the left, indicating higher rates of wasting. Conversely, for children of working mothers, the WHZ distribution is skewed more to the right, indicating higher rates of overweight. The Kolmogorov-Smirnov test for equality of distributions, **Table 3.A2** in the appendices, rejects the null hypothesis of equal distributions by mother's employment status, suggesting significant differences in the distribution patterns of wasting and overweight between the two groups.

Table 0.3 *Proportion of Mothers by Socio-Economic Across Different Occupations (in %)*

Characteristics	Service					Agriculture			Physical Labour		
	Professional & Managerial	Clerical	Sales	Services	Total Service	Agriculture Employee	Agriculture Self-Employed	Total Agriculture	Skilled Manual	Un-Skilled Manual	Total Labour
Region											
Urban	60.24	12.69	4.92	12.32	90.17	0.54	0.49	1.03	5.01	3.79	8.80
Rural	37.78	6.32	9.84	5.61	59.53	16.26	18.03	34.28	4.22	1.97	6.18
Maternal Education											
No education or primary	2.41	0.08	12.45	9.27	24.21	28.45	32.17	60.61	6.52	8.66	15.18
Secondary or higher	62.82	12.00	6.27	7.78	88.87	3.42	3.50	6.93	3.77	0.43	4.20
Wealth Index											
poorest	7.54	1.13	8.14	5.58	22.39	32.25	35.86	68.11	3.81	5.69	9.50
poor	24.57	4.37	14.11	7.98	51.04	19.15	18.80	37.95	5.41	5.60	11.01
Middle	46.95	9.95	12.78	7.71	77.39	6.01	9.15	15.16	4.47	2.98	7.45
Rich	61.02	12.00	6.47	11.84	91.32	1.15	0.53	1.68	6.11	0.88	7.00
Richest	74.23%	13.20	1.80	7.51	96.74	0	0	0	3.24	0.02	3.26

Source: Authors' calculation using data from EDHS 2005 2008 2014. Note: Rows sum to 100%.

3.4.2 Analysis Results

Table 3.4 presents a detailed analysis of the impact of maternal employment on child nutritional outcomes, employing both Linear Probability Model (LPM) and Instrumental Variable Two-Stage Least Squares (IV-2SLS) methods. To address potential endogeneity concerns, the validity of the instrument is evaluated in Table 3.5, while a comprehensive analysis with all covariates is provided in Table 3.A4 in the appendices. Models 1 and 3 in Table 3.4 include only baseline controls—child characteristics (gender, age, birth order, breastfeeding status), maternal attributes (age, education, body mass index, marital status), partner characteristics (education, employment status), household factors (size, wealth index, number of female adults), and fixed effects for governorates and survey years. Models 2 and 4 extend the analysis by incorporating maternal occupation and an interaction term (Wealth × Maternal Occupation), providing further insights into how employment type and socio-economic conditions shape child health outcomes.

- ***Linear Probability Model (LPM) Result***

Models 1 and 2 of **Table 3.4** examine the association between maternal employment and child health outcomes. ***Model 1*** estimates that maternal employment increases the likelihood of stunting by 5.9%, indicating the potential challenges faced by working mothers in balancing employment with caregiving responsibilities. ***Model 2***, which introduces an interaction term between maternal occupation and household wealth, shows a slightly higher effect of 6.3%, highlighting the influence of socio-economic factors on this relationship. These significant findings suggests that children of working mothers may be more prone to stunted growth. However, the possibility of unobserved confounding variables and reverse causality—where maternal employment and child health may simultaneously influence one another—underscores the need for a causal identification strategy, which is addressed using IV estimation.

- ***Instrumental Variable (IV) Results***

The first-stage regression, presented in **Table 3.5**, demonstrates the validity of the instrument, with the cluster average of women's employment having a statistically significant positive effect on maternal employment, with a coefficient of 22.2%. This robust relationship is supported by a first-stage F-statistic of 693.016 and a partial R^2 of 0.1676, indicating that the instrument is strong and does not suffer from weak instrument problems (Stock & Yogo, 2005).

Table 0.4 *Regression Results using LPM and IV-2sls*

	Stunted				Wasted				Underweight				Overweight			
	LPM		IV		LPM		IV		LPM		IV		LPM		IV	
Model	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**
Maternal Employment	0.059***	0.063***	0.126***	0.135***	-0.005	-0.0043	0.004	0.0042	0.003	0.00373	0.019	0.0287	0.043***	0.0421***	0.043	0.0467
	(0.0176)	(0.0214)	(0.0386)	(0.0357)	(0.007)	(0.0067)	(0.023)	(0.032)	(0.009)	(0.00884)	(0.023)	(0.0236)	(0.0145)	(0.0111)	(0.030)	(0.0212)
Wealth x Mother Occupation (Ref. Poorest & Agriculture)																
Service Occupation		-0.052		-0.113**		0.046*		0.037		0.024		0.010		-0.028		-0.027
		(0.041)		(0.053)		(0.026)		(0.032)		(0.024)		(0.031)		(0.035)		(0.043)
Poor x Service		0.014		0.011		-0.022		-0.023		-0.001		-0.002		0.021		0.021
		(0.047)		(0.047)		(0.028)		(0.028)		(0.026)		(0.026)		(0.038)		(0.038)
Middle x Service		-0.013		-0.018		-0.054**		-0.055**		-0.028		-0.029		-0.021		-0.021
		(0.042)		(0.042)		(0.026)		(0.026)		(0.025)		(0.025)		(0.037)		(0.037)
Rich x Service		-0.013		-0.019		-0.058**		-0.059**		-0.021		-0.022		-0.004		-0.004
		(0.041)		(0.041)		(0.026)		(0.026)		(0.025)		(0.025)		(0.037)		(0.037)
Richest x Service		-0.012		-0.018		-0.035		-0.036		-0.024		-0.025		0.013		0.013
		(0.041)		(0.041)		(0.026)		(0.026)		(0.024)		(0.024)		(0.038)		(0.038)
Physical Labour Occupation		0.031		0.030***		-0.023		-0.032		0.025		0.011		-0.021		-0.020
		(0.055)		(0.062)		(0.020)		(0.028)		(0.033)		(0.038)		(0.048)		(0.054)
Poor x Labour		0.089*		0.092**		0.075**		0.075**		-0.026		-0.027		0.046		0.046
		(0.074)		(0.074)		(0.038)		(0.038)		(0.044)		(0.044)		(0.073)		(0.073)
Middle x Labour		-0.16**		-0.162**		0.022		0.022		-0.091***		-0.092***		-0.115**		-0.115**
		(0.077)		(0.076)		(0.039)		(0.039)		(0.034)		(0.034)		(0.054)		(0.054)
Rich x Labour		-0.090		-0.097		0.008		0.007		0.034		0.033		-0.045		-0.046
		(0.084)		(0.084)		(0.035)		(0.035)		(0.053)		(0.053)		(0.071)		(0.071)
Richest x Labour		-0.085		-0.093		0.006		0.005		-0.016		-0.018		-0.083		-0.083
		(0.126)		(0.126)		(0.045)		(0.045)		(0.060)		(0.060)		(0.084)		(0.084)
Constant	0.371***	0.368***	0.395***	0.394***	0.110**	0.111**	0.118**	0.117**	0.120***	0.120***	0.147***	0.145***	0.172***	0.175***	0.158**	0.156**
	(0.0719)	(0.0720)	(0.0873)	(0.0873)	(0.0445)	(0.0445)	(0.0469)	(0.0469)	(0.0400)	(0.0400)	(0.0472)	(0.0470)	(0.0605)	(0.0605)	(0.0742)	(0.0742)
Observations	34,507	34,507	34,507	34,507	34,507	34,507	34,507	34,507	34,507	34,507	34,507	34,507	34,507	34,507	34,507	34,507
R-squared	0.056	0.057	0.050	0.050	0.062	0.061	0.044	0.045	0.024	0.024	0.019	0.019	0.035	0.034	0.032	0.033
Controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year & Governorates FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

Note: LPM—linear probability model, IV-2sls—instrumental variable two-stage least square. The instrument used is the cluster average of women's employment status at the governorates level and further divided into urban and rural. The dependent variables are child health outcomes, specifically Stunted, Wasted, Underweight, and Overweight. The main independent variable is maternal employment in the past 12 months. The analysis controls for child characteristics, mother's characteristics, partner's characteristics, and household characteristics. FE— fixed effect. Clustered standard errors in parentheses, * p<0.05, ** p<0.01, *** p<0.001.

The IV-2SLS estimates in ***Models 3*** and ***Model 4*** in **Table 3.4** establish a significant causal effect of maternal employment on child stunting. The results indicate that maternal employment increases the likelihood of stunting by 12.6%, with the effect slightly rising to 13.5% when the interaction term between maternal occupation and household wealth is included. These findings align with previous studies (e.g., Rashad & Sharaf, 2019; Short et al., 2002; Datar et al., 2014) and challenge the assumption that increased household income from maternal employment will improve child nutritional outcomes. Instead, these results suggest that maternal employment often imposes time constraints that reduce mothers' ability to consistently provide nutritious meals, monitor child health, and maintain caregiving routines, thereby contributing to chronic nutritional deficits such as stunting (Black et al., 2013; de Onis et al., 2013).

Table 0.5 *IV- 1st stage Result*

The Cluster Average of Women's Employment	0.222*** (0.0787)
Constant	33.61*** (1.19)
Observations	34,507
R-squared	0.8148
Adj R-squared	0.8143
First partial R2	0.1676
First-stage F-statistic	693.016
First-stage F-test P-value	0.0000

Note: The instrument used is "The cluster average of women's employment status" at the governorates level and further divided into urban and rural. Clustered standard errors in parentheses, * p<0.05, ** p<0.01, *** p<0.001.

Conversely, the effects of maternal employment on wasting, underweight, and overweight are not statistically significant in the IV-2SLS analysis. Wasting, as an indicator of acute malnutrition, tends to be influenced by short-term disruptions, such as illness or temporary food shortages, rather than maternal employment per se (Victora et al., 2008). Similarly, underweight, which reflects both chronic and acute malnutrition, shows no significant causal relationship, likely due to the mixed nature of the indicator (WHO, 1995). Overweight remains rare in low-income contexts such as Egypt, where undernutrition is the predominant issue, explaining the lack of significant association with maternal employment (Rashad et al., 2019). These results underscore the primary influence of maternal employment on long-term nutritional deficits, as captured by stunting[14], rather than on short-term or mixed malnutrition indicators.

[14] Stunting is a measure of chronic malnutrition that develops over an extended period due to persistent deficiencies in nutrition and care. However, the dataset utilised in this analysis does not include information on the duration of maternal employment, thereby limiting the ability to fully capture the temporal dimension of

Model 4 in **Table 3.4** offers valuable insights into how different types of maternal employment influence child health outcomes. Maternal employment in service occupations is associated with a significant reduction in stunting, with a decrease of 11.3 percentage points. This finding highlights the potential for income generated from service jobs to positively affect long-term child nutrition by enabling access to higher-quality food and healthcare services. Service jobs, which are generally less physically demanding and provide more predictable working hours, may allow mothers to allocate resources more effectively, striking a better balance between income generation and caregiving responsibilities. In contrast, the results for mothers engaged in physically demanding labour are less conclusive. The IV-2SLS estimates do not reveal any significant direct association between physical labour and child health outcomes, including stunting, wasting, underweight, or overweight. However, the inclusion of interaction terms between maternal occupation and household wealth sheds light on these nuanced relationships. For mothers in low-wealth households, physical labour is associated with a significant increase in stunting and wasting, reflecting the heightened trade-offs between income generation and caregiving in resource-constrained settings. Limited access to nutrition and healthcare in poorer households appears to exacerbate these negative outcomes. Interestingly, in middle-wealth households, maternal employment in physical labour roles is linked to a significant decrease in stunting. This suggests that households with moderate resources may be better equipped to mitigate the caregiving challenges posed by physically demanding jobs. The availability of better-quality nutrition, healthcare, or additional caregiving support within the household may offset the potential risks of maternal employment in such settings. These causal findings highlight the dual pathways through which maternal employment affects child health: income generation and caregiving constraints. While maternal employment provides critical financial resources, it often comes at the expense of direct caregiving, particularly in low-resource settings. In wealthier households, better access to resources mitigates the adverse effects of maternal employment on child health, allowing income gains to translate into improved nutrition and care. However, in poorer households, the time and physical demands of employment amplify caregiving deficits, leading to worse health outcomes for children.

this relationship. While the findings establish a causal link between maternal employment and higher stunting rates, the mechanism through which long-term employment influences stunting remains unclear. For instance, mothers who have recently entered the workforce may encounter distinct caregiving and nutritional challenges compared to those who have been employed over several years.

3.4.3 Heterogeneity Analysis and Robustness Check

I. Heterogeneity Analysis

The main findings from **Table 3.4** revealed a significant positive relationship between maternal employment and stunting, with children of employed mothers being 12.6% more likely to experience stunted. However, no significant causation were observed between maternal employment and other child health outcomes, such as wasting, underweight, or overweight. To delve deeper into these findings, a series of heterogeneity analyses were conducted to examine the role of age, household wealth, caregiving capacity, birth order, maternal education, regional disparities, and socio-economic status. By investigating these dimensions, the findings provide a nuanced understanding of how maternal employment interacts with socio-economic and demographic factors to shape child health outcomes.

Age-Specific Effects on Child Health Outcomes

Table 3.6 investigates the relationship between maternal employment and child health across two distinct age groups: children under two years old and those aged two to five years. The results show a consistent and significant impact of maternal employment on stunting across both age groups, with a 12.6% increase for children under two years and a similar 12.5% increase for children aged two to five years. This consistency suggests that maternal employment, regardless of the child's age, introduces challenges that compromise long-term growth, likely through reduced caregiving time and diminished attention to nutritional needs. However, the analysis of wasting reveals contrasting results: for children under two years, maternal employment increases wasting by 9.77%, whereas for those aged two to five, it reduces wasting by 4.33%. This divergence could reflect differences in how maternal employment affects the immediate nutritional environment of younger children, who are more dependent on intensive care and feeding practices, compared to older children, who may benefit from greater dietary stability or alternative caregiving arrangements. These findings highlight the importance of considering the child's developmental stage when designing interventions to mitigate the negative impacts of maternal employment.

Table 0.6 *Heterogeneity Analysis - Child Age*

	Stunted		**Wasted**		**Underweight**		**Overweight**	
	<2y	2-5y	<2y	2-5y	<2y	2-5y	<2y	2-5y
Maternal Employment	0.126*	0.125***	0.0977*	-0.043*	0.0561	0.0005	0.047	0.045
	(0.066)	(0.046)	(0.050)	(0.025)	(0.039)	(0.025)	(0.057)	(0.038)
Constant	0.467***	0.492***	0.081	0.091	0.169**	0.155**	0.369**	0.078
	(0.150)	(0.130)	(0.067)	(0.068)	(0.082)	(0.066)	(0.150)	(0.103)
Observation	14,305	20,202	14,305	20,202	14,305	20,202	14,305	20,202
R-squared	0.057	0.059	0.052	0.046	0.029	0.025	0.037	0.041
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Governorates and Year FE	yes	yes	yes	yes	yes	yes	yes	yes

Note: IV-2sls—instrumental variable two-stage least square, the instrument used is The cluster average of women's employment status at the governorates level and each governorate is further divided into urban and rural. The dependent variables are child health outcomes, specifically Stunted, Wasted, Underweight, and Overweight. The main independent variable is maternal employment in the past 12 months. The analysis controls for child characteristics (such as gender, age, birth order, and breastfeeding), mother's characteristics (age, education, body mass index, marital status), partner's characteristics (education, employment status), and household characteristics (household size, household head, number of female adults and Wealth index), FE—fixed effect. Clustered standard errors in parentheses, * p<0.05, ** p<0.01, *** p<0.001.

Caregiving Capacity and Household Composition

Table 3.7 extends the analysis by examining the role of caregiving capacity, proxied by the number of female adults in the household, in mediating the effects of maternal employment on child health. The findings highlight the critical role of caregiving support in shaping child health outcomes, particularly stunting. In households with very low caregiving capacity (one female adult), maternal employment significantly increases stunting by 2.28%. This reflects the strain placed on single caregivers, where maternal time constraints directly affect child nutrition and care. Interestingly, in households with medium caregiving capacity (three female adults), maternal employment reduces stunting by 5.33%, suggesting that shared caregiving responsibilities can effectively alleviate the caregiving burden on working mothers and improve child health. However, in households with high caregiving capacity (four or more female adults), stunting increases by 10.8%, which may seem counterintuitive. This finding could be explained by resource constraints in larger households, where the needs of additional adults may divert resources away from children, or by conflicting caregiving practices that reduce the consistency and quality of child nutrition and care. These results underscore the complex interplay between caregiving capacity, resource availability, and maternal employment in influencing child health outcomes.

Table 0.7 *Heterogeneity Analysis – Number of Female Adult in HH*

	Very Low (1 female adult)	Low (2 female adults)	Medium (3 female adults)	High (4+ female adults)
Stunted				
Maternal Employment	0.0228**	0.0240	-0.0533*	0.108**
	(0.0113)	(0.0302)	(0.0290)	(0.0539)
Constant	0.435***	0.314	0.700**	-0.0496
	(0.0950)	(0.249)	(0.338)	(0.570)
Observations	28,457	3,733	1,357	522
R-squared	0.052	0.069	0.121	0.257
Wasted				
Maternal Employment	-0.000191	0.000374	-0.0128	-0.0183
	(0.00656)	(0.0163)	(0.0189)	(0.0313)
Constant	0.136**	-0.140	0.0764	0.267
	(0.0542)	(0.118)	(0.190)	(0.275)
Observations	28,457	3,733	1,357	522
R-squared	0.049	0.052	0.104	0.137
Underweight				
Maternal Employment	0.00863	0.0218	0.0229	0.0459
	(0.00666)	(0.0177)	(0.0223)	(0.0393)
Constant	0.151***	0.0242	0.282	0.289
	(0.0501)	(0.128)	(0.215)	(0.309)
Observations	28,457	3,733	1,357	522
R-squared	0.020	0.043	0.105	0.111
Overweight				
Maternal Employment	0.0202**	-0.0149	-0.0129	0.0815*
	(0.00949)	(0.0258)	(0.0423)	(0.0467)
Constant	0.124	0.409*	0.508*	0.636
	(0.0814)	(0.231)	(0.298)	(0.550)
Observations	28,457	3,733	1,357	522
R-squared	0.034	0.052	0.069	0.181

Note: IV-2sls—instrumental variable two-stage least square, the instrument used is The cluster average of women's employment status at the governorates level and each governorate is further divided into urban and rural. The dependent variables are child health outcomes, specifically Stunted, Wasted, Underweight, and Overweight. The main independent variable is maternal employment in the past 12 months. The analysis controls for child characteristics (such as gender, age, birth order, and breastfeeding), mother's characteristics (age, education, body mass index, marital status), partner's characteristics (education, employment status), and household characteristics (household size, household head, and Wealth index), FE— fixed effect. Clustered standard errors in parentheses, * p<0.05, ** p<0.01, *** p<0.001.

The Role of Birth Order in Child Health

The analysis in **Table 3.8** sheds light on the differential impacts of maternal employment on child health based on birth order. Firstborn children are disproportionately affected, with significant increases in stunting (6.83%), underweight (2.36%), and overweight (3.72%). These findings are supported by existing studies. Sari and Sartika (2021) found that firstborn children are more than 2.31 times more likely to be stunted at birth compared to non-firstborn children. Similarly, Finlay et al. (2011) documented higher risks of stunting among firstborn children. These studies suggest that firstborns face unique vulnerabilities due to heightened caregiving demands, limited maternal experience, and resource allocation constraints, which are more pronounced for first-time mothers. In contrast, maternal employment has no significant impact on children of subsequent births, indicating that these children may benefit from more established caregiving structures or shared responsibilities within the household.

Table 0.8 *Heterogeneity Analysis – Birth Order*

	Stunted		**Wasted**		**Underweight**		**Overweight**	
	First Birth	Other Birth	First Birth	Other Birth	First Birth	Other Birth	First Birth	Other Birth
Maternal Employment	0.0683***	0.000428	0.00826	-0.00285	0.0236**	0.00390	0.0372**	0.0130
	(0.0214)	(0.0115)	(0.0124)	(0.00710)	(0.0120)	(0.00678)	(0.0181)	(0.0101)
Constant	0.815***	0.366***	0.0658	0.164***	0.211**	0.122**	0.164	0.262***
	(0.179)	(0.112)	(0.0842)	(0.0617)	(0.102)	(0.0573)	(0.142)	(0.100)
Observations	10,388	23,681	10,388	23,681	10,388	23,681	10,388	23,681
R-squared	0.052	0.054	0.046	0.046	0.028	0.020	0.032	0.037

Note: IV-2sls—instrumental variable two-stage least square, the instrument used is The cluster average of women's employment status at the governorates level and each governorate is further divided into urban and rural. The dependent variables are child health outcomes, specifically Stunted, Wasted, Underweight, and Overweight. The main independent variable is maternal employment in the past 12 months. The analysis controls for child characteristics (such as gender, age, and breastfeeding), mother's characteristics (age, education, body mass index, marital status), partner's characteristics (education, employment status), and household characteristics (household size, household head, number of female adults and Wealth index), FE— fixed effect. Clustered standard errors in parentheses, * p<0.05, ** p<0.01, *** p<0.001.

Mother Age at First Birth

Table 3.9 explores how the age at which mothers have their first child influences the relationship between maternal employment and child health outcomes. The findings reveal that younger mothers, particularly those who give birth before the age of 20, face greater challenges in balancing employment and caregiving. Maternal employment increases stunting by 3.18% and underweight by 2.03% among children born to mothers under 20 years old. These results are supported by the broader literature, which highlights the socio-economic disadvantages faced by younger mothers. For instance, Khatab (2010) and Alderman et al. (2001) have shown that early childbearing often results in interrupted education, perpetuating cycles of poverty and reducing mothers' capacity to provide adequate care for their children. Toroitich-Ruto (1998) further emphasizes that younger mothers are often unable to return to school after giving birth, compounding the long-term economic and social consequences for both mother and child.

Conversely, older mothers (aged 35–49 years at first birth) exhibit a protective effect, with maternal employment reducing stunting by 2.8%. This aligns with findings by Sari and Sartika (2021), who reported that children of mothers whose first birth occurred at age 25 or older were significantly less likely to be stunted at birth. Older mothers likely have greater resources, caregiving experience, and decision-making autonomy, enabling them to balance work and caregiving responsibilities more effectively. These results underscore the critical role of maternal age at first birth in shaping the interplay between employment and child health outcomes.

Table 0.9 *Heterogeneity Analysis - Mother Age at First Birth*

	Stunted			**Wasted**			**Underweight**			**Overweight**		
	< 20y	20-34y	35-49y	< 20y	20-34y	35-49y	< 20y	20-34y	35-49y	< 20y	20-34y	35-49y
Maternal Employment	0.0318*	0.0149	-0.028**	0.0147	-0.00377	-0.0859	0.0203*	0.00543	0.105	0.0168	0.0182*	0.147
	(0.0190)	(0.0127)	(0.151)	(0.0118)	(0.00697)	(0.0618)	-0.0112	-0.00694	-0.0786	(0.0157)	(0.0103)	(0.146)
Constant	0.376***	0.352***	12.08	0.137*	0.0614	0.572	0.111	0.172**	3.21	0.364***	0.0711	-3.236
	(0.145)	(0.127)	(7.866)	(0.0711)	(0.0754)	(3.552)	-0.0696	-0.0728	-3.951	(0.119)	(0.112)	(7.138)
Observations	11,832	21,950	207	11,832	21,950	207	11,832	21,950	207	11,832	21,950	207
R-squared	0.065	0.047	0.442	0.042	0.050	0.454	0.023	0.022	0.411	0.038	0.035	0.399

Note: IV-2sls—instrumental variable two-stage least square, the instrument used is The cluster average of women's employment status at the governorates level and each governorate is further divided into urban and rural. The dependent variables are child health outcomes, specifically Stunted, Wasted, Underweight, and Overweight. The main independent variable is maternal employment in the past 12 months. The analysis controls for child characteristics (such as gender, age, birth order, and breastfeeding), mother's characteristics (age, education, body mass index, marital status), partner's characteristics (education, employment status), and household characteristics (household size, household head , number of female adults and Wealth index), FE— fixed effect. Clustered standard errors in parentheses, * p<0.05, ** p<0.01, *** p<0.001.

Maternal Education and Child Health

The analysis in **Table 3.10** highlights the mitigating role of maternal education in the relationship between employment and child health. Maternal employment increases stunting among children of mothers with no education (7.4%) and primary education (3.9%), while the effect diminishes for mothers with secondary or higher education. This indicates that education enhances maternal efficiency in caregiving, resource allocation, and nutritional knowledge, thereby reducing the adverse effects of employment on child health. These findings underscore the critical role of maternal education in promoting child well-being and suggest that policies aimed at increasing educational attainment among women could help address the trade-offs associated with maternal employment.

Regional Disparities

Table 3.11 examines the regional variations in the impact of maternal employment on child health, revealing that children in rural areas are more vulnerable to its negative effects. In rural households, maternal employment increases stunting (2.2%), underweight (1.1%), and overweight (2.4%), while no significant effects are observed in urban settings. These disparities likely reflect the limited access to childcare, healthcare, and diverse diets in rural areas, which exacerbate the challenges of balancing employment and caregiving. These findings highlight the need for targeted interventions in rural areas to address the resource constraints that amplify the adverse effects of maternal employment on child health.

Socio-Economic Status and Wealth

Finally, **Table 3.12** explores the impact of maternal employment across wealth categories. In poor households, maternal employment significantly increases stunting (4.9%), wasting (1.4%), underweight (2.6%), and overweight (3.8%), underscoring the compounded challenges faced by these families. The absence of significant effects in middle- and high-income households suggests that wealthier families are better equipped to mitigate the trade-offs between employment and caregiving, possibly through access to childcare, healthcare, and improved nutrition. However, the findings also highlight the complex dynamics within wealthier households, where the lack of significant associations warrants further investigation into how resources and caregiving responsibilities are distributed.

Table 0.10 *Heterogeneity Analysis – Mother Education*

	Stunted			
	No Education	**Primary**	**Secondary**	**Higher**
Maternal Employment	0.0743**	0.0389*	0.0115	0.00322
	(0.0214)	(0.0328)	(0.0152)	(0.0221)
Constant	0.699***	0.459*	0.200	-0.0152
	(0.160)	(0.255)	(0.136)	(0.615)
Observations	8,673	3,506	17,581	4,309
R-squared	0.059	0.084	0.053	0.056
	Wasted			
	No Education	**Primary**	**Secondary**	**Higher**
Maternal Employment	0.0130	0.000926	0.00293	-0.0204
	(0.0120)	(0.0145)	(0.00931)	(0.0134)
Constant	0.218***	0.195	-0.0197	0.927*
	(0.0816)	(0.123)	(0.0796)	(0.528)
Observations	8,673	3,506	17,581	4,309
R-squared	0.037	0.055	0.059	0.064
	Underweight			
	No Education	**Primary**	**Secondary**	**Higher**
Maternal Employment	0.0108	0.0155	0.0136	-0.00310
	(0.0122)	(0.0177)	(0.00925)	(0.0106)
Constant	0.258***	0.171	-0.00460	0.177
	(0.0802)	(0.149)	(0.0617)	(0.286)
Observations	8,673	3,506	17,581	4,309
R-squared	0.025	0.052	0.023	0.044
	Overweight			
	No Education	**Primary**	**Secondary**	**Higher**
Maternal Employment	0.0233	-0.00338	0.0115	0.0272
	(0.0165)	(0.0318)	(0.0126)	(0.0199)
Constant	0.297**	0.526**	0.0630	-0.908**
	(0.134)	(0.229)	(0.129)	(0.424)
Observations	8,673	3,506	17,581	4,309
R-squared	0.031	0.055	0.040	0.054

Note: IV-2sls—instrumental variable two-stage least square, the instrument used is The cluster average of women's employment status at the governorates level and each governorate is further divided into urban and rural. The dependent variables are child health outcomes, specifically Stunted, Wasted, Underweight, and Overweight. The main independent variable is maternal employment in the past 12 months. The analysis controls for child characteristics (such as gender, age, birth order, and breastfeeding), mother's characteristics (age, education, body mass index, marital status), partner's characteristics (education, employment status), and household characteristics (household size, household head, number of female adults and Wealth index), FE—fixed effect. Clustered standard errors in parentheses, * p<0.05, ** p<0.01, *** p<0.001.

Table 0.11 *Heterogeneity Analysis – Region*

	Stunted		**Wasted**		**Underweight**		**Overweight**	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Maternal Employment	0.0164	0.0220**	0.00156	-0.00218	0.00926	0.0114*	0.0143	0.0235***
	(0.0165)	(0.0109)	(0.00980)	(0.00561)	(0.00984)	(0.00647)	(0.0142)	(0.00908)
Constant	0.185	0.540***	0.0767	0.0710	0.0222	0.208***	-0.0265	0.320***
	(0.155)	(0.112)	(0.0962)	(0.0499)	(0.0936)	(0.0517)	(0.116)	(0.0997)
Observations	12,732	21,337	12,732	21,337	12,732	21,337	12,732	21,337
R-squared	0.036	0.061	0.041	0.049	0.026	0.019	0.033	0.034

Note: IV-2sls—instrumental variable two-stage least square, the instrument used is The cluster average of women's employment status at the governorates level and each governorate is further divided into urban and rural. The dependent variables are child health outcomes, specifically Stunted, Wasted, Underweight, and Overweight. The main independent variable is maternal employment in the past 12 months. The analysis controls for child characteristics (such as gender, age, birth order, and breastfeeding), mother's characteristics (age, education, body mass index, marital status), partner's characteristics (education, employment status), and household characteristics (household size, number of female adults and Wealth index), FE— fixed effect. Clustered standard errors in parentheses, * p<0.05, ** p<0.01, *** p<0.001.

Table 0.12 *Heterogeneity Analysis – Wealth*

	Stunted			**Wasted**			**Underweight**			**Overweight**		
	Poor	**Middle**	**Rich**	**Poor**	**Middle**	**Rich**	**Poor**	**Middle**	**Rich**	**Poor**	**Middle**	**Rich**
Maternal Employment	0.049***	0.0012	0.0097	0.0143*	-0.0024	-0.0059	0.026***	-0.0016	0.0073	0.038***	-0.013	0.0213
	(0.015)	(0.020)	(0.016)	(0.008)	(0.011)	(0.009)	(0.009)	(0.010)	(0.009)	(0.014)	(0.016)	(0.014)
Constant	0.66***	0.52***	0.0396	0.144**	0.0237	0.056	0.245***	0.156*	0.064	0.35***	0.112	-0.087
	(0.130)	(0.183)	(0.147)	(0.066)	(0.088)	(0.093)	(0.068)	(0.085)	(0.086)	(0.116)	(0.15)	(0.122)
Observations	14,397	6,994	12,678	14,397	6,994	12,678	14,397	6,994	12,678	14,397	6,994	12,678
R-squared	0.061	0.065	0.046	0.036	0.073	0.052	0.020	0.032	0.026	0.035	0.055	0.035

Note: IV-2sls—instrumental variable two-stage least square, the instrument used is The cluster average of women's employment status at the governorates level and each governorate is further divided into urban and rural. The dependent variables are child health outcomes, specifically Stunted, Wasted, Underweight, and Overweight. The main independent variable is maternal employment in the past 12 months. The analysis controls for child characteristics (such as gender, age, birth order, and breastfeeding), mother's characteristics (age, education, body mass index, marital status), partner's characteristics (education, employment status), and household characteristics (household size, household head, and number of female adults), FE— fixed effect. Clustered standard errors in parentheses, * p<0.05, ** p<0.01, *** p<0.001.

II. Robustness Check

Evaluating the Impact of Maternal Employment on Child Health Across Nutritional Thresholds

The robustness check explores the effect of maternal employment on child nutritional outcomes using alternative thresholds for stunting (-1.5 SD and -2.5 SD) to validate the main findings. This analysis is conducted using IV-2SLS (instrumental variable two-stage least squares), where the instrument employed is the cluster average of women's employment status at the governorate level, with each governorate further divided into urban and rural areas. This approach ensures a robust identification of the causal effects of maternal employment on child health outcomes.

Table 0.13 *Robustness Analysis Using Alternative Nutritional Thresholds*

	(1) Stunting (-2)	(2) Stunting (-1.5)	(3) Stunting (-2.5)	(4) Wasted (-2)	(5) Wasted (-1.5)	(6) Wasted (-2.5)	(7) Under-weight (-2)	(8) Under-weight (-1.5)	(9) Under-weight (-2.5)	(10) Over-weight (+2)	(11) Over-weight (+1.5)	(12) Over-weight (+2.5)
Maternal Employment	0.126***	0.167**	0.101*	0.00440	0.0170	-0.0232	0.0187	0.0725	0.0181	0.0428	0.0258	-0.0148
	(0.0386)	(0.0689)	(0.0583)	(0.0228)	(0.0491)	(0.0314)	(0.0229)	(0.0475)	(0.0261)	(0.0304)	(0.0307)	(0.0256)
Constant	0.394***	0.329***	0.284***	0.117**	0.283***	0.0751	0.145***	0.294***	0.0171	0.156**	1.143***	1.189***
	(0.0873)	(0.117)	(0.0991)	(0.0469)	(0.0819)	(0.0553)	(0.0470)	(0.0875)	(0.0340)	(0.0742)	(0.0707)	(0.0626)
Observations	34,507	34,507	34,507	34,507	34,507	34,507	34,507	34,507	34,507	34,507	34,507	34,507
R-squared	0.050	0.077	0.053	0.045	0.069	0.055	0.019	0.029	0.017	0.033	0.407	0.563

Note: IV-2SLS—instrumental variable two-stage least square; the instrument used is the cluster average of women's employment status at the governorates level, with each governorate further divided into urban and rural areas. The dependent variables are child health outcomes, specifically Stunted, Wasted, Underweight, and Overweight, measured using various classification thresholds (e.g., -2 SD, -1.5 SD, +2 SD). The main independent variable is maternal employment in the past 12 months. The analysis controls for child characteristics (such as gender, age, birth order, and breastfeeding), mother's characteristics (age, education, body mass index, marital status), partner's characteristics(education, employment status), and household characteristics (household size, household head, number of female adults, and Wealth index). FE—fixed effects for survey year and governorates. Clustered standard errors are reported in parentheses. *p < 0.05, **p < 0.01, ***p < 0.001.

The results indicate a consistent and significant relationship between maternal employment and stunting across all thresholds, confirming the robustness of this relationship. At the original classification of -2 SD, maternal employment increases the likelihood of stunting by 12.6%, a result that remains significant at 1% and consistent with the main analysis. When the threshold is adjusted to -1.5 SD, the likelihood of stunting increases to 16.7% (significant at 5%), demonstrating a slightly stronger effect when a less stringent definition is applied. At the stricter -2.5 SD threshold, the magnitude of the effect diminishes to 10.1% but remains statistically significant at the 10% level. These findings underline the robustness of the stunting results and

reinforce the conclusion that maternal employment consistently increases the risk of chronic malnutrition in children, irrespective of the classification threshold. For wasting, underweight, and overweight outcomes, no significant effects of maternal employment were observed at any threshold. Overall, the robustness checks validate the primary findings of this chapter, particularly the strong and consistent relationship between maternal employment and stunting.

Evaluating the Impact of Maternal Employment on Child Health Using Alternative Instruments

The robustness check employing the proportion of female-headed households as an alternative instrument for maternal employment sheds further light on the association between maternal employment and child health outcomes while addressing socio-economic dynamics potentially reflected by this measure. **Table 3.14** reveals that the positive association between maternal employment and stunting persists, with a statistically significant IV coefficient of 0.158. This indicates that maternal employment increases the likelihood of stunting among children by 15.8%, slightly higher than the 12.6% increase reported in the primary analysis using the cluster average of women's employment as the instrument. This consistency underscores the robustness of the observed relationship and invites deeper reflection on the socio-economic dimensions captured by the alternative instrument.

The use of female-headed households as an instrument raises an important question about what this measure represents—whether it primarily reflects poverty and marginalisation or empowerment and independence. Both interpretations have implications for understanding the mechanisms underlying the relationship between maternal employment and child health. On the one hand, a higher proportion of female-headed households may signify socio-economic marginalisation, with women heading households due to factors such as widowhood, divorce, or abandonment, often under conditions of poverty. In such contexts, maternal employment could exacerbate the already constrained resources available for childcare and nutrition, intensifying the risks of stunting among children. The higher IV coefficient in this robustness check compared to the primary analysis may reflect these compounded vulnerabilities in marginalised households. On the other hand, female-headed households might also capture aspects of empowerment and autonomy, as women who head households may exercise greater decision-making authority over resources and employment choices. In such settings, the observed effect of maternal employment on stunting may be less about structural marginalisation and more about the inherent trade-offs

associated with balancing work and caregiving. For instance, even in empowered households, the absence of adequate support systems and the demands of employment could reduce the time and attention devoted to child nutrition and care, resulting in similar adverse outcomes.

Table 0.14 *Robustness Analysis Using Alternative Instruments – (The Proportion of Female-Headed Households)*

Panel A								
	Stunted		**Wasted**		**Underweight**		**Overweight**	
	LPM	IV	LPM	IV	LPM	IV	LPM	IV
Maternal Employment	0.059***	0.158**	-0.005	0.182	0.003	0.137	0.043***	0.308
	(0.0176)	(0.414)	(0.007)	(0.499)	(0.009)	(0.494)	(0.0145)	(0.073)
Constant	0.393***	0.435***	0.116**	0.123**	0.145***	0.144***	0.156**	0.179**
	(0.088)	(0.142)	(0.047)	(0.0486)	(0.047)	(0.0457)	(0.074)	(0.0881)
Observations	34,093	34,507	34,093	34,507	34,093	34,507	34,093	34,507
R-squared	0.050	0.04	0.045	0.029	0.020	0.009	0.033	0.022
controls	yes	yes	yes	yes	yes	yes	yes	yes
Survey Year FE	yes	yes	yes	yes	yes	yes	yes	yes
Governorates FE	yes	yes	yes	yes	yes	yes	yes	yes

Panel B – 1st stage	
Instrument:	
The proportion of female-headed households	0.373*** (0.107)
Constant	0.035*** (0.037)
Observations	34,507
R-squared	0.7756
Adj R-squared	0.7752
First partial R2	0.09
First-stage F-statistic	60.02
First-stage F-test P-value	0.0000

Note: Clustered standard errors in parentheses, * p<0.05, ** p<0.01, *** p<0.001. LPM—linear probability model, IV-2sls—instrumental variable two-stage least square, 1st-stage regression results are the same in the stunted, wasted, underweight, and overweight cases. The dependent variables are child health outcomes, specifically Stunted, Wasted, Underweight, and Overweight. The main independent variable is maternal employment in the past 12 months. The analysis controls for child characteristics (such as gender, age, birth order, and breastfeeding), mother's characteristics (age, education, body mass index, marital status), partner's characteristics (education, employment status), and household characteristics (household size, number of female adults and Wealth index), FE— fixed effect.

The first-stage results provide additional clarity, demonstrating a strong and statistically significant association between the proportion of female-headed households and maternal employment. The first-stage coefficient of 0.373 and an F-statistic of 60.02 confirm the

instrument's validity and relevance. Importantly, this association suggests that female-headed households are not only a meaningful proxy for maternal employment but also reflect underlying socio-economic and normative structures that shape women's participation in the labour market. The lack of significant effects on other child health outcomes, such as wasting, underweight, and overweight, in this robustness check is consistent with the primary analysis. These findings reinforce the specificity of maternal employment's association with chronic malnutrition, as captured by stunting, rather than shorter-term or weight-related indicators of nutritional status. In conclusion, the robustness check using female-headed households as an instrument confirms the primary finding that maternal employment significantly increases the likelihood of stunting among children in Egypt. The dual interpretation of this instrument—encompassing both poverty-driven marginalisation and empowerment—underscores the complex socio-economic dynamics at play. Whether reflecting resource constraints in marginalised households or caregiving trade-offs in empowered households, the results emphasise the structural challenges faced by working mothers in balancing employment and childcare.

3.5 Discussion

This chapter provides robust evidence on the relationship between maternal employment and child health outcomes in Egypt, focusing on stunting, wasting, underweight, and overweight. Utilizing data from three rounds of Egypt's Demographic and Health Surveys (2005, 2008, and 2014) and controlling for a comprehensive range of child, maternal, partner, and household characteristics, our analysis reveals that maternal employment is significantly associated with adverse child health outcomes, particularly stunting. The IV-2SLS results indicate that children of employed mothers are 12.6% more likely to experience stunting. This finding is broadly consistent with those of Rashad and Sharaf (2019), who also used EDHS 2014 and an IV-2SLS strategy. However, their analysis—based on a smaller sample and a single cross-section—estimated a larger effect, reporting that maternal employment increased stunting by 18% and wasting by 13%. In contrast, my findings show a 12.6% increase in stunting and no statistically significant effect on wasting in the pooled sample. The smaller magnitude may be due to the broader sample coverage across multiple survey waves and richer control variables. Moreover, my analysis extends the previous work by examining heterogeneity across child age groups, maternal employment sectors, and age at first birth—thereby offering a more nuanced understanding of the underlying mechanisms.

The results reveal that children under the age of two are disproportionately affected, with maternal employment increasing the likelihood of stunting by 12.6% and wasting by 9.7%., supporting findings by Popkin (1980) and Haggerty (1981). This highlights the critical need for intensive care during early childhood, a period fundamental to long-term health and development. Similarly, Abbi et al. (1991) and Engle and Pedersen (1989) documented adverse health effects for younger children in India and Guatemala, respectively, underscoring the need for intensive maternal involvement in early childhood. For children aged two to five years, the findings diverge. Maternal employment is associated with a 4.3% reduction in wasting, suggesting that as children grow older, the income effect begins to outweigh the substitution effect. This positive trend is consistent with Lamontagne et al. (1998), who found that older children benefited more from maternal employment due to improved household resources, such as better nutrition and healthcare. This age-specific heterogeneity highlights the evolving needs of children over time and the differential capacity of maternal employment to meet these needs.

While maternal employment can provide additional household resources, the trade-off in caregiving time appears to outweigh these benefits, supporting Becker's (1965) time allocation theory. This theory posits that the net impact of maternal employment depends on the balance between positive income effects and negative substitution effects. In low- and middle-income countries like Egypt, this balance is often skewed due to inadequate childcare infrastructure and limited social support systems, making the substitution effect more pronounced. Thus, Becker's framework is particularly useful in explaining why maternal employment may lead to adverse child health outcomes when caregiving time cannot be adequately compensated for.

The type of maternal employment plays a pivotal role in moderating its impact on child health. Service-sector jobs, often more formalised and stable, are associated with lower stunting rates, potentially reflecting higher income levels and better access to healthcare and nutrition. These results echo findings by Debela et al. (2021) in Tanzania, where non-agricultural employment was linked to improved child height-for-age at higher levels of labour supply. However, the increased risk of wasting associated with service jobs in this chapter underscores short-term disruptions in caregiving, a phenomenon similarly documented by Black et al. (2013) and Ruel and Alderman (2013) in contexts where unpredictable work schedules limit maternal availability. Conversely, physically demanding jobs, such as agricultural or manual labour, exacerbate the risks of stunting and wasting, particularly in low-resource settings. This finding

aligns with Nankinga et al. (2019) in Uganda, where children of agricultural workers exhibited higher stunting rates due to time-intensive work and low economic returns.

These patterns suggest that the mechanism linking maternal employment to adverse child health outcomes operates primarily through resource constraints. The effects are most pronounced among women who are poor, reside in rural areas, or have limited education—groups that typically lack access to high-quality childcare, healthcare, and flexible work arrangements. In such contexts, the substitution effect dominates, as employment tends to reduce caregiving time without generating sufficient income to compensate for that loss. This highlights the importance of socio-economic conditions in moderating the impact of maternal employment on child health.

Additionally, the heterogeneity analysis by maternal age at first birth reveals critical insights that tie directly to the findings of Chapter 2, where early motherhood was shown to negatively affect women's employment opportunities. In this chapter, the results indicate that mothers who gave birth before the age of 20 face compounded disadvantages: their children are significantly more likely to experience stunting and wasting compared to those of mothers who delayed childbirth. This finding aligns with research by Abbi et al. (1991) and Glick and Sahn (1998), who documented that early motherhood limits maternal capacity to invest in child health due to both economic constraints and reduced human capital. Early motherhood often coincides with lower educational attainment, which, as shown in studies by Afridi et al. (2016) in India and Brauner-Otto et al. (2019) in Nepal, limits mothers' ability to secure stable, higher-paying jobs, exacerbating the negative substitution effect. Conversely, mothers who delayed childbirth—typically with higher education levels and better employment prospects—were able to mitigate these trade-offs, with their children exhibiting better health outcomes.

In developed countries, the relationship between maternal employment and child health has been extensively studied, often facilitated by longitudinal data and advanced econometric methods. Research in the United States (e.g., Ruhm, 2008; Gennetian et al., 2010), Canada (Baker et al., 2008; Phipps et al., 2006), the United Kingdom (Ermisch & Francesconi, 2013), Germany (Meyer, 2016), and Australia (Bishop, 2011) reveals a multifaceted picture, highlighting the moderating roles of income, childcare availability, and maternal work conditions. In contrast, studies in developing countries typically focus on undernutrition due to resource constraints and limited healthcare access. Research in India (Afridi et al., 2016; Abbi et al., 1991), Bangladesh (Pulok et al., 2016), Uganda (Nankinga et al., 2019), and China (Short et al., 2002) consistently

underscores the dual burden of maternal employment, where caregiving trade-offs often exacerbate stunting and wasting. My findings reinforce this dual nature of maternal employment's impact on child health, underscoring the pivotal role of the quality and type of maternal employment in shaping child health outcomes.

Despite these robust findings, this chapter has some limitations. The cross-sectional nature of the data precludes an assessment of the long-term impacts of maternal employment on child health. Additionally, this chapter does not account for qualitative job characteristics, such as wages, job security, and working conditions, which may further explain variations in child health outcomes. The absence of data on childcare arrangements and nutritional intake also limits the ability to fully explore the mechanisms through which maternal employment affects child health. Future research should prioritise longitudinal data to capture the long-term effects of maternal employment and changes in employment patterns over time. Studies could also benefit from detailed information on job quality, working conditions, and childcare arrangements to better understand the trade-offs between employment and caregiving. Exploring regional differences within Egypt and incorporating data on dietary intake and child morbidity would further enhance our understanding of these dynamics. In conclusion, this chapter underscores that maternal employment in Egypt has significant implications for child health, particularly regarding stunting and wasting. These effects are most pronounced for younger children and vary by maternal occupation type, socio-economic status, and regional context. The findings highlight the need for policies that support working mothers by improving access to quality childcare, implementing flexible work arrangements, and enhancing maternal health services. Such measures can help balance the positive income effects of maternal employment with the critical need for adequate caregiving, ultimately promoting better health outcomes for children.

3.6 Conclusion

This chapter examined the relationship between maternal employment and child health outcomes in Egypt, focusing on stunting, wasting, underweight, and overweight among children. Utilizing data from the 2005, 2008, and 2014 Egypt Demographic and Health Surveys and employing both Linear Probability Models and Two-Stage Least Squares methods, the research addressed three key questions: the effect of maternal employment on child health, the influence of the nature of maternal work, and how this relationship varies among different age groups. The findings reveal that maternal employment is significantly associated with adverse child health outcomes, particularly an increased likelihood of stunting by 13%. The nature of maternal employment plays a critical role; service-sector employment showed mixed effects—reducing stunting but increasing wasting—while physically demanding labour did not exhibit significant associations. Additionally, younger children, especially those under two years old, are more vulnerable to the negative impacts of maternal employment, highlighting the crucial need for maternal care during early childhood. These results underscore the complex interplay between maternal employment and child health, emphasizing the need for policies that support working mothers. Enhancing access to quality childcare, implementing flexible working conditions, and improving maternal health services are essential steps. Moreover, promoting educational and economic opportunities for women could mitigate the negative impacts of maternal employment on child health by enabling mothers to secure better employment that balances income generation with caregiving responsibilities.

Appendices

Table 3.A1. *Variable Description*

#	DHS	Variable	Description
Outcome variables- Continuous variables - WHO z score			
-	Hw70	HAZ	Height for age standard deviation (according to WHO)
-	Hw71	WAZ	Weight for age standard deviation (according to WHO)
-	Hw72	WHZ	Weight for height standard deviation (according to WHO)
Outcome variables- Binary outcome variables			
1	Hw70	stunted	=1 if HAZ<-2; Otherwise Stunted=0
2	Hw72	wasted	=1 if WHZ<-2; Otherwise wasted =0
3	Hw72	overweight	=1 if WHZ>+2; Otherwise, overweight =0
4	Hw71	underweight	=1 if WAZ<-2; Otherwise, underweight =0
Main independent variable			
5	V731	Employ12m	Mothers employed in the past 12 month
Controls			
Child's characteristics			
6	B4	Gender	Child gender, Female =0 and male=1
7	HW1	Childage	Child age in months
8	B0	Twin	If the child Single or Multiple Births. New variable created: 0 if the child is born as a single birth, and 1 if multiple.
9	M18	Birthsize	Size of child at birth. 1 larger than average, 2 average size, 3 smaller than average, 4 very small
10	bord	birthorder	Birth order number gives the order in which the children were born. New variable created: 1= first child, 2= 2nd and 3rd child, 3= 4th and 5th child, 4= 6th child and higher
11	M4	breasfeeding	The duration of breastfeeding of the child in months. The maximum period allowed during the data editing was the interval between the date of birth of the child and the date of interview. New variable created: 0= never breastfeeding, 1= had breastfeeding in the past, 2= still breastfeeding,
Mother's characteristics			
12	V012	Mage	Mother age in years
13	V133	Mtotedu	Mother total education in Years.
14	v438	mheigh	According to WHO standard, 1 Short if the mother height < 152cm, and 2 Tall if the mother height > 152cm
15	V445	Bmi	Body mass index for the respondent (Mother) 1 Underweight, 2 Normal weights, 3 Overweight, 4 Obese
16	V501	Marital	Marital status: 1 Married, 3 Widowed, 4 Divorced, 5 Not living together
Partner/ husband's characteristics			
17	v715	hustotedu	Partner total education in years
18	v705	husemployed	Husband employment status, 1 if partner employed and 0 otherwise.
Household's characteristics			
19	v137	Nochildern	Number of children under 5 in the HH.
20	v151	Household head	1= male, 2=female.
21	V138	Nofadult	The number of female adults in the household
22	v102	ruralurban	Region (1-urban, 2-rural)
23	V190	Wealth	Wealth index the highest is 5 and the lowest is 1

Source: DHS dataset (2005,2008,2014).

Table 3.A2. *Kolmogorov-Smirnov Test*

	Kolmogorov-Smirnov test	
	D	**P-Value**
HAZ	0.0141	0.680
WHZ	0.0380	0.001
WAZ	0.0371	0.002

Source: Author creation using DHS dataset (2005,2008,2014). Kolmogorov-Smirnov Test for the equality of distributions, we conclude that we Failed to reject the null hypothesis of equality of distributions of Height-for-age z-score (HAZ) by mother's employment status (p-value=0.680), which means that there is no difference between working mothers and non-working mothers 'distribution. However, we reject the null hypothesis of equality of distributions of weight-for-height z-score (WHZ) and weight-for-age z-score (WAZ) by mother's employment status (p-value= 0.001 and p-value=0.002).

Table 3.A3. *Summary Statistics*

Variables	(1)		(2)		(3)			
	All sample		Non-working mothers		Working mothers		(2) minus (3)	
	Mean	SD	Mean	SD	Mean	SD	Diff.	SD
Child Health Indicators+								
Stunted	0.239	(0.0041)	0.2376	(0.0043)	0.2472	(0.0083)	-0.0097	(0.0084)
Wasted	0.0687	(0.0022)	0.07	(0.0024)	0.0612	(0.0040)	0.0087 **	(0.0040)
Underweight	0.0546	(0.0017)	0.0546	(0.0018)	0.0547	(0.0039)	-0.0001	(0.0041)
Overweight	0.1541	(0.0033)	0.1508	(0.0033)	0.1742	(0.0071)	-0.0234 ***	(0.0070)
Child Characteristics								
Child gender								
Female	0.4834	(0.0029)	0.4836	(0.0031)	0.4819	(0.0075)	0.0017	(0.0080)
Male	0.5166	(0.0029)	0.5164	(0.0031)	0.5181	(0.0075)	-0.0017	(0.0080)
Child Age (months)	28.6536	(0.0919)	28.3488	(0.0983)	30.4873	(0.2310)	-2.1385 ***	(0.2466)
Child age group								
Child age < 2	0.4214	(0.0027)	0.4296	(0.0029)	0.3721	(0.0065)	0.0575***	(0.0071)
Child age > 2	0.5786	(0.0027)	0.5704	(0.0029)	0.6279	(0.0065)	-0.0575***	(0.0071)
Birth type								
Single	0.9792	(0.0009)	0.9794	(0.0009)	0.9782	(0.0023)	0.0013	(0.0025)
Multiple	0.0208	(0.0009)	0.0206	(0.0009)	0.0218	(0.0023)	-0.0013	(0.0025)

Notes: Linearized Standard errors are provided in parentheses. + Child Health Indicators, stunted, wasted and underweight occurs when a child's (HA, WH, and WA) Z-score is below the median (SD, -2), and overweight occurs when a child's WH-Z-score is above the median (SD, 2). ***p < .01; **p < .05; *p < .1.

Table 3.A3. *(Continued)*

Variables	(1)		(2)		(3)		(2) minus (3)	
	All sample		Non-Working mothers		Working mothers			
	Mean	SD	Mean	SD	Mean	SD	Diff.	SD
Child Characteristics								
Birth size								
Very large	0.0034	(0.0003)	0.0032	(0.0003)	0.0049	(0.0010)	-0.0017	(0.0011)
Larger than average	0.0301	(0.0011)	0.0306	(0.0012)	0.027	(0.0027)	0.0035	(0.0029)
Average size	0.8222	(0.0028)	0.8209	(0.0031)	0.8297	(0.0062)	-0.0088	(0.0068)
Smaller than average	0.1041	(0.0022)	0.1039	(0.0024)	0.1051	(0.0051)	-0.0012	(0.0056)
Very small	0.0402	(0.0014)	0.0414	(0.0015)	0.0332	(0.0030)	0.0081 **	(0.0033)
Birth order of child	2.54	(0 .0144)	2.51	(0.0151)	2.72	(0.032)	-0.2089***	(0.0323)
1st born	0.312	(0.0026)	0.3215	(0.0028)	0.2549	(0.0063)	0.0666 ***	(0.0068)
2nd - 3rd born	0.4738	(0.0027)	0.4695	(0.0030)	0.4992	(0.0075)	-0.0297 ***	(0.0081)
4th - 5th born	0.1584	(0.0024)	0.1541	(0.0025)	0.1841	(0.0065)	-0.03 ***	(0.0069)
6th born and above	0.0558	(0.0018)	0.0548	(0.0018)	0.0618	(0.0046)	-0.0069	(0.0047)
Breastfeeding								
Never breastfed	0.0508	(0.0016)	0.0501	(0.0017)	0.0552	(0.0041)	-0.0051	(0.0044)
Breastfed in the past	0.6402	(0.0028)	0.6344	(0.0030)	0.6755	(0.0068)	-0.0412 ***	(0.0073)
Currently breastfeeding	0.309	(0.0026)	0.3155	(0.0028)	0.2693	(0.0060)	0.0462 ***	(0.0064)

Notes: Linearized Standard errors are provided in parentheses. ***p < .01; **p < .05; *p < .1.

Table 3.A3. *(Continued)*

Variables	(1) All sample		(2) Non-Working mothers		(3) Working mothers		(2) minus (3)	
	Mean	SD	Mean	SD	Mean	SD	Diff.	SD
Mother Characteristics								
Mother's age (years)	28.4084	(0.0466)	28.0281	(0.0476)	30.6896	(0.1156)	-2.6615 ***	(0.1178)
Mother's total education (years)	7.9131	(0.0710)	7.5618	(0.0688)	10.0179	(0.1646)	-2.4561 ***	(0.1558)
Mother BMI								
Underweight	0.0052	(0.0005)	0.0052	(0.0005)	0.0053	(0.0015)	-0.0001	(0.0015)
Normal	0.2516	(0.0039)	0.2569	(0.0042)	0.2198	(0.0084)	0.0371 ***	(0.0089)
Overweight	0.4054	(0.0040)	0.4057	(0.0043)	0.4037	(0.0093)	0.0021	(0.0100)
Obese	0.3378	(0.0046)	0.3322	(0.0048)	0.3712	(0.0099)	-0.039 ***	(0.0102)
Mother heigh								
Mother is short <152 cm	0.0912	(0.0025)	0.093	(0.0027)	0.0803	(0.0049)	0.0127 **	(0.0052)
Mother is tall > 152 cm	0.9088	(0.0025)	0.907	(0.0027)	0.9197	(0.0049)	-0.0127 **	(0.0052)
Marital status								
Married	0.9842	(0.0009)	0.9858	(0.0009)	0.9746	(0.0026)	0.0111 ***	(0.0027)
Widowed	0.0055	(0.0005)	0.005	(0.0006)	0.0088	(0.0014)	-0.0039 **	(0.0015)
Divorced	0.0057	(0.0005)	0.0048	(0.0005)	0.0108	(0.0017)	-0.006 ***	(0.0018)
No longer living together/separated	0.0046	(0.0005)	0.0044	(0.0006)	0.0057	(0.0014)	-0.0012	(0.0015)
Partner Characteristics								
Father employed								
No	0.0661	(0.0020)	0.0641	(0.0020)	0.0784	(0.0055)	-0.0143 **	(0.0057)
Yes	0.9339	(0.0020)	0.9359	(0.0020)	0.9216	(0.0055)	0.0143 **	(0.0057)
Father's total education	8.9669	(0.0580)	8.7022	(0.0570)	10.5576	(0.1364)	-1.8554 ***	(0.1331)

Notes: Linearized Standard errors are provided in parentheses. ***p < .01; **p < .05; *p < .1.

Table 3.A3. *(Continued)*

Variables	(1)		(2)		(3)		(2) minus (3)	
	All sample		Non-Working mothers		Working mothers			
	Mean	SD	Mean	SD	Mean	SD	Diff.	SD
Household Characteristics								
Number of children under five in the household	1.7825	(0.0168)	1.7902	(0.0167)	1.7369	(0.0372)	0.0532	(0.0352)
Number of adult women in the household	1.2325	(0.0114)	1.2401	(0.0113)	1.1869	(0.0241)	0.0532 **	(0.0224)
Household Head								
Male	0.953	(0.002)	0.953	(0.001)	0.950	(0.004)	0.0024	(0.0043)
Female	0.047	(0.002)	0.047	(0.001)	0.049	(0.004)	-0.0024	(0.0043)
Residence								
Urban	0.3446	(0.0096)	0.3380	(0.0097)	0.3841	(0.0147)	-0.0462 ***	(0.0122)
Rural	0.6554	(0.0096)	0.662	(0.0097)	0.6159	(0.0147)	0.0462 ***	(0.0122)
Wealth Index								
Poorest	0.194	(0.0050)	0.1961	(0.0052)	0.1813	(0.0107)	0.0148	(0.0106)
Poorer	0.201	(0.0043)	0.2087	(0.0046)	0.1551	(0.0076)	0.0536 ***	(0.0083)
Middle	0.2286	(0.0046)	0.2347	(0.0048)	0.1919	(0.0086)	0.0427 ***	(0.0085)
Richer	0.2055	(0.0047)	0.2046	(0.0051)	0.2111	(0.0088)	-0.0064	(0.0093)
Richest	0.1708	(0.0052)	0.1559	(0.0050)	0.2606	(0.0109)	-0.1047 ***	(0.0098)

Notes: Linearized Standard errors are provided in parentheses. ***p < .01; **p < .05; *p < .1.

Table 3.A4 *Regression Results using the LPM [1] and IV-2sls [2] Method*

Variables	LPM				1st stage [a]	IV-2SLS			
	(1) Stunted	(2) Wasted	(3) Under-weight	(4) Over-weight	(5) AWE[b]	(6) Stunted	(7) Wasted	(8) Under-weight	(9) Over-weight
Working regularly over past year	0.059***	-0.005	0.003	0.043***		0.126***	0.004	0.019	0.043
	(0.018)	(0.007)	(0.009)	(0.015)		(0.039)	(0.023)	(0.023)	(0.030)
Child's sex (Ref. male)	-0.036***	-0.008***	-0.017***	0.0047	-0.001	-0.035***	-0.008***	-0.017***	0.005
	(0.005)	(0.003)	(0.003)	(0.005)	(0.002)	(0.005)	(0.003)	(0.003)	(0.005)
Child's age in months/100	0.650***	-0.388***	-0.216***	-0.289***	0.034	0.646***	-0.389***	-0.217***	-0.289***
	(0.087)	(0.0570)	(0.057)	(0.079)	(0.026)	(0.087)	(0.057)	(0.057)	(0.079)
Child's age in months squared/100	-0.011***	0.005***	0.003***	0.003**	-0.003	-0.011***	0.005***	0.003***	0.003**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Child has a twin	0.066***	0.008	0.020	-0.006	-0.009	0.067***	0.008	0.021*	-0.006
	(0.0211)	(0.0116)	(0.0124)	(0.0157)	(0.006)	(0.021)	(0.012)	(0.012)	(0.016)
Size at birth (Ref. Very large)									
Larger than average	-0.046	-0.007	0.002	-0.022	-0.04**	-0.043	-0.007	0.003	-0.022
	(0.048)	(0.025)	(0.024)	(0.039)	(0.015)	(0.048)	(0.025)	(0.024)	(0.039)
Average	-0.018	-0.006	0.005	-0.033	-0.04**	-0.015	-0.005	0.005	-0.033
	(0.046)	(0.024)	(0.024)	(0.036)	(0.014)	(0.046)	(0.024)	(0.024)	(0.036)
Smaller than average	0.025	0.001	0.024	-0.049	-0.03**	0.028	0.001	0.025	-0.049
	(0.047)	(0.024)	(0.025)	(0.035)	(0.015)	(0.047)	(0.024)	(0.025)	(0.037)
Very small	0.0490	0.0133	0.042*	-0.040	-0.03**	0.052	0.014	0.043*	-0.040
	(0.046)	(0.026)	(0.025)	(0.039)	(0.015)	(0.046)	(0.026)	(0.025)	(0.039)
Birth order of child (Ref. 1st child)									
2nd - 3rd child	0.018***	0.004	0.003	-0.006	0.004*	0.018***	0.003	0.003	-0.006
	(0.007)	(0.002)	(0.004)	(0.005)	(0.002)	(0.007)	(0.004)	(0.004)	(0.005)
4th - 5th child	0.013	0.014**	0.010*	-0.015	0.02***	0.012	0.014**	0.010*	-0.015
	(0.011)	(0.006)	(0.006)	(0.009)	(0.003)	(0.011)	(0.006)	(0.006)	(0.010)
6th child or higher	0.030*	0.009	0.002	-0.022*	0.03***	0.028*	0.008	0.002	-0.022*
	(0.016)	(0.009)	(0.008)	(0.013)	(0.005)	(0.016)	(0.009)	(0.008)	(0.013)

Notes: Clustered Standard errors are provided in parentheses. ****$p < 0.01$; **$p < 0.05$; *$p < 0.1$. [a]1st-stage regression results are the same in the wasted, underweight, and overweight cases. Standard errors in parentheses, [b] AWE is the Instrument "the cluster average women employment".

Table 3.A4. *(Continued)*

Variables	LPM				1st stage [a]	IV-2SLS			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Stunted	Wasted	Under-weight	Over-weight	AWE[b]	Stunted	Wasted	Under-weight	Over-weight
Breastfeeding (Ref. never breastfed)									
had breastfed in the past	0.003	-0.001	0.002	0.022*	0.003	0.003	-0.001	0.002	0.022*
	(0.014)	(0.009)	(0.007)	(0.012)	(0.005)	(0.014)	(0.009)	(0.007)	(0.012)
still breastfeeding	0.011	-0.017*	-0.006	-0.002	0.003	0.010	-0.017*	-0.006	-0.002
	(0.016)	(0.010)	(0.009)	(0.014)	(0.005)	(0.016)	(0.010)	(0.009)	(0.014)
Mother's current age in years/100	-0.835**	0.172	-0.130	-0.453	0.64***	-0.875**	0.166	-0.139	-0.453
	(0.425)	(0.233)	(0.225)	(0.386)	(0.126)	(0.424)	(0.233)	(0.224)	(0.385)
Mother's current age squared/100	0.012*	-0.003	0.002	0.008	-0.01***	0.012*	-0.003	0.002	0.008
	(0.007)	(0.004)	(0.004)	(0.006)	(0.002)	(0.007)	(0.004)	(0.004)	(0.006)
Mother's education in single years/100	-0.395**	-0.109	-0.181*	0.364**	-0.34***	-0.366*	-0.105	-0.174	0.364**
	(0.199)	(0.117)	(0.107)	(0.160)	(0.057)	(0.199)	(0.118)	(0.108)	(0.160)
Education squared/100	0.016	0.007	0.007	-0.029**	0.015***	0.015	0.006	0.007	-0.028**
	(0.014)	(0.008)	(0.008)	(0.011)	(0.004)	(0.014)	(0.008)	(0.008)	(0.011)
Mother BMI (Ref. underweight)									
Normal	0.034	0.030**	0.021	0.066***	0.015	0.033	0.030**	0.021	0.066***
	(0.034)	(0.014)	(0.016)	(0.022)	(0.012)	(0.034)	(0.014)	(0.016)	(0.022)
Overweight	0.034	0.020	0.009	0.091***	0.014	0.033	0.021	0.009	0.091***
	(0.033)	(0.0141)	(0.016)	(0.021)	(0.012)	(0.034)	(0.014)	(0.016)	(0.021)
obese	-0.010	0.005	-0.001	0.083***	0.010	-0.010	0.0046	-0.001	0.083***
	(0.034)	(0.014)	(0.016)	(0.022)	(0.012)	(0.034)	(0.014)	(0.016)	(0.022)
Mother is tall (Ref. short)	-0.088***	0.012**	-0.020***	0.029***	0.007**	-0.089***	0.012**	-0.020***	0.029***
	(0.011)	(0.005)	(0.006)	(0.007)	(0.003)	(0.011)	(0.005)	(0.01)	(0.01)

Notes: Clustered Standard errors are provided in parentheses. ****$p < 0.01$; **$p < 0.05$; *$p < 0.1$. [a]1st-stage regression results are the same in the wasted, underweight, and overweight cases. Standard errors in parentheses, [b] AWE is the Instrument "the cluster average women employment".

Table 3.A4. *(Continued)*

Variables	LPM				1st stage [a]	IV-2SLS			
	(1) Stunted	(2) Wasted	(3) Under-weight	(4) Over-weight	(5) AWE[b]	(6) Stunted	(7) Wasted	(8) Under-weight	(9) Over-weight
Marital status (Ref. Married)									
Widowed	-0.028	0.004	0.029	-0.031	0.028**	-0.029	0.004	0.028	-0.030
	(0.031)	(0.019)	(0.022)	(0.026)	(0.011)	(0.030)	(0.018)	(0.022)	(0.026)
Divorced	0.009	0.023	-0.009	-0.018	-0.017	0.010	0.022	-0.008	-0.018
	(0.036)	(0.026)	(0.017)	(0.029)	(0.012)	(0.037)	(0.026)	(0.017)	(0.029)
No longer living together/separated	0.042	-0.046***	-0.001	0.072	-0.015	0.043	-0.046***	-0.001	0.071
	(0.044)	(0.011)	(0.022)	(0.044)	(0.013)	(0.044)	(0.011)	(0.022)	(0.044)
Partner is employed	-0.011	0.005	-0.007	-0.005	0.010***	-0.011	0.005	-0.007	-0.005
	(0.010)	(0.006)	(0.006)	(0.009)	(0.003)	(0.010)	(0.006)	(0.006)	(0.009)
Father's education in single years/100	-0.002***	5.72e-05	-0.001	0.001	-0.001***	-0.002***	7.04e-05	-0.001	0.001
	(0.001)	(0.000)	(0.000)	(0.001)	(0.002)	(0.001)	(0.001)	(0.003)	(0.002)
Number of children under 5 in household	0.004	-8.74e-05	-0.003*	-0.003	0.005***	0.003	-0.001	-0.003*	-0.003
	(0.001)	(0.001)	(0.002)	(0.003)	(0.001)	(0.004)	(0.002)	(0.002)	(0.004)
Number of adult women in household	-0.002	-0.002	0.003	-0.002	0.010***	-0.003	-0.002	0.003	-0.002
	(0.006)	(0.003)	(0.003)	(0.005)	(0.002)	(0.006)	(0.003)	(0.003)	(0.005)
Female Household Head	-0.0247*	-0.005	-0.012*	0.003	0.011	-0.026*	-0.005	-0.011*	0.003
	(0.0139)	(0.007)	(0.007)	(0.012)	(0.012)	(0.014)	(0.007)	(0.007)	(0.0124)
Rural (Ref. urban)	0.016	0.044*	0.016	0.005	0.070**	0.019	0.044*	0.017	0.005
	(0.034)	(0.024)	(0.016)	(0.026)	(0.029)	(0.034)	(0.024)	(0.016)	(0.026)
Wealth index (Ref. poorest)									
Poorer	0.006	-0.004	-0.001	-0.011	-0.036***	0.009	-0.004	-0.001	-0.011
	(0.009)	(0.005)	(0.005)	(0.007)	(0.003)	(0.01)	(0.006)	(0.005)	(0.008)
Middle	-0.002	0.005	0.005	-0.004	-0.041***	0.002	0.006	0.006	-0.004
	(0.010)	(0.005)	(0.005)	(0.008)	(0.003)	(0.010)	(0.005)	(0.005)	(0.008)
Richer	0.003	0.006	0.0006	-0.004	-0.036***	0.008	0.007	0.002	-0.004
	(0.0120)	(0.007)	(0.006)	(0.009)	(0.003)	(0.012)	(0.007)	(0.006)	(0.010)
Richest	0.013	0.009	0.001	0.013	-0.023***	0.017	0.010	0.002	0.013
	(0.015)	(0.008)	(0.007)	(0.013)	(0.004)	(0.015)	(0.008)	(0.007)	(0.013)

Notes: Clustered Standard errors are provided in parentheses. ****$p < 0.01$; **$p < 0.05$; *$p < 0.1$. [a]1st-stage regression results are the same in the wasted, underweight, and overweight cases. Standard errors in parentheses, [b] AWE is the Instrument "the cluster average women employment".

Table 3.A4. *(Continued)*

Variables	LPM				1st stage [a]	IV-2SLS			
	(1) Stunted	(2) Wasted	(3) Under-weight	(4) Over-weight	(5) AWE[b]	(6) Stunted	(7) Wasted	(8) Under-weight	(9) Over-weight
Wealth x Mother occupation (Ref. Poorest & Agriculture)									
Mother is working in Service	-0.052	0.046*	0.024	-0.028	0.749***	-0.113**	0.037	0.010	-0.027
	(0.041)	(0.026)	(0.024)	(0.035)	(0.011)	(0.053)	(0.032)	(0.031)	(0.043)
Poor x Service	0.014	-0.022	-0.001	0.021	0.029**	0.011	-0.023	-0.002	0.021
	(0.047)	(0.028)	(0.026)	(0.038)	(0.013)	(0.047)	(0.028)	(0.026)	(0.038)
Middle x Service	-0.013	-0.054**	-0.028	-0.021	0.017	-0.018	-0.055**	-0.029	-0.021
	(0.042)	(0.026)	(0.025)	(0.037)	(0.012)	(0.042)	(0.026)	(0.025)	(0.037)
Rich x Service	-0.013	-0.058**	-0.021	-0.004	-0.045***	-0.019	-0.059**	-0.022	-0.004
	(0.041)	(0.026)	(0.025)	(0.037)	(0.012)	(0.041)	(0.026)	(0.025)	(0.037)
Richest x Service	-0.012	-0.035	-0.024	0.013	-0.096***	-0.018	-0.036	-0.025	0.013
	(0.041)	(0.026)	(0.024)	(0.038)	(0.012)	(0.041)	(0.026)	(0.024)	(0.038)
Mother is working in Physical Labour	0.031	-0.023	0.025	-0.021	0.737***	-0.030	-0.032	0.011	-0.020
	(0.055)	(0.020)	(0.033)	(0.048)	(0.017)	(0.062)	(0.028)	(0.038)	(0.054)
Poor x Labour	-0.089	0.075**	-0.026	0.046	-0.023	-0.092	0.075**	-0.027	0.046
	(0.074)	(0.038)	(0.044)	(0.073)	(0.024)	(0.074)	(0.038)	(0.044)	(0.073)
Middle x Labour	-0.16**	0.022	-0.091***	-0.115**	0.017	-0.162**	0.022	-0.092***	-0.115**
	(0.077)	(0.039)	(0.034)	(0.054)	(0.025)	(0.076)	(0.039)	(0.034)	(0.054)
Rich x Labour	-0.090	0.008	0.034	-0.045	0.020	-0.097	0.007	0.033	-0.046
	(0.084)	(0.035)	(0.053)	(0.071)	(0.024)	(0.084)	(0.035)	(0.053)	(0.071)
Richest x Labour	-0.085	0.006	-0.016	-0.083	-0.028	-0.093	0.005	-0.018	-0.083
	(0.126)	(0.045)	(0.060)	(0.084)	(0.029)	(0.126)	(0.045)	(0.060)	(0.084)
Survey Year FE	yes	yes	yes	yes	yes	yes	yes	yes	yes
Governorates FE	yes	yes	yes	yes	yes	yes	yes	yes	yes
Constant	0.393***	0.116**	0.145***	0.156**	33.61***	0.394***	0.117**	0.145***	0.156**
	(0.088)	(0.047)	(0.047)	(0.074)	(1.19)	(0.087)	(0.046)	(0.047)	(0.074)
Observations	34,507	34,507	34,507	34,507	34,507	34,507	34,507	34,507	34,507
R-squared	0.050	0.045	0.020	0.033	0.814	0.050	0.045	0.020	0.033

Notes: Clustered Standard errors are provided in parentheses. ****$p < 0.01$; **$p < 0.05$; *$p < 0.1$. [a]1st-stage regression results are the same in the wasted, underweight, and overweight cases. Standard errors in parentheses, [b] AWE is the Instrument "the cluster average women employment".

Table 3.A5. *Sub-Sample Group Analysis by Child age using IV-2SLS*

	IV-Group 1: Child Age < 2y				IV-Group 2: Child Age > 2y			
Variables	**(1) Stunted**	**(2) Wasted**	**(3) Underweight**	**(4) Overweight**	**(5) Stunted**	**(6) Wasted**	**(7) Underweight**	**(8) Overweight**
Working regularly over past year	0.126*	0.0977*	0.0561	0.0470	0.125***	-0.0433*	0.000486	0.0445
	(0.0656)	(0.0499)	(0.0386)	(0.0567)	(0.0458)	(0.0246)	(0.0252)	(0.0381)
Child's sex (Ref. male)	-0.0678***	-0.0143***	-0.0313***	0.0124*	-0.0122*	-0.00328	-0.00726**	9.38e-05
	(0.00799)	(0.00545)	(0.00465)	(0.00703)	(0.00678)	(0.00361)	(0.00307)	(0.00582)
Child's age in months/100	0.278	-1.645***	-0.678***	-0.681***	-0.293	-0.142	-0.240	-0.0955
	(0.252)	(0.193)	(0.153)	(0.251)	(0.295)	(0.159)	(0.152)	(0.245)
Child's age in months squared/100	0.0152	0.0551***	0.0184***	0.0190*	0.00141	0.000985	0.00249	-0.000153
	(0.0110)	(0.00766)	(0.00609)	(0.0103)	(0.00353)	(0.00188)	(0.00181)	(0.00293)
Child has a twin	0.0958***	0.0267	0.0453**	-0.0331	0.0430*	0.000419	0.00635	0.0129
	(0.0366)	(0.0209)	(0.0225)	(0.0245)	(0.0250)	(0.0123)	(0.0133)	(0.0206)
Size at birth (Ref. Very large)								
Larger than average	0.00118	0.0919***	-0.0113	-0.168	-0.0590	-0.0278	0.0115	0.0103
	(0.108)	(0.0227)	(0.0634)	(0.112)	(0.0537)	(0.0297)	(0.0253)	(0.0382)
Average	0.0248	0.0904***	0.00304	-0.155	-0.0268	-0.0243	0.00766	-0.0138
	(0.106)	(0.0158)	(0.0619)	(0.111)	(0.0520)	(0.0289)	(0.0250)	(0.0337)
Smaller than average	0.0600	0.0998***	0.0183	-0.178	0.0239	-0.0205	0.0307	-0.0227
	(0.107)	(0.0181)	(0.0625)	(0.112)	(0.0529)	(0.0289)	(0.0259)	(0.0347)
Very small	0.121	0.121***	0.0467	-0.157	0.00988	-0.0153	0.0393	-0.0278
	(0.107)	(0.0212)	(0.0624)	(0.112)	(0.0529)	(0.0308)	(0.0273)	(0.0366)
Birth order of child (Ref. 1st child)								
2nd - 3rd child	0.0188*	0.000984	0.00106	0.0135	0.0179**	0.00455	0.00391	-0.0190***
	(0.0110)	(0.00744)	(0.00627)	(0.0104)	(0.00872)	(0.00464)	(0.00409)	(0.00737)
4th - 5th child	-0.00171	0.0160	0.00251	0.00431	0.0239*	0.0110	0.0142**	-0.0280**
	(0.0166)	(0.0113)	(0.0101)	(0.0155)	(0.0134)	(0.00747)	(0.00638)	(0.0119)
6th child or higher	0.0129	-0.00257	-0.00773	-0.0281	0.0382*	0.0116	0.00663	-0.0212
	(0.0247)	(0.0151)	(0.0143)	(0.0213)	(0.0196)	(0.0109)	(0.00933)	(0.0156)

Note: Clustered Standard errors in parentheses. ****p < 0.01; **p < 0.05; *p < 0.1.

Table 3.A5. *(continued)*

Variables	IV-Group 1: child Age < 2y				IV-Group 2: Child Age > 2y			
	(1) Stunted	(2) Wasted	(3) Underweight	(4) Overweight	(5) Stunted	(6) Wasted	(7) Underweight	(8) Overweight
Breastfeeding (Ref.never breastfed)								
breasfed in the past	-0.0288	-0.000137	0.00461	-0.0145	0.0167	-0.00884	0.000568	0.0356***
	(0.0258)	(0.0158)	(0.0136)	(0.0249)	(0.0167)	(0.0100)	(0.00888)	(0.0135)
still breastfeeding	-0.0204	-0.000313	-0.00503	-0.0247	0.119***	0.0252	0.0721***	-0.00381
	(0.0244)	(0.0150)	(0.0136)	(0.0228)	(0.0347)	(0.0207)	(0.0249)	(0.0245)
Mother's current age in years/100	-1.723***	0.200	-0.266	-0.887	-0.330	0.193	-0.0714	-0.245
	(0.632)	(0.388)	(0.388)	(0.586)	(0.585)	(0.304)	(0.286)	(0.510)
Mother's current age squared/100	0.0280***	-0.00373	0.00486	0.0148	0.00277	-0.00301	0.000550	0.00521
	(0.0106)	(0.00663)	(0.00665)	(0.00992)	(0.00909)	(0.00476)	(0.00449)	(0.00800)
Mother's education in single years/100	-0.00540	-0.127	-0.0632	0.321	-0.576**	-0.0609	-0.220*	0.389*
	(0.302)	(0.191)	(0.170)	(0.250)	(0.250)	(0.136)	(0.122)	(0.200)
Education squared/100	-0.0136	0.00972	-0.00839	-0.0195	0.0331*	0.00171	0.0158*	-0.0336**
	(0.0209)	(0.0133)	(0.0120)	(0.0173)	(0.0171)	(0.00961)	(0.00870)	(0.0146)
Mother BMI (Ref. underweight)								
Normal	0.0898**	0.0289	0.0409**	0.0917***	-0.000834	0.0254	0.00834	0.0407
	(0.0398)	(0.0195)	(0.0193)	(0.0236)	(0.0465)	(0.0217)	(0.0260)	(0.0298)
Overweight	0.101**	0.0153	0.0347*	0.120***	-0.0105	0.0187	-0.00911	0.0608**
	(0.0398)	(0.0194)	(0.0191)	(0.0236)	(0.0463)	(0.0218)	(0.0256)	(0.0291)
obese	0.0561	-0.00153	0.0170	0.113***	-0.0508	0.00311	-0.0130	0.0535*
	(0.0398)	(0.0194)	(0.0191)	(0.0238)	(0.0463)	(0.0219)	(0.0259)	(0.0294)
Mother is tall (Ref. short)	-0.102***	0.00829	-0.0124	0.0232**	-0.0759***	0.0137**	-0.0251***	0.0348***
	(0.0145)	(0.00865)	(0.00835)	(0.0111)	(0.0135)	(0.00570)	(0.00722)	(0.00837)
Marital status (Ref. Married)								
Widowed	0.183**	0.0512	0.144*	-0.00114	-0.0961***	-0.00950	-0.00600	-0.0393
	(0.0862)	(0.0498)	(0.0737)	(0.0693)	(0.0281)	(0.0195)	(0.0168)	(0.0264)
Divorced	0.142	-0.0452	-0.0206	0.0429	-0.0170	0.0384	-0.00436	-0.0368
	(0.0874)	(0.0346)	(0.0392)	(0.0688)	(0.0394)	(0.0279)	(0.0178)	(0.0317)
No longer living together/separated	0.0821	-0.0679***	-0.0307	0.107*	0.0109	-0.0314*	0.0218	0.0512
	(0.0723)	(0.0130)	(0.0293)	(0.0652)	(0.0550)	(0.0170)	(0.0323)	(0.0557)

Note: Clustered Standard errors in parentheses. ****p < 0.01; **p < 0.05; *p < 0.1.

Table 3.A5. *(continued)*

	IV-Group 1: child Age < 2y				IV-Group 2: child Age > 2y			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	**Stunted**	**Wasted**	**Underweight**	**Overweight**	**Stunted**	**Wasted**	**Underweight**	**Overweight**
Partner is employed	-0.000122	-0.00337	-0.0116	0.0106	-0.0180	0.0101	-0.00437	-0.0144
	(0.0160)	(0.0110)	(0.00987)	(0.0146)	(0.0132)	(0.00664)	(0.00673)	(0.0118)
Partner education in single years/100	-0.00111	0.000301	6.05e-05	-0.000684	-0.00252***	-5.52e-05	-0.000565	0.000984
	(0.00101)	(0.000690)	(0.000653)	(0.000897)	(0.000929)	(0.000488)	(0.000418)	(0.000727)
Number of children under 5 in household	0.00229	0.000540	-0.00389	-0.00249	0.00530	-0.000834	-0.00215	-0.00538
	(0.00492)	(0.00319)	(0.00275)	(0.00371)	(0.00498)	(0.00183)	(0.00192)	(0.00332)
Number of adult women in household	-0.00333	-0.00396	0.00397	-0.00681	-0.00301	-0.00207	0.00176	0.00219
	(0.00758)	(0.00464)	(0.00405)	(0.00579)	(0.00746)	(0.00297)	(0.00349)	(0.00577)
Female Household Head	-0.044**	0.009	0.012	-0.008	-0.013	-0.016*	-0.012	0.0112
	(0.019)	(0.013)	(0.011)	(0.018)	(0.018)	(0.008)	(0.008)	(0.017)
Rural (Ref. urban)	0.0556	0.0533	0.0293	-0.0105	-0.00528	0.0373	0.00828	0.0121
	(0.0585)	(0.0370)	(0.0223)	(0.0467)	(0.0374)	(0.0240)	(0.0201)	(0.0360)
Wealth index (Ref. poorest)								
Poorer	0.00941	0.00612	0.00335	-0.0189	0.0108	-0.00841	-0.00286	-0.00427
	(0.0145)	(0.00865)	(0.00801)	(0.0120)	(0.0121)	(0.00592)	(0.00576)	(0.00926)
Middle	0.00426	0.00778	0.0144*	-0.0178	-0.00101	0.00480	7.19e-06	0.00512
	(0.0153)	(0.00890)	(0.00829)	(0.0128)	(0.0132)	(0.00668)	(0.00628)	(0.0112)
Richer	0.0168	0.00744	0.00948	-0.0146	0.00251	0.00834	-0.00200	0.00513
	(0.0179)	(0.0104)	(0.00912)	(0.0153)	(0.0162)	(0.00831)	(0.00747)	(0.0127)
Richest	0.0166	0.0114	0.0186	-0.00376	0.0175	0.0112	-0.00865	0.0270*
	(0.0207)	(0.0124)	(0.0120)	(0.0190)	(0.0188)	(0.0103)	(0.00849)	(0.0141)
Constant	0.467***	0.0809	0.169**	0.369**	0.492***	0.0906	0.155**	0.0779
	(0.150)	(0.0669)	(0.0824)	(0.150)	(0.130)	(0.0682)	(0.0668)	(0.103)
Observations	14,305	14,305	14,305	14,305	20,202	20,202	20,202	20,202
R-squared	0.057	0.052	0.029	0.037	0.059	0.046	0.025	0.041

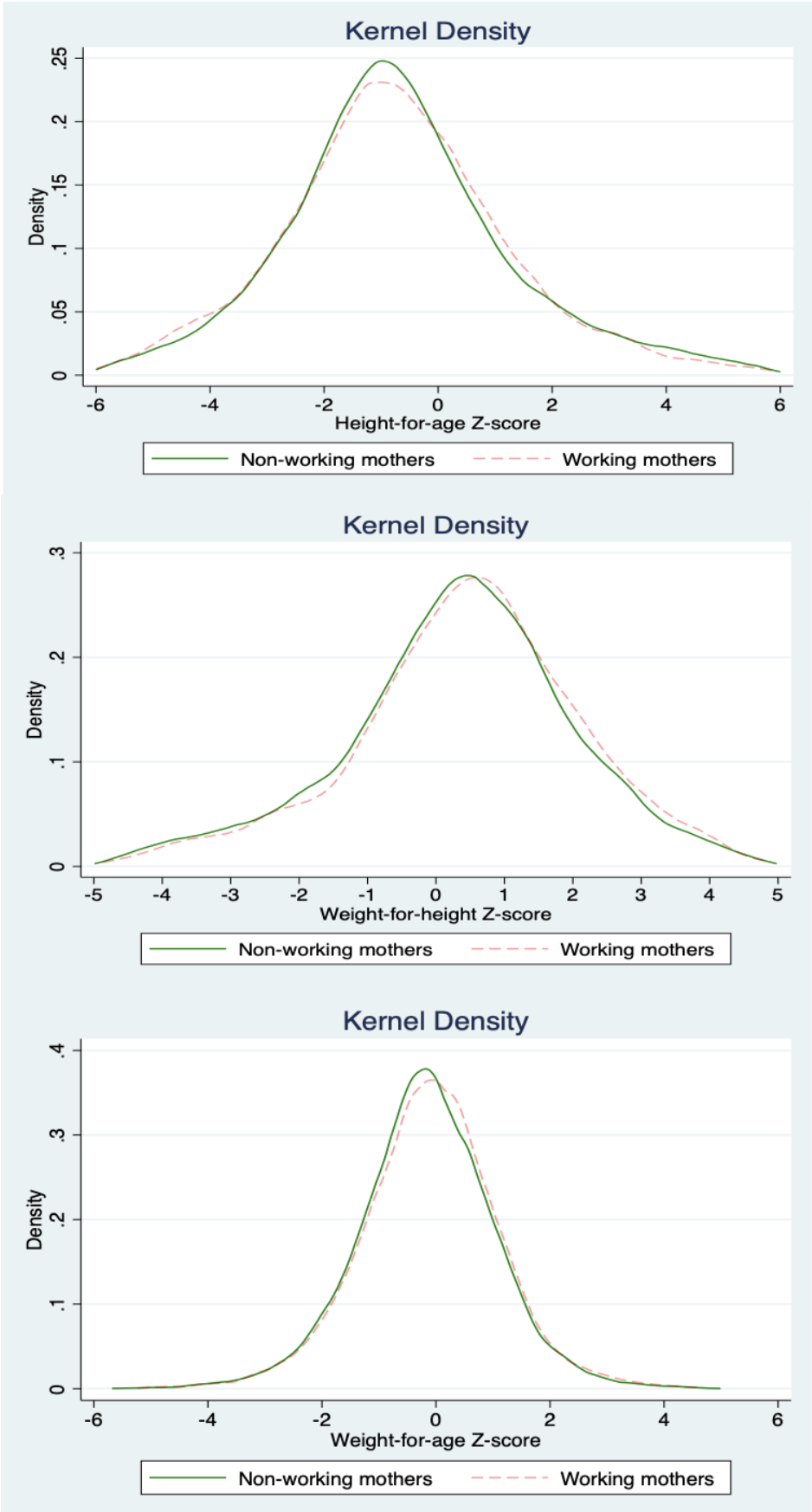
Note: Clustered Standard errors in parentheses. ****p < 0.01; **p < 0.05; *p < 0.1.

Table 3.A6. *The Impact of Maternal Employment in Child- Health*

	HAZ		WAZ		WHZ	
	LPM	IV	LPM	IV	LPM	IV
Maternal Employment	-0.160**	-0.293*	-0.055	-0.029	0.067	0.252
	0.093	0.280	0.057	0.173	0.079	0.238
constant	-1.034***	-1.038***	-0.488***	-0.488***	0.397***	0.403***
	0.420	0.419	0.259	0.259	0.356	0.356
controls	yes	yes	yes	yes	yes	yes
Survey Year FE	yes	yes	yes	yes	yes	yes
Governorates FE	yes	yes	yes	yes	yes	yes
OBS	22,553	22,553	22,553	22,553	22,553	22,553
R-squared	0.1241	0.124	0.0796	0.0796	0.1152	0.1149

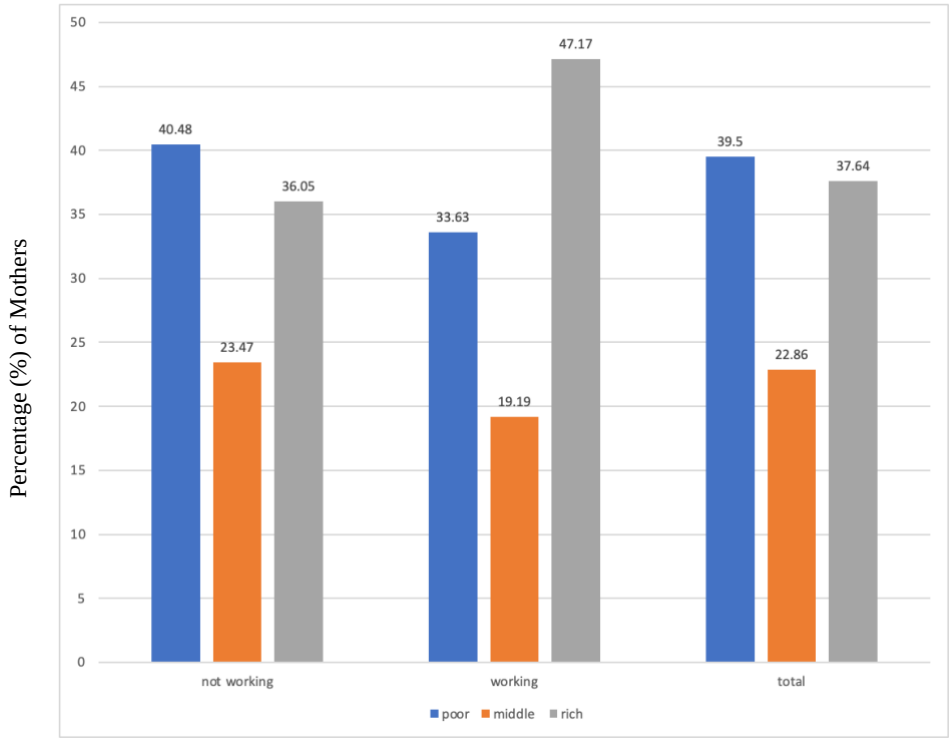
Note: Clustered standard errors in parentheses, * p<0.05, ** p<0.01, *** p<0.001. LPM—linear probability model, IV-2sls—instrumental variable two-stage least square. The dependent variables are child health outcomes, specifically (HAZ), (WAZ), and (WHZ). The main independent variable is maternal employment in the past 12 months. The analysis controls for child characteristics (such as gender, age, birth order, and breastfeeding), mother's characteristics (age, education, body mass index, marital status), partner's characteristics (education, employment status), and household characteristics (household size and number of female adults), FE— fixed effect.

Figure 3.A1. *Kernel Density (HAZ-WHZ, WAZ)*



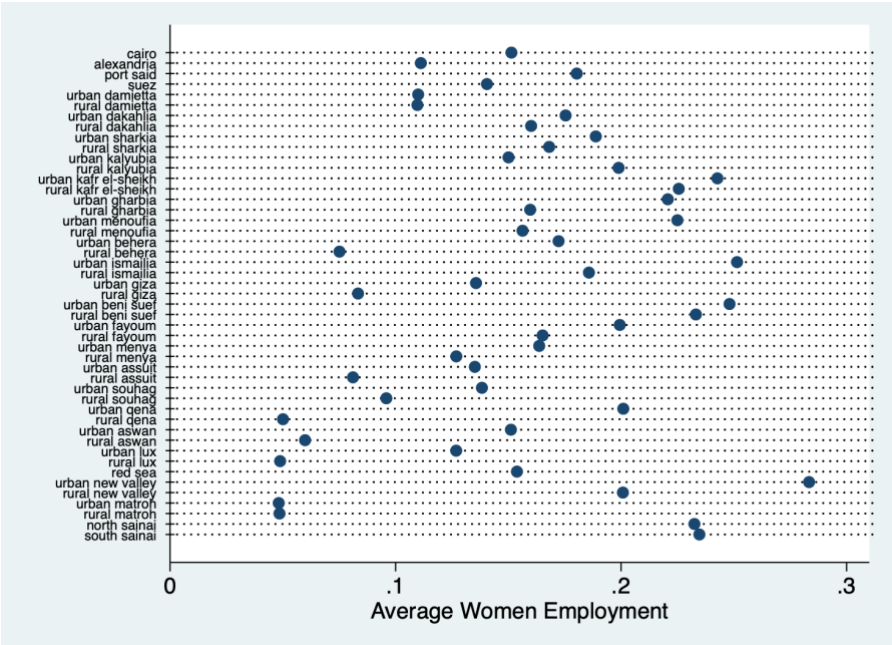
Source: Author creation using DHS dataset (2005,2008,2014)

Figure 3.A2 *percentage of working and non-working mothers by wealth index*



Source: Author creation using DHS dataset (2005,2008,2014). Note: Wealth index: poor and poorest were merged into poor, and richest and rich were merged into rich.

Figure 3.A3 *The cluster average women employment by Governorates*



Source: Author creation using DHS dataset (2005,2008,2014) Note: This chapter has expanded governorates variable from 26 governorates to 47 by split each governorate into rural/urban, However, if a governorate has less than 150 observations in either urban, or rural areas, we leave it as it is, such as the first four governorates: Cairo Alexandria, Port-said, and Suez.

Chapter 4

Legal reforms and Women Employment: Evidence from Saudi Arabia

Abstract

This chapter investigates the impact of Saudi Arabia's 2019 legal reforms on women's labour force participation (FLFP), utilising Before-and-After Analysis and Propensity Score Matching (PSM) to derive robust estimates. As a cornerstone of the Vision 2030 initiative, these reforms introduced transformative changes, including the removal of male guardianship restrictions, expanded access to passports, and enhanced employment protections. The PSM analysis reveals a significant Average Treatment Effect on the Treated (ATET), with women's employment increasing by 10.5% following the reforms. Sector-specific analysis highlights substantial growth in female employment within traditionally male-dominated sectors, such as Construction and Trade & Transportation, where the private sector experienced a 22.7% rise in female participation. These findings provide compelling evidence of the efficacy of legal reforms in addressing structural barriers and promoting gender equity within conservative labour markets. Grounded in feminist legal theory and human capital theory, this chapter underscores how legal reforms can dismantle structural barriers and activate untapped human capital, thereby contributing to broader economic growth. However, the persistent influence of social norms suggests the need for further research into the intersection of policy and cultural dynamics. Future studies should explore the long-term sustainability of these employment gains and the evolving role of social norms in shaping women's labour market outcomes.

Keywords: *Gender Equality, Labour Force Survey, Legal Reform, Vision 2030; Feminist Legal Theory; Human Capital Theory; SDG 5, Saudi Arabia*

4.1 Introduction

Mary Beard[15] (2017) said, "You cannot easily fit women into a structure that is already coded as male; you have to change the structure." Gender equality in the labour market remains a crucial issue globally, impacting both social justice and economic development. Despite decades of progress in education and empowerment, women's participation in the labour force remains significantly lower than that of men (Akhmetova et al., 2020; Cortes & Pan, 2018). Globally, only about 50% of women over the age of 15 participate in the formal labour force, compared to 75% of men (Tyson & Klugman, 2017). Moreover, women are disproportionately employed in part-time, insecure, and low-paying jobs and consistently earn less than men for the same work (Akhmetova et al., 2020; Cortes & Pan, 2018). Although there have been slight improvements in women's earnings relative to men's since the 1990s, progress has been slow, with some estimates suggesting that achieving equal pay for equal work could take over 75 years at the current pace (Kabeer, 2012). Economic inequality among women is not only a matter of justice and human rights, but also significantly impacts national welfare. Closing gender gaps in the workforce could significantly boost global GDP, potentially adding $12 trillion to the global economy (Tyson & Klugman, 2017; Woetzel, 2015).

In Saudi Arabia, addressing gender disparities is central to achieving the country's economic ambitions under Vision 2030. Historically, women in Saudi Arabia faced substantial legal and social barriers to workforce participation, including male guardianship laws and gender-based discrimination (Aldossari & Chaudhry, 2024). These restrictions not only reinforced patriarchal norms but also undermined economic productivity by limiting women's contributions to the labour market. Drawing on Feminist Legal Theory (MacKinnon, 1987) and Human Capital Theory (Becker, 1964), this chapter frames these historical inequalities as systemic barriers that restricted women's access to economic opportunities and underutilised their skills and qualifications. Feminist Legal Theory (MacKinnon, 1987) argues that laws are rarely neutral but instead reflect and reinforce existing power structures, often to the detriment of women. In Saudi Arabia, the 2019 legal reforms—eliminating male guardian requirements

[15] Beard, M. (2017). *Women & power: A manifesto*. Profile Books.

for employment, travel, and other personal legal matters—represent a transformative step towards substantive equality (Fredman, 2011). Substantive equality goes beyond removing legal restrictions by addressing structural disadvantages and enabling women to meaningfully participate in economic and social spheres. At the same time, Human Capital Theory (Becker, 1964) provides a compelling economic rationale for these reforms by emphasising the inefficiencies that arise when women's skills and education are underutilised. Prior to the reforms, Saudi women, despite high levels of educational attainment, remained excluded from key sectors of the economy due to legal and cultural constraints. By removing barriers to employment, the 2019 reforms opened new sectors such as construction, trade, and logistics to female workers, allowing them to better leverage their skills and contribute to economic growth. These reforms thus align with Vision 2030's aim of diversifying the economy, enhancing women's participation, and achieving broader economic development. As a result of these legal advancements, Saudi Arabia's rank in the World Bank's Women, Business, and the Law (WBL) Index[16] experienced a significant improvement—from 25.6 out of 100 in 2019 to 80 out of 100 in 2021—marking one of the largest jumps globally during this period (World Bank, 2021). This progress reflects the expanding legal infrastructure that supports women's participation in the labour market.

4.1.1 Research Questions

The existing global literature (Hallward-Driemeier & Gajigo, 2015; Heath & Tan, 2020; Peterman, 2011) has thoroughly explored the relationship between legal reforms and women's employment, emphasising the critical role these reforms play in improving female labour market outcomes across diverse socio-economic settings. In the Saudi Arabian context, studies have investigated the effects of specific reforms, such as the lifting of the driving ban (Alkhuzam et al., 2023; Daher et al., 2023) and the Nitaqat program (Cortés et al., 2023; Miller et al., 2022; Peck, 2017), on women's participation in the labour force. However, a notable gap remains in the literature concerning the specific impact of the 2019 legal reforms on women's employment in Saudi Arabia. Although Parveen (2021) has provided valuable insights into the

[16] Refer to Figure 4.A1 and 4.A2 in the Appendices for further details.

overall rise in female labour force participation following the 2019 reforms, her analysis remains largely descriptive and lacks a sector-specific focus. Similarly, Rizvi and Hussain (2022) have developed a theoretical framework to explore the broader implications of the 2019 legal reforms for gender equality, but their work does not include empirical analysis specific to the Saudi context. As a result, the effects of these reforms on women's labour force participation, particularly across different sectors, remain under-explored. Without a rigorous, empirical understanding of how the reforms have influenced participation in various economic activities, policymakers may find it challenging to develop targeted interventions to address areas where progress is still needed.

This chapter seeks to address this gap by analysing the impact of the 2019 legal reforms on women's labour force participation in Saudi Arabia. Specifically, it investigates two key research questions:

1) How have the 2019 legal reforms influenced women's labour force participation in Saudi Arabia?
2) Which sectors or economic activities experienced the most significant changes in women's labour force participation following the 2019 reform?

To answer these questions, this chapter employs a Before-and-After analysis and Propensity Score Matching (PSM) to address selection bias and enhance the robustness of the findings. Using Labour Force Survey (LFS) data from GASTAT for the years 2019 and 2022, the chapter offers a rigorous evaluation of the reforms' effects, shedding light on how these legal changes have influenced gender norms and enhanced women's participation in the labour market. The findings are contextualised through the lens of Feminist Legal Theory (MacKinnon 1987) and Human Capital Theory (Becker 1964). Feminist Legal Theory provides a critical perspective on how the 2019 reforms dismantled structural legal barriers that previously limited women's economic participation, while Human Capital Theory highlights the economic rationale for enabling women to leverage their education and skills in the labour market.

This chapter makes several significant contributions to the literature on women's employment and legal reforms in Saudi Arabia. First, the results of the before-and-after analysis reveal a substantial increase in female employment, with a 12% rise following the 2019 reforms. The PSM analysis further corroborates these findings, demonstrating a 10.5% increase in female employment (ATET). These results underscore the reforms' effectiveness in promoting women's economic inclusion, aligning with the objectives of Vision 2030 to diversify the Saudi economy and enhance female workforce participation. Second, this chapter provides a sector-specific analysis, offering a nuanced understanding of the reforms' differential impacts across various industries. Significant growth was observed in traditionally male-dominated sectors, including Construction (6.6% increase) and Trade & Transportation (5.2% increase), as well as service-oriented sectors such as Accommodation and Food Services (3.9% increase). Interestingly, female employment in the Education sector declined, indicating evolving employment preferences and opportunities as women shifted toward roles in emerging and diversified industries. This sectoral analysis highlights the transformative potential of targeted legal reforms in enabling women to enter previously inaccessible economic spaces and suggests that these shifts may reflect broader socio-economic transformations. By focusing on sectoral dynamics and applying a rigorous methodological framework, this chapter advances existing research on legal reforms and gender equality. While previous studies (Heath & Tan, 2020; Peterman, 2011) have examined the impacts of legal changes on women's employment in other contexts, this chapter provides empirical evidence specific to Saudi Arabia. The findings emphasize the importance of targeted policies in breaking down structural barriers and facilitating women's integration into diverse economic sectors, contributing to the broader discourse on gender equality.

The following sections present a historical background, a literature review in Section 4.3, the methodology in Section 4.4, results in Section 4.5, and discussion in Section 4.6. The chapter concludes with Section 4.7.

4.2 Historical Background and Vision 2030

Historically, Saudi women have faced substantial barriers to economic participation, shaped by a complex interweaving of cultural, religious, social, and political influences (Hamdan, 2005). The discovery of oil in the 20th century and the rise of Wahhabism significantly contributed to the imposition of more restrictive laws on women, focusing on strict gender segregation, limitations on their mobility, and the enforcement of conservative dress codes (Le Renard, 2008). Despite attempts at modernisation during the 1950s and 1960s, such as reforms aimed at transforming the country, women continued to face severe restrictions in various facets of their lives (Al-Rasheed, 2013). In 1979, the "Islamic Awakening" further entrenched these limitations, with stricter dress codes, heightened gender segregation, and more pronounced restrictions on women's participation in public life (Doumato, 1999).

From 1979 to 2016, Saudi women's lives were shaped by a combination of restrictive policies and slow, incremental progress. During this period, women's roles were largely confined to domestic settings, with their economic participation limited to specific sectors such as education and healthcare, which were deemed socially acceptable for women. The labour force participation of Saudi women remained low, as societal norms and legal frameworks perpetuated gender roles that tied women to caregiving and household responsibilities.

Despite these constraints, women's access to higher education expanded significantly in the 2000s. As shown in **Figure 4.1(a)**, gross enrolment ratios for women in tertiary education rose sharply, particularly from the early 2000s, surpassing global averages by the mid-2010s. By this time, women's enrolment rates had exceeded world rate, reflecting a shift in societal attitudes and significant investment in women's education. At the same time, fertility rates were declining sharply, as depicted in **Figure 4.1(b)**, the fertility rate fell from approximately eight children per woman in the 1960s to just under three by 2015. This decline was influenced by several factors, including improved access to family planning, delayed marriage and childbearing, and rising educational attainment among women. Fertility rates approaching replacement levels by 2015 should have created more opportunities for women to join the

workforce, as reduced childcare responsibilities are often associated with increased female employment.

However, despite these improvement in education and fertility rates, female labour force participation remained stagnant. Societal norms and structural barriers continued to limit women's economic integration. Many jobs were designated as unsuitable for women, confining them to a narrow range of occupations such as teaching or nursing. Furthermore, the male guardianship system posed a significant obstacle to women's economic participation. Women often required the explicit approval of a male guardian to work, travel, or engage in certain activities. Even women with the education and desire to work could be prevented from doing so if their guardians disapproved of their employment. Additionally, travel restrictions, including the need for guardian approval to obtain a passport or travel abroad, excluded women from jobs that required mobility, further limiting their employment opportunities.

Recognising the need for transformative change, Vision 2030 was announced on 25 April 2016 by Deputy Crown Prince Mohammed bin Salman. This comprehensive economic, political, and social development initiative aimed to diversify the Saudi economy, reduce dependence on oil revenues, and promote gender equality. Vision 2030 identified women's empowerment as a central objective, with a stated goal of increasing female labour force participation (FLFP) to 30% by 2030. The initiative emphasised the removal of structural barriers to economic engagement, enhanced access to education, and the creation of new opportunities for women in various sectors. The framework also aligned with the United Nations Sustainable Development Goals (SDGs), particularly SDG 5, which prioritises gender equality and the empowerment of women (Alessa et al., 2022).

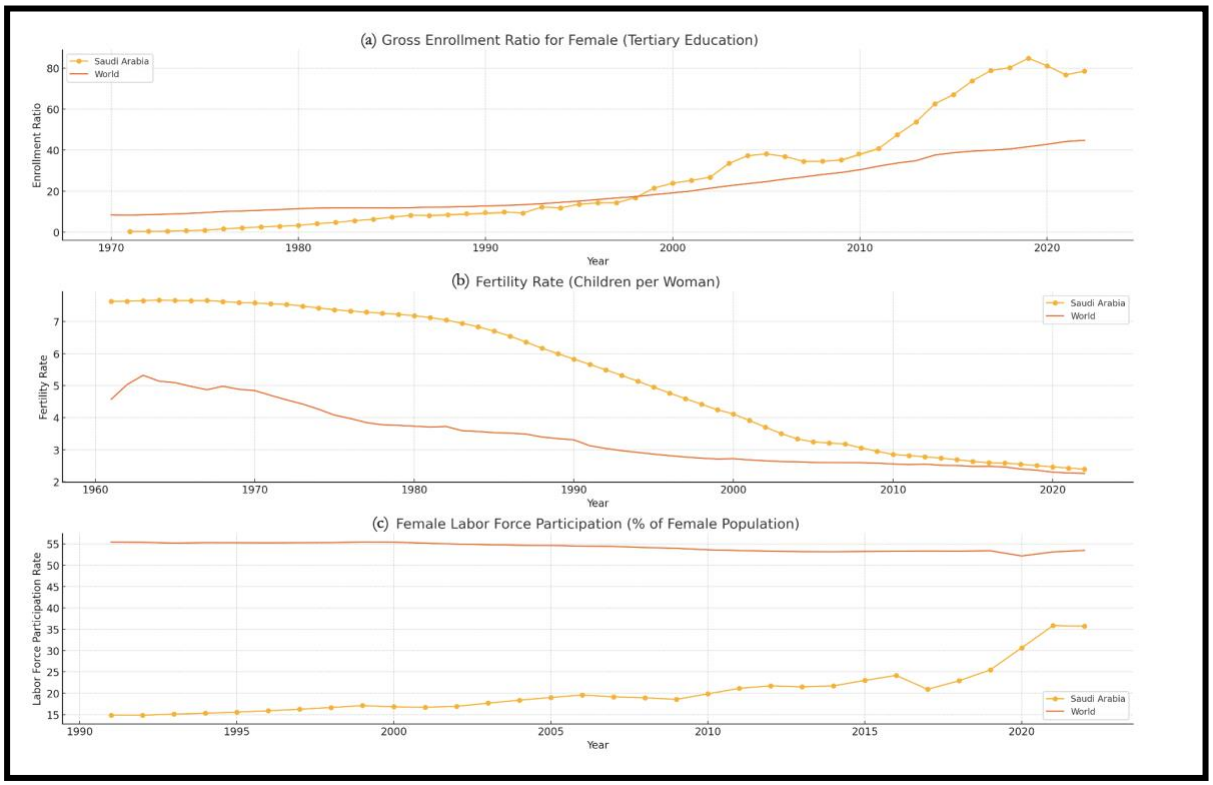
As part of Vision 2030's commitment to gender equality, the 2019 legal reforms were introduced to address the structural and societal barriers that had historically constrained women's participation in the workforce. These reforms, as detailed in **Table 4.A1**, marked a turning point in Saudi Arabia's labour market by removing the requirement for male guardian approval for women to work, granting them the right to obtain passports and travel without permission, and opening previously male-dominated industries to female workers. Other

provisions, such as aligning retirement ages for men and women and implementing anti-discrimination laws, created a more equitable environment for women in the labour market.

The impact of these reforms is evident in **Figure 4.1(c)**, where a noticeable increase in female labour force participation begins around 2017, coinciding with the introduced of Vision 2030, and becomes more pronounced following the implementation of the 2019 legal reforms. By 2021, Saudi Arabia achieved its Vision 2030 target of 30% female labour force participation, nearly a decade ahead of schedule. This remarkable progress demonstrates the effectiveness of the legal reforms and policy measures implemented under Vision 2030. However, despite these achievements, female participation in the labour market still lags behind the global average, highlighting the need for sustained policy efforts to address remaining structural and cultural barriers.

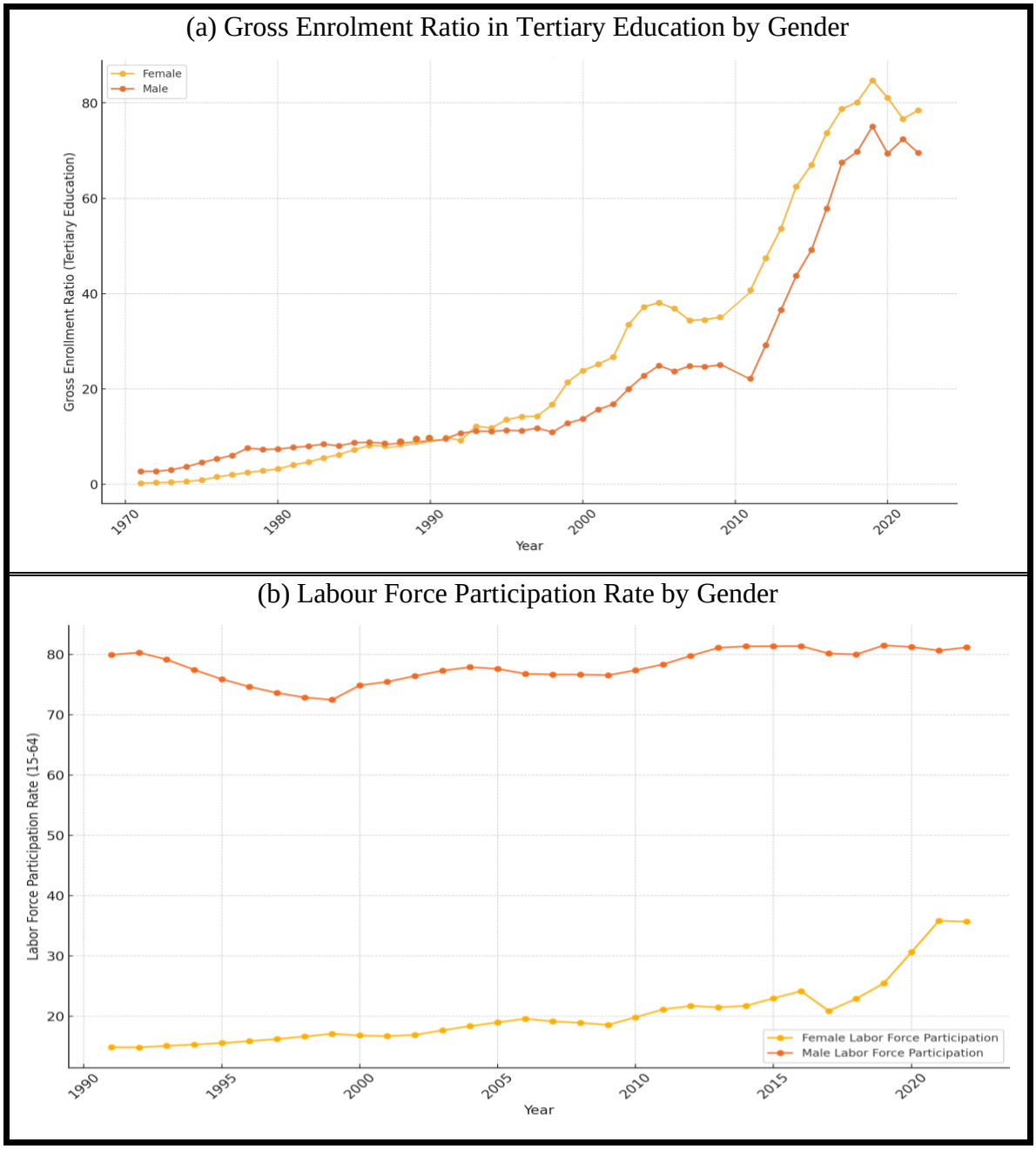
This transformation is further elaborated in **Figure 4.2**, which highlights the gender disparity in education and employment. **Figure 4.2(a)** demonstrates that not only has female enrolment in tertiary education surged, but it has also surpassed male enrolment in recent years, underscoring the considerable progress Saudi women have made in education. However, despite these educational gains, **Figure 4.2(b)** shows that male labour force participation has remained consistently high, at around 80%, while female participation has historically lagged far behind. Only around 2019, following the 2019 legal reforms, does female labour force participation show a noticeable upward trajectory. Reforms such as the removal of the driving ban and the relaxation of restrictions within the male guardianship system have played a pivotal role in enabling more women to enter the workforce. Nevertheless, female participation remains well below that of men, indicating that additional structural and cultural barriers continue to hinder full economic integration.

Figure 0.1 *Female Education, Fertility Rate, and Employment*



Source: Data from World Development Indicators. Aggregation method: Weighted average. Accessed on 06/28/2024. Note: (a). School Enrolment, Tertiary, Female (% Gross): Gross enrolment ratio is the total enrolment, regardless of age, as a percentage of the population of the age group that officially corresponds to tertiary education. Tertiary education typically requires the completion of secondary education. (b). Fertility Rate (Births per Woman): The total fertility rate is the number of children a woman would bear if she lived through her childbearing years, based on age-specific fertility rates of the specified year. (c). Labour Force Participation Rate, Female (% of Female Population Ages 15-64): The labour force participation rate is the proportion of females aged 15-64 who are economically active, including those supplying labour for the production of goods and services during a specified period.

Figure 0.2 *Education and Employment by Gender in Saudi Arabia*



Source: World Development Indicators. Aggregation method: Weighted average. Accessed on 06/28/2024. Note: (a). School Enrolment, Tertiary, (% Gross): Gross enrolment ratio is the total enrolment, regardless of age, as a percentage of the population of the age group that officially corresponds to tertiary education. Tertiary education typically requires the completion of secondary education. (b). Labour Force Participation Rate, (% of Population Ages 15-64): The labour force participation rate is the proportion of the population aged 15-64.

4.3 Literature Review

4.3.1 Theoretical Framework

This chapter draws on Feminist Legal Theory and Human Capital Theory to analyse the economic implications of the 2019 legal reforms on women's labour force participation (FLFP) in Saudi Arabia. Together, these perspectives provide a structured lens for understanding how legal frameworks and institutional reforms shape labour market outcomes for women, while also informing the interpretation of observed changes in employment patterns following the reforms.

Feminist Legal Theory (MacKinnon, 1987; Smart, 1989) challenges the assumption that law is objective or neutral, instead highlighting how legal structures historically reflect and reinforce patriarchal power relations. From this perspective, laws have long served to codify gendered hierarchies by formally restricting women's rights and access to public and economic life. In the Saudi context, prior to 2019, women were constrained by a legal framework that embedded male guardianship principles and excluded them from decision-making spheres and sectors of employment. Feminist legal theorists argue that formal equality—simply removing legal barriers—is insufficient to redress historical disadvantages. Instead, reforms must pursue substantive equality Fredman (2016), which requires transforming the underlying structures that perpetuate disadvantage. The 2019 reforms, by removing explicit gender-based legal barriers (e.g., the requirement for male guardian approval to work or travel), represent an attempt to address these structural inequalities. However, through this lens, the reforms are not merely technical legal adjustments but are part of a broader process of redistributing power and reconfiguring the gendered nature of the Saudi labour market.

Human Capital Theory, developed by Becker (1964) and Mincer (1974), complements this legal analysis by explaining the economic inefficiencies that result from gender-based exclusion. The theory posits that individuals invest in education and skills to improve their productivity and earnings, and that labour markets are more efficient when such investments are rewarded equally. However, when women face legal or cultural barriers to labour market access—as has historically been the case in Saudi Arabia—the return on their human capital

investments is artificially suppressed. This leads to underutilisation of talent, which in turn depresses aggregate economic productivity. The 2019 reforms opened previously restricted sectors such as construction, transportation, and trade to women, increasing the scope for returns to education and skills. As Duflo (2012); (Goldin, 2014) argue, increased female labour force participation is not only a gender equity issue but also an engine for economic growth. Therefore, Human Capital Theory provides a rationale for expecting that legal reforms which remove discriminatory barriers should enhance both women's individual labour market outcomes and broader macroeconomic performance.

Together, Feminist Legal Theory and Human Capital Theory offer a cohesive analytical framework. Feminist legal theory helps to interrogate the historical biases embedded in Saudi labour law and highlights the significance of the 2019 reforms in addressing deep-seated structural inequalities. Human Capital Theory, in turn, clarifies the economic logic underpinning the reforms and informs the empirical expectation that these legal changes will increase women's labour force participation by reducing inefficiencies in the allocation of human capital.

4.3.2 The Impact of Legal Reforms on Women Employment

Legal reforms designed to enhance female labour force participation (FLFP) have played a pivotal role in addressing gender disparities globally. These reforms, often targeting structural and institutional barriers, aim to create equitable opportunities for women. Their impact, however, varies significantly across socio-economic and cultural contexts, reflecting the interplay between legal frameworks and societal norms. This section reviews the global and Saudi Arabian experiences with legal reforms, focusing on their role in shaping women's employment outcomes.

Globally, reforms aimed at improving women's legal rights, particularly in developing countries, have demonstrated measurable impacts on employment. In Ethiopia, the family law reforms of 2000 serve as a notable example. These reforms abolished a husband's authority to restrict his wife's employment, mandated mutual consent for marital property decisions, and increased the minimum marriage age for women. Hallward-Driemeier and Gajigo (2015)

analysed these reforms using panel regression models and found that women in regions where reforms were implemented earlier experienced significant increases in skilled, paid, full-time employment. This underscores the transformative potential of legal changes in dismantling traditional barriers and facilitating economic opportunities for women. Similarly, in India, amendments to the Hindu Succession Act in the 1990s granted women equal inheritance rights, which Heath and Tan (2020) demonstrated had profound effects on women's autonomy and labour market engagement. Their analysis, employing ordinary least squares regression, revealed a 5.7 percentage point increase in the probability of women working year-round and a 6.1 percentage point rise in paid employment. These findings highlight the importance of property rights in enabling economic empowerment, particularly in patriarchal contexts where access to assets has traditionally been restricted for women. In Tanzania, the significance of property and inheritance rights for women's employment was further highlighted by Peterman (2011). Examining the impact of legal reforms on women's property rights using linear probability models, the study found that communities with stronger rights witnessed significantly higher rates of employment outside the home, self-employment, and gross earnings. These findings align with global evidence that access to and control over property not only increases women's economic participation but also enhances their bargaining power within households, particularly among disadvantaged groups such as those with lower levels of education.

In developed economies, legal reforms have often focused on parental leave policies and anti-discrimination laws. While these reforms have promoted women's employment, their impacts have been mixed. For example, parental leave reforms in Austria extended maternity leave from one to two years, which Lalive and Zweimüller (2009) evaluated using linear probability models. The results indicated that extended leave reduced women's likelihood of returning to work in the short term. Similarly, Schönberg and Ludsteck (2014) analysed similar reforms in Germany using a difference-in-differences approach and found that extended leave policies delayed women's return to the workforce, reducing employment rates in the short term. However, Ruhm (2008) studied paid parental leave policies across nine EU countries and

identified a nuanced trade-off: short periods of leave (around three months) increased FLFP by 3–4%, whereas extended leave (over nine months) had negligible employment benefits and led to a 3% reduction in wages. These findings underscore the challenges of balancing family leave policies with the goal of maintaining women's long-term attachment to the labour market. Anti-discrimination legislation, particularly in the United States, has provided valuable insights into the complexities of legal reforms aimed at promoting gender equality. Neumark and Stock (2001) employed a Difference-in-Differences (DiD) framework to assess the impact of the Equal Pay Act and Equal Employment Opportunity Act on women's employment and earnings. While these laws successfully increased women's earnings—by 4.1% for black women and 1.2% for white women—they were associated with a decline in employment rates for both groups, likely due to increased compliance costs for employers. These findings highlight a potential trade-off between wage equality and employment opportunities, suggesting that employers may adjust hiring practices in response to increase regulatory costs.

Turning to Saudi Arabia, the legal reforms introduced under the Vision 2030 initiative represent a watershed moment in addressing gender disparities in the labour market. Among these, two key reforms stand out: the 2018 removal of the driving ban for women and the 2019 legal reforms, which systematically dismantled structural barriers to women's economic participation. The latter reforms introduced workplace protections, prohibited gender-based discrimination, and aligned retirement ages for men and women (The Embassy of the Kingdom of Saudi Arabia, 2019). In line with Feminist Legal Theory (MacKinnon, 1987), these changes challenge entrenched gender inequalities, enabling women's participation in the labour market. Furthermore, Human Capital Theory (Becker, 1964) provides an economic rationale for these reforms, as they unlock women's previously underutilised skills and qualifications, contributing to national productivity and economic growth. These measures collectively contributed to a significant rise in female labour force participation (FLFP), from 17.7% in 2016 to 33.2% in 2022 (GASTAT, 2022).

For decades, Saudi Arabia's ban on women driving epitomised the entrenched gender inequalities within the country's social and legal systems. Until June 2018, Saudi women relied

on male relatives, private drivers, or other means of transportation, severely limiting their physical mobility and economic opportunities (Williams et al., 2019; Zeitoun et al., 2023). The lifting of the ban marked a symbolic and practical shift in Saudi Arabia's approach to gender equality, granting women autonomy over their mobility and improving their access to employment. Amjad (2024) examines the impact of the 2018 driving law reforms on women's employment in Saudi Arabia. Employing quantitative data from the Saudi General Authority for Statistics, the World Bank, and the International Labour Organization, alongside qualitative interviews conducted from 2018 to 2020, she utilizes time-series and regression analyses as well as thematic analysis. The study reveals significant increases in women's workforce engagement and mobility, accompanied by shifts in societal attitudes towards gender roles. However, despite the lifting of the driving ban, only 2% of women in the country had obtained a driver's licence two years later (Daher et al., 2023). This low rate of licensure was due to several barriers. Initially, only one school was authorised to offer the required training and licence testing to women, and the fee for the course was 3,000 SAR ($800 USD), which is 50% of the average monthly salary of Saudi women and six times higher than the course fee for men. These constraints significantly limited women's de facto access to driving, even though they had the de jure right. To address these barriers, Daher et al. (2023) conducted a randomised controlled trial that provided a randomly chosen group of women with immediate and free access to the driving school, thereby granting them de facto rights to the legal reform. Using a randomised sample of 606 women from low-income backgrounds in Riyadh over an 18-month period from July 2019 to December 2020, the study revealed that the treated women were 35% more likely to be employed and made 19% more trips without male accompaniment. However, it is important to note that this study period overlaps with the onset of the COVID-19 pandemic, which may have influenced women's mobility patterns and work behaviours. Mobility restrictions and lockdowns likely reduced the number of trips made overall, while simultaneously accelerating the adoption of remote work in certain sectors. These dynamics could have moderated the observed effects of increased mobility or altered the nature of employment opportunities accessible to women during this time. Nevertheless, the study also

noted a decrease in economic autonomy among the treated women, suggesting that cultural and logistical challenges continue to impede full economic empowerment despite increased mobility.

Moreover, Saleh and Malibari (2021) conducted a series of focus groups in Riyadh before and after the repeal of the driving ban, engaging in two sessions—one in 2014 and another in 2019—with six groups consisting of 30 women each. Their qualitative research revealed that individuals who employed personal drivers in 2014 tended to retain them in 2019, suggesting that the driving ban was not the predominant impediment to their mobility. They argued that regulatory and legal restrictions posed greater barriers to women's economic participation, particularly in accessing formal employment and entrepreneurial opportunities. These findings underscore the importance of complementary policies to support legal reforms and maximise their potential. ***Figure 4.A3*** provides clear evidence supporting this argument, showing that female labour force participation (FLFP) in Saudi Arabia experienced only modest growth after the driving ban repeal in 2018. The significant increase in FLFP occurs after the implementation of the 2019 legal reforms, highlighting their transformative role in addressing deeper structural barriers to women's employment.

The 2019 legal reforms constituted a pivotal moment in Saudi Arabia's broader Vision 2030 framework, designed to enhance women's economic empowerment. Key provisions[17] included removing the requirement for male guardian approval for employment, granting women the right to travel without prior approval, and prohibiting workplace discrimination. Additionally, these reforms opened male-dominated industries, such as construction and logistics, to female workers, aligning retirement ages for men and women to foster a more equitable labour market environment (Aldawsari et al., 2022; GASTAT, 2022). Despite the transformative nature of these reforms, much of the existing research on women's employment in Saudi Arabia focuses on socio-cultural barriers rather than directly assessing the impact of

[17] Further details about the 2019-reform are provided next in Section 4.4.1.

legal changes. Bursztyn et al. (2020), highlighted the role of misperceived[18] social norms in shaping women's labour supply decisions. They found that men systematically underestimated the level of societal approval for women working outside the home among their peers. Specifically, a sample of 500 Saudi men aged 18 to 35 substantially underestimated support for women's employment within their demographic group. When these misperceptions were corrected through randomly provided accurate information about peers' views, men were more likely to support their wives in seeking employment. These findings were further validated in an online survey of 1,500 married Saudi men, where 92% underestimated the proportion of their neighbours who supported women working. By addressing these second-order beliefs—men's perceptions of others' beliefs—the study demonstrates how correcting social norm misperceptions can positively influence labour supply decisions, highlighting the interplay between societal attitudes and economic behaviour. Building on this, Alkhuzam et al. (2023) examine the role of correcting misperceptions about social norms in shaping attitudes toward female labour force participation (FLFP). Using survey experiments and information treatments, the study finds that Saudi students systematically underestimated societal support for women working outside the home. However, attempts to correct these misperceptions did not lead to uniform positive changes. Instead, they either had no effect or created negative spillover effects on related beliefs, such as the impact of women working on family life. These findings underscore the complexity of addressing socio-cultural barriers to FLFP, highlighting that changing perceptions about one aspect of women's employment might inadvertently reinforce concerns about other areas, such as family dynamics.

Similarly, Aloud et al. (2020) investigate the significance of social norms, information gaps, and family constraints in explaining the low rates of female labour force participation in conservative societies like Saudi Arabia. The study utilises a randomised information experiment embedded in a survey of female university students at King Saud University. The

[18] *Misperceived norms refer to a phenomenon where individuals hold inaccurate beliefs about others' opinions or behaviours. In this context, Saudi men underestimated the level of societal approval for women working outside the home within their peer groups. This "pluralistic ignorance" can distort decision-making and perpetuate behavioural barriers to female labour market participation (Bursztyn et al., 2020).*

findings reveal that information treatments significantly increased the students' expectations of labour force participation, with additional emphasis on the role of parental expectations. Lastly, Eger et al. (2022) examine barriers to integrating women into all-male firms in Riyadh using a survey of 410 firms. The study employs best subset selection and linear probability model regression to identify determinants of female employment within firms. The results indicate that personal opinions and manager demographics significantly influence whether firms employ women, with physical workspace constraints also playing a crucial role. While these studies provide valuable insights into the socio-cultural barriers to female employment, they do not directly analyse the impact of the 2019 legal reforms.

Parveen (2021) and Rizvi and Hussain (2022) provide more focused analyses of the post-reform period. Parveen (2021), using data from GASTAT (2010–2020), identified improvements in FLFP following the 2019 reforms, attributing these gains to the removal of male guardianship restrictions and workplace anti-discrimination laws. However, her analysis relied on descriptive statistics and did not explore sector-specific dynamics. Similarly, Rizvi and Hussain (2022) examined the transformative effects of the reforms, focusing on legislative changes and improvements in women's legal rights. Their findings highlight a shift in women's employment patterns, with increasing participation in sectors previously dominated by men. However, their analysis remains largely descriptive and theoretical, lacking empirical verification or detailed exploration of sector-specific outcomes.

In conclusion, existing literature underscores the importance of legal reforms in addressing gender disparities, yet significant gaps remain in understanding their granular impact. Most studies focusing on Saudi context adopt qualitative or descriptive approaches, providing limited insights into sectoral dynamics and empirical relationships (Alkhuzam et al., 2023; Aloud et al., 2020; Bursztyn et al., 2020; Parveen, 2021; Rizvi & Hussain, 2022). This chapter contributes to the literature by employing raw Labour Force Survey (LFS) data for two waves (2019) and (2022) from GASTAT, which has not been extensively used in academic research due to access restrictions. By applying both a before-after analysis and Propensity Score Matching (PSM) methodology, this chapter rigorously estimates the overall and sector-

specific impacts of the 2019 legal reforms on women's employment in Saudi Arabia. Focusing on both traditionally male-dominated sectors, such as construction and logistics, and female-dominated fields like education and healthcare, this analysis provides a comprehensive understanding of how legal reforms interact with sectoral characteristics to shape women's workforce integration. By addressing these gaps, this chapter contributes to the broader discourse on legal reforms and gender equality, offering empirical insights into the mechanisms through which policy interventions can promote sustainable economic inclusion for women.

4.4 Methodology

4.4.1 The Treatment: The 2019 Legal Reform

The treatment under consideration in this chapter is the legal reforms introduced in Saudi Arabia in August 2019 as part of the broader Vision 2030 framework. These reforms were designed to address the entrenched legal and institutional barriers that had historically constrained women's participation in the labour market. The reforms marked a pivotal shift in the legal landscape, directly targeting cultural, structural, and economic impediments to female employment.

One of the most transformative aspects of the 2019 reforms was the removal of the requirement for male guardian approval for women to work. Previously, women could only seek employment if they received explicit permission from a male guardian, such as a husband, father, or brother. This restriction not only limited women's economic autonomy but also significantly curtailed their opportunities to enter the workforce, especially in male-dominated sectors or jobs requiring travel. The abolition of this requirement granted women greater independence and enabled them to make their own career choices. The reforms also addressed travel restrictions that had further constrained women's mobility and economic participation. Before 2019, women required a guardian's approval to obtain passports and travel abroad, which limited their ability to pursue employment opportunities involving domestic or international travel. The reforms granted women the right to obtain passports and travel without prior approval, thereby opening up access to a wider range of employment opportunities, particularly in sectors such as trade, consulting, and logistics.

Another critical component of the reforms was the introduction of anti-discrimination laws aimed at protecting women in the workplace. These laws included provisions to prohibit termination based on pregnancy or marital status, ensure equal pay for equal work, and prevent gender-based discrimination in hiring practices. Such measures sought to create a more equitable and inclusive work environment, particularly in sectors where women had historically been underrepresented. Additionally, the reforms opened up male-dominated industries, such as construction, manufacturing, and transportation, to female workers. Previously, societal norms and occupational segregation limited women's employment to specific sectors such as

education and healthcare. By removing these constraints, the reforms enabled women to enter industries that were crucial to the diversification of the Saudi economy, aligning with Vision 2030's goal of broadening the economic base beyond oil revenues. The alignment of retirement ages for men and women was another notable provision of the 2019 reforms. Prior to this change, women were often required to retire earlier than men, which limited their career progression and lifetime earnings. By aligning retirement ages, the reforms created a level playing field, allowing women to participate more fully in the labour market over their lifetimes.

It is important to note that while the reform package comprised multiple components—removal of guardianship restrictions, travel rights, anti-discrimination laws, and retirement age alignment—the analysis in this chapter treats them as a bundled "treatment." Due to data limitations, it is not possible to empirically isolate the effects of each reform element. Nevertheless, recognising their distinct purposes and likely differential effects enhances our understanding of the overall impact. The collective implementation of these reforms signals a broader institutional shift toward gender equality in the labour market, which this chapter aims to evaluate through their combined influence on women's labour force participation. Finally, While the reforms were primarily directed at women, the broader economic restructuring could have indirect spillover effects on male employment as well. Accordingly, this chapter examines two distinct samples—male and female—to assess both the direct and indirect effects of the reforms on labour market outcomes.

4.4.2 Before-After Analysis

This chapter examines the impact of the 2019 legal reforms on Female labour force participation (FLFP) in Saudi Arabia, both at an aggregate level and within specific economic sectors. To assess these effects, the chapter adopts a before-after analysis framework, drawing inspiration from Bergemann and Riphahn (2023), who evaluated parental leave reforms in Germany. This approach is particularly appropriate in the current context given the nationwide implementation of the reforms, which leaves no obvious untreated comparison group.

The before-after approach allows for the inclusion of all individuals regardless of their labour force status at baseline, providing a broad view of how employment outcomes evolve

over time. However, unlike Bergemann and Riphahn (2023), this analysis does not explicitly model censored observations using a hazard framework. Entry into the labour force is not treated as a time-to-event process, and thus, potential right-censoring—where individuals may enter the labour force after the observation period—cannot be formally addressed. The method nonetheless enables the inclusion of time-varying covariates such as age, education, and marital status, which are crucial for capturing heterogeneity in women's labour market responses.

While this before-after framework does not yield causal estimates, it offers valuable descriptive insights into shifts in FLFP surrounding the implementation of the reform. This approach is particularly useful in identifying broad trends and associations, especially when more sophisticated quasi-experimental methods are constrained by data limitations. As highlighted by Bergemann and Riphahn (2023), such an approach can still illuminate important policy-relevant patterns in labour force dynamics. Accordingly, this section provides a comprehensive descriptive analysis of the 2019 legal reforms' influence on women's participation in the labour market in Saudi Arabia.

I. Estimating The Overall Impact of the 2019 Legal Reform

The first step in the empirical strategy involves estimating the overall effect of the 2019 legal reforms on FLFP by comparing pre-reform data from 2019 with post-reform data from 2022. The estimation relies on the following baseline equation:

$$\lambda_i(t) = \lambda_0(t) + \alpha\, reform + \beta Z_i + \varepsilon_i \qquad (4.1)$$

Where:

- $\lambda_i(t)$ represents the likelihood of individual i participating in the labour force at time t,
- $reform_i$ is a binary variable indicating the post-reform period,
- Z_i is a vector of control variables, including individual characteristics such as age, education level, marital status, household size, and regional fixed effects,
- α measures the average effect of the reform on women's labour force participation at the individual level, and
- ε_i is an error term.

This baseline model estimates the aggregate effect of the reforms by isolating differences in FLFP between the pre- and post-reform periods. The inclusion of control variables is crucial for addressing potential confounding effects arising from changes in demographic or socio-economic characteristics over time. For example, variations in educational attainment or marital status could independently influence employment decisions. By incorporating these controls, the analysis aims to ensure that the estimated effects reflect the direct impact of the reforms rather than extraneous factors.

II. Sectoral Analysis: The Impact of 2019 Legal Reform on Employment Across Economic Sectors

In addition to aggregate effects, this chapter investigates sectoral differences in the impact of the 2019 legal reforms. It hypothesises that the reforms had heterogeneous effects across sectors, with traditionally male-dominated industries—such as Agriculture and Mining, Construction, and Trade and Transportation—experiencing greater increases in female participation than sectors historically dominated by women, such as Education and Healthcare. To test this hypothesis, the model is extended to include sectoral indicators and their interactions with the reform variable:

$$\lambda_i(t) = \lambda_0(t) + \alpha\, reform_i + \sum_{s=1}^{s} \delta_s\, sector_i + \sum_{s=1}^{s} \gamma_s\, (reform_i \times sector_i) + \beta Z_i + \varepsilon_i \qquad (4.2)$$

Where:

- $sector_i$ is a vector of dummy variables representing the ten key sectors of the economy, which are: Agriculture and Mining, Manufacturing and Utilities, Construction, Trade and Transportation, Accommodation and Food Services, Financial and Real Estate Activities, Education, Health and Social Work, Public Administration and Defence, and General Services, and
- γ_s captures the interaction between the reform and the sector, allowing us to estimate how the effect of the reform varies across industries and individuals.

By interacting the reform variable with sectoral indicators, the model identifies whether the reforms had differential effects across industries. For instance, sectors such as Construction, Manufacturing, and Trade and Transportation are hypothesised to experience larger increases

in FLFP due to the reforms' focus on expanding opportunities in traditionally male-dominated fields. In contrast, female-dominated sectors like Education and Healthcare may exhibit more modest changes. This sectoral analysis provides a granular understanding of how the reforms influenced different areas of the economy, aligning with Vision 2030's objectives of diversifying the economy and expanding women's roles in fields previously less accessible to them.

While the before-after analysis provides valuable insights, it is essential to account for potential selection bias. Selection bias arises when the demographic composition of the female workforce—such as age, education, and marital status—differs significantly between the pre- and post-reform periods (Angrist & Pischke, 2009; Heckman, 1979). If such changes occur, the estimated effects of the reforms may be confounded by underlying shifts in workforce characteristics rather than reflecting the true impact of the policy. Evidence from Table 4.2 highlights substantial differences in the demographic composition of the female labour force between 2019 and 2022. For instance, the share of women aged 15–24 increased from 10.8% to 14.3%, while the proportion in the prime working-age group (25–54) declined from 86.9% to 81.1%. Similarly, educational attainment shifted significantly, with the share of women holding a Bachelor's degree falling from 62.5% to 51.3%, while the proportion with a Master's degree more than doubled from 1.3% to 2.7%. Marital status also evolved, with the share of never-married women decreasing from 27.7% to 25.4%, and the proportion of widowed women declining from 3.2% to 1.5%. These statistically significant changes indicate that the composition of the female workforce varied substantially across the two periods, potentially confounding the interpretation of the reforms' effects. To mitigate this issue, the analysis adopts a Propensity Score Matching (PSM) approach in the subsequent section. PSM creates matched samples of women from the pre- and post-reform periods based on comparable observable characteristics, thereby reducing selection bias and enhancing the reliability of the estimates.

4.4.3 Propensity Scores Matching (PSM)

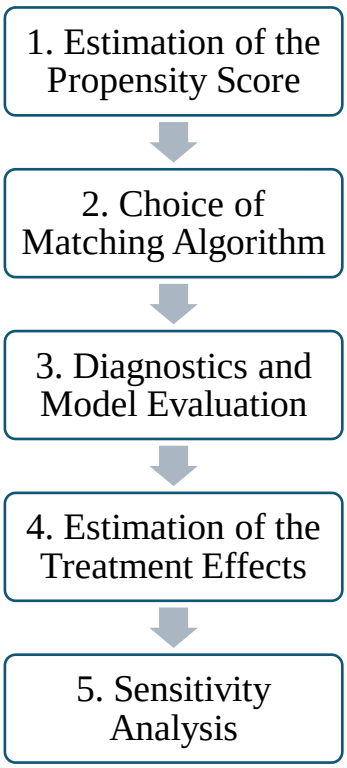
To address the issue of selection bias and improve the validity of the analysis, this chapter employs Propensity Score Matching (PSM), a widely recognised methodology developed by Rosenbaum and Rubin (1983). PSM is particularly suitable in policy evaluation contexts where randomised control trials (RCTs) are infeasible (Holland, 1986). PSM involves estimating the probability of receiving treatment (i.e., being in the post-reform period) given a set of observed covariates, such as age, education, marital status, household size, and regional factors. These probabilities, known as propensity scores, are used to match individuals in the pre-reform (2019) and post-reform (2022) periods, ensuring that the matched samples are similar in their demographic and socio-economic composition. This approach effectively reduces selection bias by balancing observable characteristics between the two groups.

Other methods, such as Difference-in-Differences (DiD), could also be applied to estimate causal effects. DiD compares the change in outcomes between treated and untreated groups before and after the intervention. However, DiD was not feasible for this chapter due to the absence of a proper control group. Since all women in Saudi Arabia were exposed to the reforms after 2019, there is no unaffected group to serve as a comparison. DiD requires a control group that remains unexposed to the treatment, which is impossible in this nationwide reform context. In contrast, PSM does not rely on the existence of a distinct control group. Instead, it allows for comparison between women in the post-reform 2022 dataset (treated) and women in the pre-reform 2019 dataset (untreated). By matching individuals from both periods based on their observable characteristics, effectively approximating random assignment (Becker & Caliendo, 2007). This allows us to attribute differences in labour force outcomes more confidently to the 2019 legal reforms, rather than to pre-existing differences between women in the two periods, thereby reducing confounding bias and enhancing the accuracy of estimating the reforms' impact on FLFP (Caliendo & Kopeinig, 2008).

To capture the nuanced effects of the reform, PSM is applied separately for men and women, allowing for gender-specific estimates of the reform’s impact. This approach directly assesses the effects on women while accounting for any indirect spillover effects on men, which

may result from broader economic shifts associated with Vision 2030. Although the reforms primarily aimed at increasing women's employment, the analysis reveals positive secondary impacts on male employment. These outcomes likely arise from enhanced labour market flexibility and expanded opportunities across various sectors triggered by the reforms (World Bank, 2020). **Figure 4.3** illustrates the five key steps in the PSM procedure adopted in this chapter. The process begins with the estimation of the propensity score using a logit model, predicting the likelihood of receiving treatment based on covariates such as age, marital status, education level, household size, and regional factors. Following this, a matching algorithm is selected to pair treated and control individuals based on similar propensity scores. Diagnostics and model evaluation are conducted to ensure balance in covariate distribution between the matched groups. Subsequently, the treatment effects—specifically the Average Treatment Effect on the Treated (ATT)—are estimated by comparing employment outcomes between the treated and control groups. Finally, a sensitivity analysis assesses the robustness of the estimated effects to potential unobserved confounding variables.

Figure 0.3 *Propensity Score Matching (PSM) Flow*



Source: Own illustration.

1. Estimation of Propensity Scores Matching (PSM)

The first step in PSM is to estimate the propensity score, which represents the conditional probability of receiving the treatment —being exposed to the 2019 legal reforms—given a set of observable covariates. In this context, the treatment group comprises Saudi women in 2022 (post-reform), while the control group consists of Saudi women in 2019 (pre-reform). These covariates include key demographic and socio-economic factors such as age, marital status, education level, household size, household head, and regional factors. The propensity score is estimated using a logistic regression model that includes key demographic and socio-economic factors such as age, marital status, education level, household size, household head status, and regional characteristics, as shown below:

$$P(Treatment_i = 1|X_i) = \frac{e^{\beta_0+\beta_1 X_i}}{1+ e^{\beta_0+\beta_1 X_i}} \qquad (4.3)$$

Where:

- $Treatment_i = 1$ if individual ii is observed in the post-reform period (2022), and 0 if in the pre-reform period (2019).
- $X_i$is a vector of observable covariates, including age, education, marital status, and regional factors.

Once the propensity scores are estimated, individuals in the treated group (those in the post-reform period) are matched with individuals in the control group (those in the pre-reform period) who exhibit similar propensity scores. This matching process ensures that any differences observed in employment outcomes between the two groups can be attributed to the reform rather than by pre-existing differences in observable characteristics (age, marital status, education level, household size, household head, and region). By closely aligning individuals based on similar likelihoods of participating in the labour force, we effectively balance the sample on observable covariates, reducing potential biases related to selection on observable factors. To achieve this, several matching algorithms are applied, including Nearest Neighbor Matching (NNM), Kernel Matching (KM), and Radius Matching (RM). These matching methods allow us to identify pairs or groups of women from both the pre- and post-reform

periods who are similar in their observable characteristics, isolating the effect of the reform itself (Caliendo & Kopeinig, 2008; Dehejia & Wahba, 2002; Leuven & Sianesi, 2003).

- **Assumptions for Identification**

For PSM to yield unbiased estimates of the treatment effect, three critical assumptions must be satisfied:

A1) Conditional Independence Assumption (CIA):

This assumption posits that after conditioning on observable covariates X_i, the potential outcomes are independent of treatment status. Formally, this can be expressed as:

$$(Y_0, Y_1) \perp T \mid X$$

where Y_0 and Y_1 are the potential outcomes for untreated and treated individuals, respectively, and T is the treatment indicator. The CIA ensures that any systematic differences between treated and untreated individuals can be attributed to the treatment itself, assuming all relevant covariates are controlled for (Rosenbaum & Rubin, 1983).

A2) Common Support Condition:

This assumption ensures that for each value of X_i, there is a positive probability of receiving treatment or remaining untreated:

$$0 < \mathrm{P}_r(T_i = 1|X_i) < 1$$

The common support condition guarantees sufficient overlap in the characteristics of treated and untreated individuals, enabling meaningful comparisons. Without this overlap, the matching procedure may fail, as it would be impossible to find untreated individuals with similar propensity scores to their treated counterparts (Heckman et al., 1997).

A3) Stable Unit Treatment Value Assumption (SUTVA):

SUTVA assumes that the treatment status of one individual does not affect the potential outcomes of another. In this context, it implies that one woman's labour market outcomes are unaffected by whether other women in the sample are treated (i.e., exposed to the reforms):

$$(Y_{it}, Y_{ic}) \perp T_j \quad for \quad i \neq j$$

for any individuals i and j. This assumption ensures that the treatment effect is not influenced by spillover effects or interactions between treated and untreated individuals (Rubin, 1978).

By satisfying these assumptions, PSM provides a robust framework for reducing selection bias in estimating the effects of the 2019 legal reforms on female labour force participation. Through the matching process, PSM adjusts for observable differences between treated (post-reform) and untreated (pre-reform) individuals, allowing us to create comparable groups in terms of demographic and socio-economic characteristics. This adjustment enables a more credible analysis of the reforms' impact by ensuring that observed differences in labour market outcomes are less likely to be due to pre-existing disparities. However, it is essential to note that while PSM effectively reduces selection bias based on observable variables, it does not support causal inference. The method adjusts only for measured covariates and cannot account for unobserved factors, such as individual motivation, social networks, or social norm towards female employment, which could still influence labour force participation. If these unobserved characteristics differ systematically between the treated and control groups, they may introduce bias into the estimated effects of the reforms (Heckman et al., 1998).

2. Matching Procedure

After estimating propensity scores, the next critical step in Propensity Score Matching (PSM) is selecting a suitable matching algorithm to pair treated individuals with control individuals who have similar propensity scores. The objective is to construct a valid counterfactual, enabling the estimation of treatment effects while reducing selection bias (Rosenbaum & Rubin, 1983). Various matching algorithms are available, each with strengths and weaknesses depending on the dataset and research context. This section outlines three commonly used matching techniques—Nearest Neighbour Matching (NNM), Caliper Matching, and Kernel Matching—and discusses their methodological implications.

i. Nearest Neighbour Matching (NNM)

Nearest Neighbour Matching is among the most widely used matching algorithms due to its intuitive simplicity and computational efficiency. Under NNM, each treated individual is matched with the control individual whose propensity score is closest. This method can be implemented either with or without replacement. Matching with replacement allows control units to be matched to multiple treated units, which helps reduce bias by ensuring that the best

possible match is always selected. However, this approach may increase variance, as certain control units may be disproportionately represented (Caliendo & Kopeinig, 2008). On the other hand, matching without replacement restricts the use of each control unit to one match, which reduces variance but may increase bias if the pool of comparable controls is limited. A key consideration in NNM is the distance metric used to determine the closeness of propensity scores. While the default approach often relies on simple Euclidean distance, more sophisticated measures, such as Mahalanobis distance, can be employed to account for the covariance structure of the covariates, thereby improving the robustness of matches (Stuart, 2010). Another limitation of NNM is that it does not account for poor-quality matches, which may lead to biased estimates if treated units have no sufficiently similar control counterparts.

ii. Calliper Matching

Caliper Matching refines the NNM approach by imposing a maximum allowable difference (caliper) between the propensity scores of treated and control individuals. This constraint improves the quality of matches by excluding poorly matched control units, thereby reducing bias (Austin, 2011). The choice of caliper width is critical: a smaller caliper enhances match quality but reduces the number of matches, potentially decreasing the statistical power of the analysis. In contrast, a larger caliper increases the likelihood of bias, as it allows for poorer matches. Austin (2011) recommends setting the caliper width at 0.2 times the standard deviation of the logit-transformed propensity scores to strike a balance between match quality and sample size. However, the choice of caliper width may vary depending on the specific dataset and research question. Caliper Matching is particularly useful in settings where there is a risk of large discrepancies in propensity scores between treated and control groups, as it mitigates the impact of these discrepancies on the estimated treatment effects.

iii. Kernel Matching

Kernel Matching differs from the previous methods by using all available control units to estimate the counterfactual outcomes for treated individuals. This approach assigns weights to each control unit based on the similarity of their propensity scores to those of the treated unit. Control units with propensity scores closer to the treated unit are assigned higher weights,

while those further away receive lower weights (Heckman et al., 1997). The weighted average of control outcomes is then used to construct the counterfactual for each treated unit.

One advantage of Kernel Matching is that it reduces variance by incorporating more information from the control group. However, this method may introduce bias if the weights are poorly calibrated or if distant controls contribute significantly to the counterfactual estimate. The choice of bandwidth in Kernel Matching plays a critical role in balancing the bias-variance trade-off. A smaller bandwidth ensures that only control units with very similar propensity scores contribute to the estimate, reducing bias but potentially increasing variance. Conversely, a larger bandwidth incorporates more control units, reducing variance but risking higher bias due to poorer-quality matches. Kernel Matching is particularly effective in large datasets where sufficient control units are available to construct robust counterfactuals for treated units. However, it requires careful tuning of the bandwidth parameter and selection of the kernel function, such as Gaussian or Epanechnikov, to optimise performance (Caliendo & Kopeinig, 2008).

In this chapter, all three matching methods—Nearest Neighbour Matching, Caliper Matching, and Kernel Matching—are evaluated to ensure the robustness of the estimated treatment effects. By comparing results across these methods, this approach accounts for potential trade-offs in bias and variance, providing a comprehensive assessment of the impact of the 2019 legal reforms on female labour force participation in Saudi Arabia. This multi-method approach enhances the credibility and generalisability of the findings.

3. Diagnostics of the Propensity Score Model

Before estimating the treatment effects, we need to conduct various diagnostic checks to evaluate the performance of the propensity score model and ensure the robustness of the treatment assignment for the analysis of the 2019 legal reforms on female labour force participation (FLFP) in Saudi Arabia.

i. Common Support Evaluation

The first diagnostic involves evaluating the region of common support, which refers to the overlap in propensity score distributions between the treated and control groups. Common

support is assessed by examining the density distributions of both groups and comparing their ranges (i.e., minima and maxima of propensity scores) (Caliendo & Kopeinig, 2008). If there is insufficient overlap between the two groups, the common support assumption may be violated, leading to biased estimates. Therefore, when common support problems are identified, several approaches can be taken. One common method is to exclude observations outside the common support region, though this may lead to a reduction in sample size (Caliendo & Kopeinig, 2008).

ii. **Covariate Balance Assessment**

Next, the adequacy of the treatment assignment model is evaluated through covariate balance diagnostics. The primary goal of PSM is to balance covariates between the treated and control groups, ensuring that any observed differences in outcomes are due to the treatment rather than pre-existing differences. one common approach for evaluating the performance of the propensity score model is covariate balance. Covariate balance is assessed by comparing the means of covariates between the treated and control groups using the Standardized Mean Difference (SMD) (Caliendo & Kopeinig, 2008). For continuous variables, the SMD is calculated as:

$$SMD_j = \frac{\overline{X}_{1j} - \overline{X}_{0j}}{\sqrt{\frac{(s_{1j}^2 + s_{0j}^2)}{2}}}$$

where $\overline{X}_{1j}\ and\ \overline{X}_{0j}$ represent the weighted means, and $s_{1j}^2 and\ s_{0j}^2$ denote the weighted variances of covariate j in the treatment (T=1) and control (T=0) groups, respectively (Rosenbaum & Rubin, 1985). For binary covariates, the SMD is computed as:

$$SMD_j = \frac{\overline{X}_{1j} - \overline{X}_{0j}}{\sqrt{\overline{X}_{1j}(1 - \overline{X}_{1j}) + \overline{X}_{0j}(1 - \overline{X}_{0j})}}$$

Where $\overline{X}_{1j}\ and\ \overline{X}_{0j}$ represent the prevalence of the covariate in the treated and control groups, respectively (Austin, 2011).

4. Estimation of Treatment Effects

After matching, I estimate the Average Treatment Effect on the Treated (ATT) and the Average Treatment Effect (ATE) to assess the impact of the reform on women employment in Saudi Arabia.

The treatment effects are calculated as follows:

$$ATE = E(y\_1 - y\_0) \qquad (4.4)$$

$$ATET = E(y\_1 - y\_0 \,|T = 1) \qquad (4.5)$$

Where:

- y_1 represents the employment outcomes in the post-reform period.
- y_0 represents the employment outcomes if the individual has not received the treatment (been in the pre-reform period).
- T=1 indicates the treated group (post-reform participants).

The ATE measures the expected difference in FLFP outcomes between the post-reform and pre-reform groups for the entire population, while the ATET focuses specifically on the impact of the reform for women who participated in the labour force after the reform. These estimates provide insight into both the overall and specific effects of the 2019 reforms on labour market participation for men and women. Importantly, by estimating ATE and ATET separately for men and women, we are able to draw conclusions about the gender-differentiated impacts of the reform.

5. Sensitivity Analysis

To assess the robustness of the treatment effect estimates and address potential hidden biases, a sensitivity analysis was conducted using Rosenbaum bounds (Rosenbaum, 2002). While Propensity Score Matching (PSM) controls for observed covariates, it cannot account for unobserved confounders that may influence both the likelihood of treatment (post-reform) and the outcome (employment). These unobserved variables could introduce hidden bias, which may distort the estimated effects of the 2019 legal reforms on female labour force participation (FLFP).

The Rosenbaum bounds approach helps evaluate how sensitive the results are to the presence of such hidden biases. Specifically, this method assesses how strongly an unobserved variable would need to affect treatment assignment to change the inference about the treatment effects. The formula for the bounds on the odds ratio is:

$$\frac{1}{\Gamma} \leq \frac{\pi_j /(1-\pi_j)}{\pi_k /(1-\pi_k)} \leq \Gamma$$

where Γ=exp(η), and π_j and π_k represent the probabilities of treatment for individuals j and k with identical observed covariates. If Γ=1, there is no hidden bias, while values of Γ>1 allow for increasing levels of unobserved bias.

In this chapter, the "mhbounds" command in Stata was employed to perform the sensitivity analysis for binary outcome variables (employment). A range of Γ values from 1 to 6 was tested, with higher values indicating stronger potential biases. In the social sciences, a Γ value of 1.2 is often seen as a critical threshold for moderate sensitivity to hidden bias (Becker & Caliendo, 2007). If the treatment effect remains significant at higher Γ values, this indicates that the results are robust and unlikely to be driven by unobserved confounders. In summary, the sensitivity analysis provides insight into the extent to which the results depend on the unconfoundedness assumption. By confirming that the estimated treatment effects are robust to hidden biases, this analysis strengthens the validity of the findings regarding the impact of the 2019 legal reforms on female labour force participation.

4.4.4 Data and Variables

i. Data Source

The primary dataset for this analysis is the Labour Force Survey (LFS), conducted by the General Authority for Statistics (GASTAT). The LFS is a nationally representative survey targeting individuals aged 15 years and older, capturing key labour market indicators, including employment, unemployment, and labour force participation. It disaggregates data by demographic and regional characteristics, enabling detailed analyses of labour market dynamics. Since its inception in 1999, the LFS has adhered to international standards set by the International Labour Organization (ILO), ensuring consistency and comparability with global labour market studies. This alignment with international norms makes the dataset a robust and reliable source for examining Saudi Arabia's labour market. For this chapter, data from two specific years were utilised: 2019, representing the pre-reform period, and 2022, reflecting the post-reform period. The 2019 dataset initially included 28,966 observations, of which 15,233 were Saudi nationals. Following data cleaning and a focus on Saudi nationals, 9,438 observations were retained. Similarly, the 2022 dataset began with 55,780 observations, of which 36,590 were Saudi nationals, and 9,097 observations were retained after cleaning. The focus on Saudi nationals is justified as the 2019 legal reforms specifically targeted this group, allowing for a precise assessment of their impact.

One of the key strengths of the LFS is its granularity, providing individual-level data on variables such as age, gender, education, marital status, employment type, and industry. This level of detail facilitates a comprehensive analysis of labour market dynamics and enables the identification of specific sectors and demographic groups most affected by the 2019 legal reforms. Unlike the aggregated data that is publicly available, the raw data employed in this chapter offers richer insights and allows for more nuanced conclusions. The use of raw data from the LFS, which is notoriously difficult to access due to stringent privacy restrictions, marks a significant contribution to the literature on Saudi Arabia's labour market. Although the LFS is conducted quarterly, only annual datasets for 2019 and 2022 were available for this chapter. The choice of these two years reflects both practical and methodological

considerations. The reforms under examination were implemented in August 2019 and using data from the years immediately before and after the reform ensures a focused timeframe to evaluate their impact. While the inclusion of earlier datasets could have added historical context, access restrictions imposed by GASTAT limited this possibility. Nonetheless, focusing on these two years allows for the isolation of reform effects while minimising confounding influences from unrelated policy changes or external events. All analyses were performed using STATA 17.0 (StataCorp, College Station, TX, USA).

ii. Variables

Table 4.1 summarises the variables utilised in this analysis, categorising them into outcome variables and control variables (observable covariates). The outcome variables include employment status, economic sector, and specific economic activities, which serve as key indicators for assessing the impact of the 2019 legal reforms on women's labour market outcomes. The control variables encompass demographic and household characteristics, including age, marital status, education level, household size, household headship, and region. These variables are integral to the analytical framework of this chapter. They facilitate both the initial before-and-after analysis and the subsequent Propensity Score Matching (PSM) approach. By incorporating these controls, the propensity scores are constructed to ensure a balanced comparison between the treatment and control groups, thereby enhancing the robustness of the causal inference. This comprehensive set of variables enables the chapter to provide a nuanced understanding of how the 2019 legal reforms influenced women's employment dynamics in Saudi Arabia.

- **Outcome Variable**

To address the first research question, **"How have the 2019 legal reforms impacted women's labour force participation in Saudi Arabia?"**, this chapter employs the variable **Employment Status**. This outcome variable measures whether individuals are currently employed or not, with the following coding: Employed = 1 and Not Working = 0. The "Not Working" category encompasses both unemployed individuals and those not participating in the labour force. This classification allows for a clear distinction between employed and non-

employed individuals, enabling a focused analysis of the changes in women's labour force participation attributable to the 2019 legal reforms.

Table 0.1 *Variable Description*

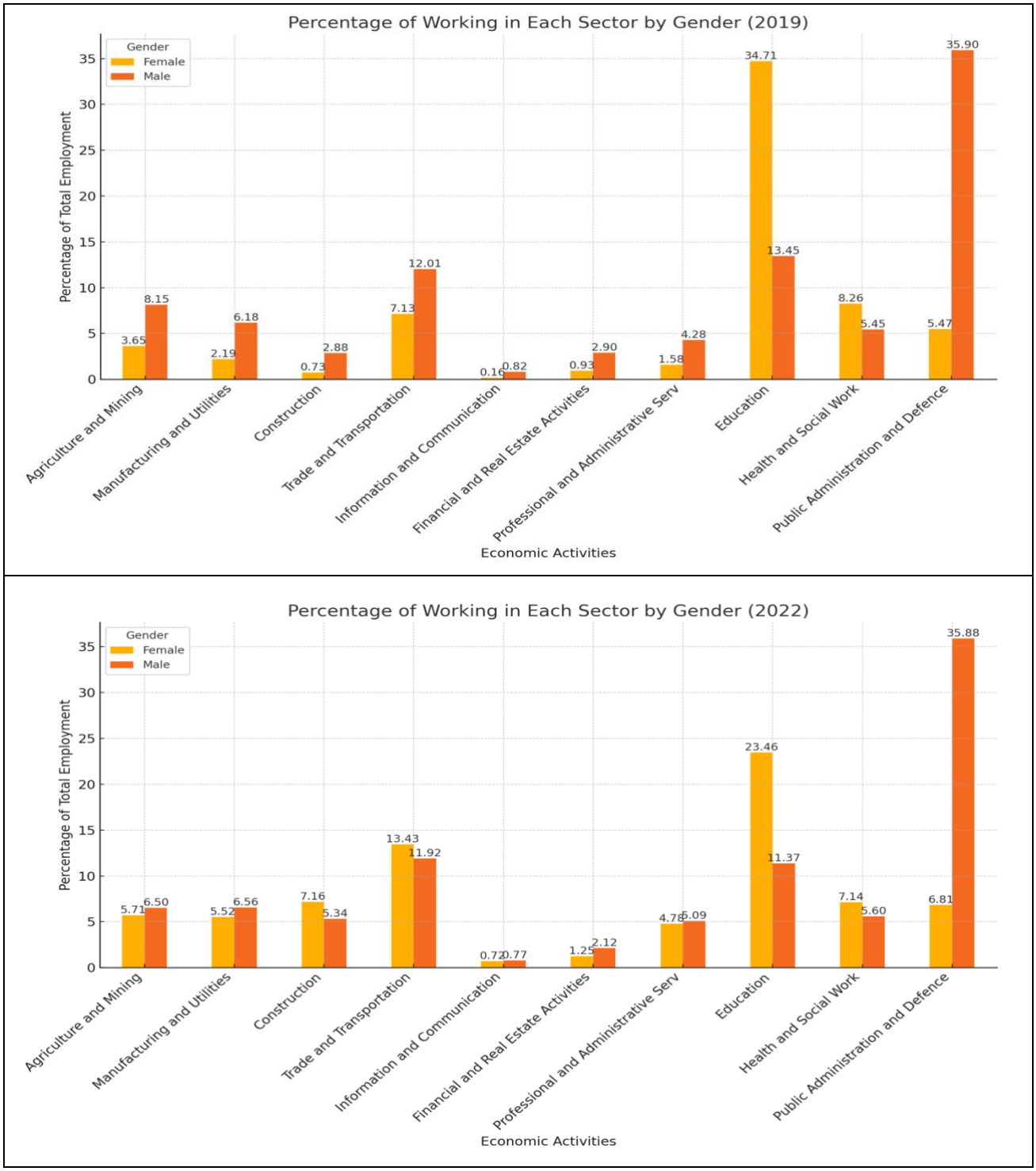
	Variable	Variable Name	Description	Coding
Outcome variable	Employment Status	labor_	Measures the employment status, used as the primary outcome variable.	Employed = 1, Unemployed = 0
	Economic Sector	sector	Measures the type of sector that the individual is employed in.	Government sector = 1, Private sector = 2
	Economic Activates	activ	Measures the specific economic activity the individual is engaged in.	Agriculture and Mining=1, Manufacturing and Utilities=2, Construction=3, Trade and Transportation=4, Accommodation and Food Services=5, Financial and Real Estate Activities=6, Education=7, Health and Social Work=8, Public Administration and Defence=9, General Services=10, Not Applicable=14
Control Variables / Observable Covariates				
Individual Ch's	Age	age_	Reflects the age of the participant, categorized into age groups to examine employment trends across different life stages and their impact on employment opportunities.	15-24 = 1, 25-54 = 2, 55-64 = 3, 65+ = 4
	Educational Level	education_	Indicates the highest level of education attained, used to evaluate its correlation with employment likelihood and the type of employment accessed.	No education = 0, Below Primary Education = 1, Primary Education = 2, Secondary Education = 3, Post-Secondary = 4, Bachelor's Degree = 5, Master's Degree = 6, PhD = 7
	Marital Status	marital_	Records the marital status of the individual, which influences economic responsibilities and employment decision-making.	Never been married = 1, Married = 2, Divorced = 3, Widowed = 4
Household Ch's	Household Head	Head_	If the individual is the household head, affecting their economic contributions and dependency within the household.	Head of Household = 1, and 0 otherwise.
	Number of Household Members	num_HH_member	Represents the total number of members in the household, used to assess how household size might influence employment decisions due to economic pressures.	Continuous Variable
Region	Administrative Unit	region_	Represents the region where the individual resides, used to analyze regional differences in employment trends.	Al-Baha = 12, Al-Jouf = 13, Aseer = 6, Eastern Province = 5, Hail = 8, Jazan = 10, Madinah = 3, Makkah = 2, Najran = 11, Northern Borders = 9, Qassim = 4, Riyadh = 1, Tabuk = 7

Source: Labour Force Survey (LFS) conducted by the General Authority for Statistics (GASTAT).

To explore the second research question, **"Which economic activities have experienced the most significant changes in women's labour force participation following the 2019 legal reforms in Saudi Arabia?"**, the chapter uses the variables sector and **Economic Activities**. This variable categorises economic activities into 13 sectors, as identified by the GASTAT in Saudi Arabia. GASTAT employs the fourth revision of the International Standard Industrial Classification of All Economic Activities (ISIC, Rev.4) issued by the United Nations Economic and Social Council, for its LFS. The ISIC, Rev.4 classification system organises economic activities into sections, divisions, groups, classes, and branches, providing a detailed framework for data collection and presentation across various sectors. For the purposes of this chapter, the original 21 sectors were consolidated into 13 broader categories. This reclassification simplifies the analysis and enhances the ability to examine trends in labour force participation across different economic sectors. Detailed descriptions of the merged sector groups are presented in **Table 4.A2** in the appendices.

Figure 4.4 presents the percentage distribution of Saudi workers in various economic activities by gender for the years 2019 and 2022. The data reveal notable shifts in employment patterns across different sectors, highlighting significant changes in female employment. For instance, the education sector, which had a high percentage of female workers in 2019 (34.71%), saw a decrease to 23.46% by 2022. Conversely, sectors such as health and social work, which were traditionally less female-dominated, experienced increases in female participation from 8.26% in 2019 to 11.37% in 2022. Additionally, the manufacturing and utilities sector observed an increase in female employment from 0.72% in 2019 to 5.52% in 2022. These shifts reflect the impact of legislative improvements in Saudi Arabia following 2019 legal reform as part of the Saudi Vision 2030, which aims to enhance women's economic opportunities and participation across various sectors.

Figure 0.4 *Saudi Workers in Economic Activities by Gender*



Source: Labour Force Survey (LFS) conducted by the General Authority for Statistics (GASTAT). Note: the numbers represent the percentage of the total employment for each gender within each economic activity.

- **Control Variables / Observable Covariates**

This chapter employs a comprehensive set of control variables, referred to as observable covariates in the Propensity Score Matching (PSM) framework, to ensure the robustness and accuracy of the analysis. These variables play a critical role in both the before-after analysis and the PSM method. In the before-after analysis, they are used to control for individual and household characteristics, offering a descriptive understanding of shifts in women's employment patterns over time. In the PSM analysis, these variables are integral to constructing propensity scores and ensuring balance between treatment (post-reform) and control (pre-reform) groups, thereby reducing selection bias.

Firstly, individual characteristics such as age, education, and marital status are included as observable covariates. Age is categorised into four distinct groups: 15–24, 25–54, 55–64, and 65+. This classification facilitates the investigation of employment trends across different life stages, acknowledging that economic needs and opportunities vary significantly among these age groups. Educational attainment is included with categories ranging from no education to PhD, which is crucial for assessing the relationship between educational level and employment likelihood, as higher educational attainment is typically associated with improved employment prospects and higher earnings (Card, 1999). Marital status is recorded with categories including never been married, married, divorced, and widowed, accounting for the influence of marital status on economic responsibilities and employment decisions. This recognises that family dynamics and economic pressures differ across marital statuses (Assaad et al., 2022).

In addition to individual characteristics, household characteristics are incorporated as observable covariates to further refine the analysis. The relationship to the household head is classified into categories such as head of household, husband/wife, son/daughter, brother/sister, mother/father, daughter/son-in-law, grandson/granddaughter, other relatives, and no relationship. This variable is vital for understanding an individual's economic role and dependency within the household, as different roles can significantly impact economic contributions and employment opportunities (Gonzales et al., 2015). The number of household members is treated as a continuous variable, allowing for an examination of how household

size may influence employment decisions; larger households may exert increased economic pressures, thereby affecting employment patterns (Hendy, 2010). Additionally, the administrative region of residence is included to account for regional variations in employment trends, with regions categorised as Al-Baha, Al-Jouf, Aseer, Eastern Province, Hail, Jazan, Madinah, Makkah, Najran, Northern Borders, Qassim, Riyadh, and Tabuk. By integrating these individual and household-level variables, the chapter ensures a comprehensive approach to assessing the impact of the 2019 legal reforms. This combination of controls in the before-after analysis and observable covariates in the PSM framework allows for a nuanced understanding of the factors influencing women's employment in Saudi Arabia. The robust methodological framework provides a detailed examination of how legal reforms have reshaped labour market outcomes, capturing the multifaceted nature of employment decisions and their underlying determinants.

4.5 Results

4.5.1 Descriptive Statistics

Tables 4.2 and 4.3 present the descriptive statistics for the Saudi female and male labour force samples in 2019 and 2022, capturing key shifts in labour market dynamics following the 2019 legal reforms. These tables focus on the primary outcome variables—employment status and sector of employment—along with key covariates such as age, marital status, and education.

For the female sample (**Table 4.2**), there is a significant increase in employment, rising from 66.5% in 2019 to 80.7% in 2022. This suggests a substantial positive impact of the 2019 reforms on female labour force participation. Sectoral distribution highlights important changes: employment in the private sector increased significantly by 23.7%, while government sector employment saw a notable decline of 9.7%. This shift likely reflects a broader trend of increasing female participation in the private sector, a key objective of Saudi Arabia's economic diversification agenda. Additionally, the educational attainment of women shows important changes, with a significant decline in the proportion of those holding Bachelor's degrees (from 62.5% in 2019 to 51.3% in 2022). In contrast, there was an increase in the share of women with

Master's degrees, rising from 1.3% to 2.7%, indicating a growing number of women pursuing higher educational qualifications in response to the evolving labour market.

Table 0.2 *Descriptive Statistics- Saudi Female Sample*

Variable	2019			2022			T-test	
	Obs	**Mean**	Std. Dev.	Obs	**Mean**	Std. Dev.	**Diff (2022-2019)**	Std. Dev.
Employment Status								
1. Employed	2469	**0.665**	0.472	3141	**0.807**	0.395	**0.142*** **	0. .012
Household Head								
Yes	2469	**0.047**	0.213	3141	**0.059**	0.236	**0.012***	0.006
Age								
1. 15-24	2469	**0.108**	0.006	3141	**0.143**	0.006	**0.035*** **	0.008
2. 25-54	2469	**0.869**	0.007	3141	**0.811**	0.007	**-0.058*** **	0.009
3. 55-64	2469	**0.018**	0.003	3141	**0.039**	0.003	**0.022*** **	0.004
4. +65	2469	**0.005**	0.001	3141	**0.006**	0.001	**0.002**	0.001
Educational Level								
0. No education	2469	**0.017**	0.128	3141	**0.025**	0.155	**0.008****	0.004
1. Below Primary Education	2469	**0.005**	0.07	3141	**0.007**	0.082	**0.002**	0.002
2. Primary Education	2469	**0.071**	0.257	3141	**0.107**	0.309	**0.036*** **	0.008
3. Secondary Education	2469	**0.173**	0.378	3141	**0.219**	0.414	**0.046*** **	0.011
4. Post-Secondary	2469	**0.091**	0.288	3141	**0.096**	0.295	**0.005**	0.008
5. Bachelor's Degree	2469	**0.625**	0.484	3141	**0.513**	0.5	**-0.113*** **	0.013
6. Master's Degree	2469	**0.013**	0.113	3141	**0.027**	0.162	**0.014*** **	0.004
7. PhD	2469	**0.005**	0.072	3141	**0.007**	0.082	**0.001**	0.002
Marital Status								
1. Never been married	2469	**0.277**	0.009	3141	**0.254**	0.008	**-0.022***	0.012
2. Married	2469	**0.648**	0.010	3141	**0.678**	0.008	**0.030****	0.013
3. Divorced	2469	**0.043**	0.004	3141	**0.053**	0.004	**0.010***	0.006
4. Widowed	2469	**0.032**	0.004	3141	**0.015**	0.002	**-0.017*** **	0.004
Occupational Sector								
1.Governament	2469	**0.435**	0.496	3141	**0.338**	0.473	**-0.097*** **	0.013
2. Private	2469	**0.228**	0.419	3141	**0.464**	0.499	**0.237*** **	0.012
3. Other (Not Applicable/Undefined)	2469	**0.335**	0.472	3141	**0.193**	0.395	**-0.142*** **	0.011
Economic Activities								
Agriculture and Mining	2468	**0.027**	0.161	3141	**0.01**	0.099	**-0.017*** **	0.004
Manufacturing and Utilities	2468	**0.022**	0.146	3141	**0.053**	0.223	**0.031*** **	0.005
Construction	2468	**0.007**	0.085	3141	**0.075**	0.263	**0.068*** **	0.005
Trade and Transportation	2468	**0.071**	0.257	3141	**0.131**	0.337	**0.060*** **	0.008
Accommodation and Food Services	2468	**0.01**	0.098	3141	**0.049**	0.215	**0.039*** **	0.004
Financial and Real Estate Activities	2468	**0.009**	0.094	3141	**0.013**	0.115	**0.004**	0.003
Education	2468	**0.347**	0.476	3141	**0.234**	0.424	**-0.113*** **	0.012
Health and Social Work	2468	**0.083**	0.275	3141	**0.065**	0.247	**-0.017****	0.007
Public Administration and Defence	2468	**0.055**	0.227	3141	**0.073**	0.261	**0.018*** **	0.007
General Services	2468	**0.034**	0.182	3141	**0.084**	0.277	**0.049*** **	0.006
Not Applicable	2468	**0.335**	0.472	3141	**0.213**	0.41	**-0.121*** **	0.012

Source: Labour Force Survey (LFS) conducted by the General Authority for Statistics (GASTAT). Note: (Obs) is the number of observations, (Mean) is the mean values, and (Std. Dev.) is the standard deviations.

In the male sample (**Table 4.3**), employment rates remained relatively stable, with a modest yet statistically significant increase from 93.6% in 2019 to 94.9% in 2022. Household

headship, however, saw a significant decline from 76.8% in 2019 to 71.8% in 2022, possibly reflecting shifts in household structures and economic responsibilities. In terms of sectoral employment, the male sample mirrors the trends observed in the female sample, with a significant reduction in government sector employment (by 2.2%) and a corresponding increase in private sector participation. Educational attainment among men also improved significantly, particularly at the secondary and post-secondary levels.

Table 0.3 *Descriptive Statistics- Saudi Male Sample*

Variable	2019			2022			T-test	
	Obs	**Mean**	Std. Dev.	Obs	**Mean**	Std. Dev.	**Diff (2022-2019)**	Std. Dev.
Employment Status								
1. Employed	6969	**0.936**	0.245	6083	**0.949**	0.22	**0.0129****	0.004
Household Head								
Yes	6969	**0.768**	0.422	6083	**0.718**	0.45	**-0.050*****	0.008
Age								
1. 15-24	6969	**0.111**	0.314	6083	**0.155**	0.362	**0.044*****	0.006
2. 25-54	6969	**0.793**	0.405	6083	**0.763**	0.426	**-0.030*****	0.007
3. 55-64	6969	**0.067**	0.25	6083	**0.057**	0.232	**-0.010****	0.004
4. +65	6969	**0.029**	0.167	6083	**0.025**	0.157	**-0.004**	0.003
Educational Level								
0. No education	6969	**0.02**	0.14	6083	**0.012**	0.111	**-0.008****	0.002
1. Below Primary Education	6969	**0.005**	0.069	6083	**0.003**	0.053	**-0.002***	0.001
2. Primary Education	6969	**0.151**	0.358	6083	**0.105**	0.307	**-0.046*****	0.006
3. Secondary Education	6969	**0.429**	0.495	6083	**0.37**	0.483	**-0.060*****	0.009
4. Post-Secondary	6969	**0.102**	0.303	6083	**0.145**	0.352	**0.043*****	0.006
5. Bachelor's Degree	6969	**0.276**	0.447	6083	**0.331**	0.471	**0.055*****	0.008
6. Master's Degree	6969	**0.013**	0.112	6083	**0.026**	0.161	**0.014*****	0.003
7. PhD	6969	**0.004**	0.067	6083	**0.008**	0.088	**0.003****	0.001
Marital Status								
1. Never been married	6969	**0.276**	0.447	6083	**0.312**	0.463	**0.036*****	0.008
2. Married	6969	**0.706**	0.455	6083	**0.664**	0.472	**-0.04*****	0.008
3. Divorced	6969	**0.015**	0.121	6083	**0.022**	0.146	**0.007****	0.002
4. Widowed	6969	**0.003**	0.052	6083	**0.002**	0.05	**-0.0003**	0.001
Occupational Sector								
1. Governament	6969	**0.596**	0.491	6083	**0.586**	0.493	**-0.010**	0.009
2. Private	6969	**0.337**	0.473	6083	**0.359**	0.48	**0.022****	0.008
3. Other (Not Applicable/Undefined)	6969	**0.064**	0.245	6083	**0.051**	0.221	**-0.013****	0.004
Economic Activities								
Agriculture and Mining	6969	**0.07**	0.255	6083	**0.04**	0.196	**-0.03*****	0.004
Manufacturing and Utilities	6969	**0.062**	0.241	6083	**0.065**	0.247	**0.003**	0.004
Construction	6969	**0.029**	0.167	6083	**0.054**	0.227	**0.026*****	0.004
Trade and Transportation	6969	**0.12**	0.325	6083	**0.117**	0.322	**-0.003**	0.006
Accommodation and Food Services	6969	**0.011**	0.106	6083	**0.022**	0.148	**0.011*****	0.002
Financial and Real Estate Activities	6969	**0.029**	0.168	6083	**0.021**	0.144	**-0.008****	0.003
Education	6969	**0.134**	0.341	6083	**0.116**	0.32	**-0.018****	0.006
Health and Social Work	6969	**0.055**	0.227	6083	**0.055**	0.229	**0.001**	0.004
Public Administration and Defence	6969	**0.359**	0.48	6083	**0.358**	0.48	**-0.001**	0.008
General Services	6969	**0.067**	0.25	6083	**0.084**	0.278	**0.018*****	0.005
Not Applicable	6969	**0.064**	0.245	6083	**0.065**	0.247	**0.001**	0.004

Source: Labour Force Survey (LFS) conducted by the General Authority for Statistics (GASTAT). Note: (Obs) is the number of observations, (Mean) is the mean values, and (Std. Dev.) is the standard deviations.

4.5.2 Before-After Results

This chapter conducts an empirical examination of the 2019 legal reforms, focusing on their impact on women's labour force participation, employing a Before-After analysis approach, the chapter empirically addresses two pivotal research questions: first, it evaluates the overall impact of the reforms on women's labour force participation; second, it explores the specific sectors and economic activities that have witnessed the most significant shifts in female employment post-reform. The dependent variable across all analyses is the employment status of individuals. The primary variable of interest is the post-reform period indicator (Post), which captures the effect of the 2019 legal reforms on women's employment. In the sectoral and economic activity analysis, an interaction term between sector and post-reform (sector*post) is included to assess how the impact of the reforms varies across different sectors and economic activities.

The results of the before-and-after analysis, as presented in **Table 4.4**, provide critical insights into the impact of the 2019 legal reforms on women's employment in Saudi Arabia. The table is structured into two panels: ***Panel A*** focuses on the female sample, while ***Panel B*** presents results for the male sample. Across both panels, three models are employed, progressively incorporating additional controls to improve the robustness and interpretability of the findings. ***Model 1*** serves as the baseline specification, including only the post-reform indicator and individual-level controls such as age, marital status, and education, along with regional fixed effects. This model provides an initial estimate of the overall effect of the reforms without accounting for sectoral or economic activity-specific factors. ***Model 2*** expands the analysis by introducing sectoral controls, comparing employment outcomes across the private and government sectors. This step allows for an assessment of whether the reforms had differential effects by sector. ***Model 3*** further refines the analysis by including controls for specific economic activities, such as education, construction, and trade, to capture sector-specific dynamics.

Table 0.4 *The Impact of the 2019 Legal Reforms on Women's Employment- Before-After Analysis*

Variables / Model	Panel A: Female			Panel B: Male		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Post Reform	0.1201***	0.0001	0.0207	0.0211***	-1.29E-06	0.0076**
	(0.0116)	(0.0001)	(0.0107)	(0.0041)	(0.0000)	(0.0025)
Sector (ref. 1.Government)						
2. Private		-0.0004			0.0001	
		(0.0004)			(0.0002)	
Interaction: sector # Post Reform						
2. Private # Post		0.0016			0.0063	
		(0.0016)			(0.0045)	
Economic Activities (ref. 1. Agriculture and Mining)						
Manufacturing and Utilities			0.0239*			0.0199***
			(0.0101)			(0.0031)
Construction			0.0244*			0.0218***
			(0.0103)			(0.0032)
Trade and Transportation			0.0226*			0.0160***
			(0.0100)			(0.0026)
Accommodation and Food Services			0.0278**			0.0259***
			(0.0104)			(0.0036)
Financial and Real Estate Activities			0.0238*			0.0107***
			(0.0108)			(0.0027)
Education			0.0348**			0.0198***
			(0.0106)			(0.0034)
Health and Social Work			0.0298**			0.0199***
			(0.0105)			(0.0032)
Public Administration and Defence			0.0312**			0.0205***
			(0.0104)			(0.0032)
Interaction: Economic Activities # post reform						
Manufacturing and Utilities # Post			0.0252*			-0.0066*
			(0.0117)			(0.0027)
Construction # Post			0.0243*			-0.0065*
			(0.0122)			(0.0028)
Trade and Transportation # Post			0.0234*			-0.0023
			(0.0113)			(0.0025)
Accommodation and Food Services # Post			0.0282*			-0.0076*
			(0.0116)			(0.0030)
Financial and Real Estate Activities # Post			-0.0147			0.0002
			(0.0119)			(0.0031)
Education # Post			-0.088***			-0.02
			(0.0106)			(0.0026)
Health and Social Work # Post			-0.019			-0.0074**
			(0.0108)			(0.0025)
Public Administration and Defence # Post			0.0207			-0.0076**
			(0.0109)			(0.0025)
Constant	0.7881***	1.0021***	0.9901***	0.8852***	0.9995***	0.9767***
	(0.0501)	(0.0021)	(0.0216)	(0.0144)	(0.0004)	(0.0119)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Region-FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5610	5610	5610	13052	13052	13052
R-sqr	0.11	1	0.95	0.11	1	0.91

Note: The before-and-after analysis employs linear regression with clustered standard errors shown in parentheses. Statistical significance levels are denoted as follows: * p<0.05, ** p<0.01, *** p<0.001. The dependent variable is women's employment status. Model 1 includes the baseline variables, consisting of the post-reform indicator, individual characteristics (age, education, and marital status), household characteristics (relationship to the household head and household size), and regional fixed effects (FE) across Saudi Arabia's 13 administrative regions. Model 2 builds on the baseline by incorporating sectoral variables, allowing for comparisons between private and government employment. Model 3 further extends the analysis by introducing economic activity categories, capturing sector-specific dynamics.

The results of ***Model 1*** for the female sample reveal a statistically significant increase in employment by approximately 12% following the reforms. This highlights the substantial impact of the reforms in enhancing women's participation in the labour market. For the male sample, there is also a positive post-reform effect, though the increase is considerably smaller at just over 2%. This disparity suggests that the legal reforms disproportionately benefited women, which aligns with their primary objective of addressing structural barriers to female employment and advancing gender equality in the workforce. ***Model 2*** incorporates sectoral variables to examine differences between government and private sector employment. While the coefficient for private sector employment is positive for both women and men, it is statistically insignificant in both panels. This indicates that while there are indications of increased employment in the private sector, the results are not robust enough to draw definitive conclusions about the reforms' sector-specific impacts on private sector employment.

Model 3, which incorporates economic activity categories, provides a detailed understanding of sector-specific impacts. For females, employment increased significantly in sectors such as Education, which saw a rise of 3.5%, Accommodation and Food Services with an increase of around 2.8%, and Construction, which experienced growth of approximately 2.4%. These results highlight the effectiveness of the reforms in enabling women to enter traditionally male-dominated sectors like construction while enhancing their representation in education and service-oriented industries. For males, significant increases are observed in sectors such as Accommodation and Food Services, where employment grew by approximately 2.6%, Education, which saw a rise of 2%, and Health and Social Work, which experienced a similar increase of 2%. The interaction terms between economic activities and the post-reform indicator offer further insights. For females, positive and statistically significant impacts are evident in male-dominated sectors such as Construction, where employment increased by approximately 2.4%, and Trade and Transportation, which saw a rise of around 2.3%. These findings indicate that the reforms were particularly effective in breaking gender barriers within these industries. However, declines were observed in traditionally female-dominated sectors, such as Education with a significant decrease of 9%. These shifts suggest that as women

transitioned into more diverse roles, employment gains in historically female-oriented sectors may have plateaued or slightly declined. For males, the interaction terms reveal significant negative effects in most economic activities. For instance, employment in Construction decreased by approximately 0.7%, while Accommodation and Food Services saw a decline of around 0.8%. These results suggest that although the reforms primarily aimed to increase female employment, they may have caused slight displacement effects for male workers.

While the before-after analysis provides valuable insights into the temporal shifts in female labour force participation (FLFP) following the 2019 legal reforms, its results may be influenced by differences in sample characteristics between the pre- and post-reform periods. To address potential selection bias and enhance the robustness of the findings, the chapter employs Propensity Score Matching (PSM) in the subsequent analysis. By adjusting for observable differences between the two periods, PSM offers a more rigorous framework for assessing the empirical impact of the 2019 legal reforms on women's employment outcomes, ensuring greater reliability and precision in the results.

4.5.3 Propensity Score Matching (PSM) Results

1. Estimation of the Propensity Score

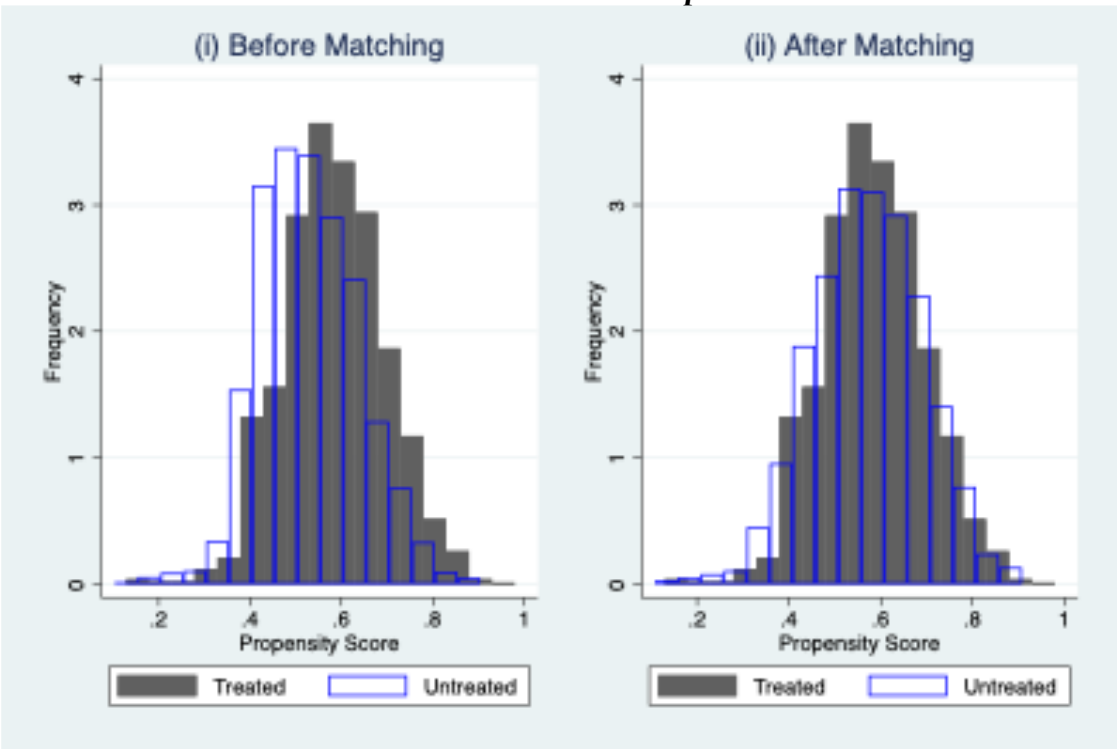
The first step in the PSM process is the estimation of propensity scores for each individual within the dataset. This is achieved by employing a logit regression model, where the binary dependent variable indicates the post-reform status (1 for post-reform, 0 for pre-reform). The model incorporates covariates such as age, education level, marital status, region, household head status, and household size, generating a propensity score for each observation. This score summarises each individual's likelihood of being in the treatment group, conditional on their observable characteristics.

Figure 4.5 illustrates the distribution of propensity scores for both female (***Panel A***) and male (***Panel B)*** samples, shown before and after matching. The comparison of treated and untreated groups across propensity scores allows for an evaluation of the PSM process in balancing the covariates between these groups, thereby reducing selection bias. The alignment

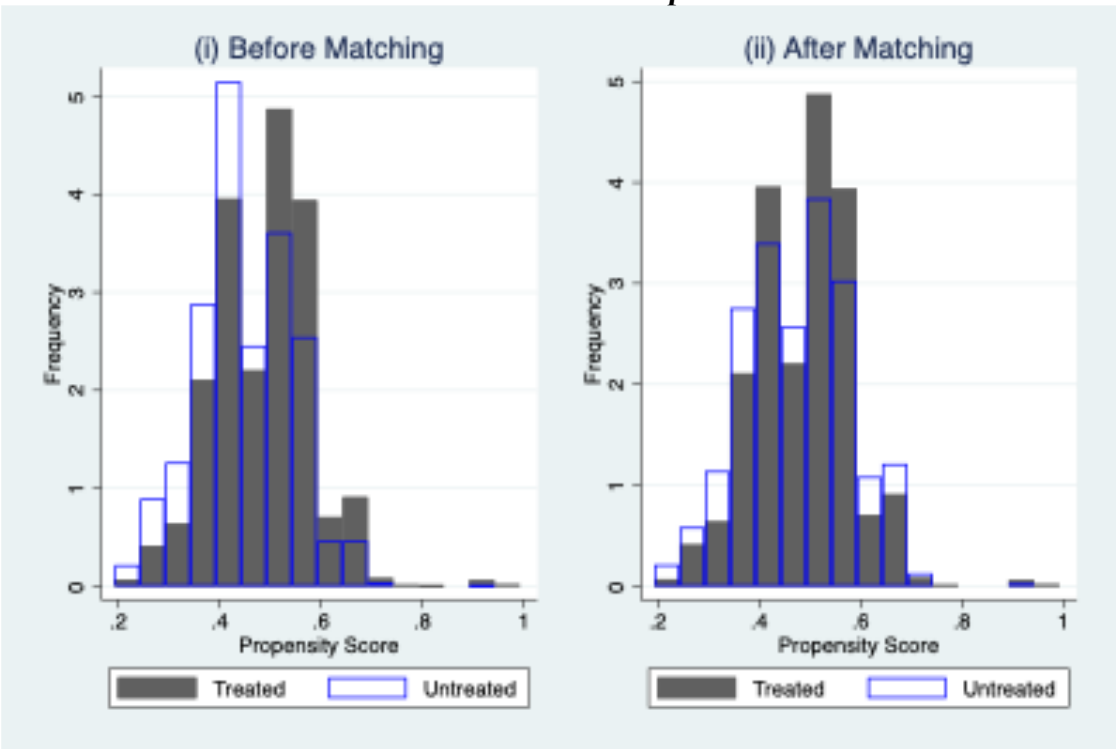
of these distributions post-matching is essential to verify that PSM has successfully created a comparable control group for causal inference.

Figure 0.5 *Distribution of Propensity Scores Before and After Matching*

Panel A: Female Sample



Panel B: Male Sample



In ***Panel A***, the female sample, the subfigure (i), the treated group's propensity scores are concentrated around the 0.5 to 0.7 range before matching, while the untreated group is more dispersed, highlighting pre-matching differences in selection likelihood. After matching, as shown in subfigure (ii), the treated and untreated groups exhibit much greater overlap in their propensity score distributions, confirming that the matching process has achieved a good balance between the two groups. A similar pattern is observed in ***Panel B*** for the male sample. Subfigure (i) shows the distribution of propensity scores for males before matching, where a clear disparity exists between the treated and untreated groups. The treated group's propensity scores are concentrated at higher values, notably between 0.4 and 0.7, while the untreated group displays a broader distribution across lower scores. This imbalance suggests that, before matching, treated individuals were more likely to be selected based on observable characteristics. However, after matching, as depicted in subfigure (ii), the distribution for both groups becomes much more aligned, indicating that the matching process has successfully balanced the observable covariates.

Using the matched samples, both the Average Treatment Effect on the Treated (ATET) and the Average Treatment Effect (ATE) were estimated. The matching process yielded 3,894 matched samples of women and 7,462 matched samples of men, ensuring robust and reliable estimates of the treatment effect. This substantial alignment between the distributions after matching reinforces the validity of subsequent analyses, allowing for more confident attribution of observed differences in outcomes to the treatment rather than to pre-existing differences between the groups.

2. Choice of Matching Algorithm

The primary objective of propensity score estimation is to achieve covariate balance between the treatment and control groups, thereby enabling credible causal inference (Rosenbaum and Rubin, 1983). Following the estimation of propensity scores, it is critical to evaluate whether the matching process has successfully reduced observable differences between groups. This is typically done through covariate balancing tests, which assess whether the distribution of key characteristics—such as age, education, and marital status—is comparable across matched

individuals. A well-balanced sample enhances the validity of the matched control group as a counterfactual for the treatment group (Caliendo and Kopeinig, 2008).

As shown in Table 4.5, all three methods substantially reduced the bias across covariates, with KBM consistently achieving the lowest post-matching bias. For instance, in the case of the "Bachelor's Degree" variable, the bias was reduced to –1.0% using KBM, compared to –2.9% with NNM and –1.6% with RM. Similarly, the variable "Age group 2 (25–54)" showed post-matching bias of only –0.5% under KBM, whereas the corresponding values were –4.4% (NNM) and –1.6% (RM). Across nearly all covariates, KBM outperformed the other two techniques in terms of absolute bias reduction and balance improvement.

Further supporting evidence is presented in Table 4.6, which reports statistical tests for matching quality. For the female sample, the pseudo-R^2 after matching dropped to 0.001 under KBM, compared to 0.006 under NNM and 0.001 under RM, indicating a greater reduction in explanatory power of covariates and better balance. Additionally, the p-value for the likelihood ratio test increased to 0.999 for KBM, compared to 0.996 for RM and 0.320 for NNM. This suggests that KBM achieved the most statistically balanced distribution of covariates post-matching. The mean and median bias after matching were also lowest for KBM (1.1% and 1.0% respectively), further confirming the superior performance of this method. The male sample in Panel B of Table 4.6 exhibits similar patterns, with KBM yielding the lowest median bias (0.7%), lowest mean bias (1.1%), and the highest p-value (0.993) for the likelihood ratio test post-matching.

Taken together, these diagnostics strongly support the use of Kernel-Based Matching (KBM) as the preferred matching algorithm in this chapter. It provides the best overall covariate balance, minimises selection bias, and ensures the robustness of the treatment effect estimation. Consequently, the results reported in the following sections are based on KBM as the primary matching method.

Table 0.5 *Covariate Balancing Tests for Propensity Score using NNM, RM, and KBM*

		Nearest Neighbor Matching (NNM)						Radius Matching (RM)						Kernel Based Matching (KBM)					
		Mean		%	%reduced			Mean		%	%reduced			Mean		%	%reduced		
Variable	**Sample**	**Treated**	**Control**	**Bias**	**|bias|**	**Test**	**p>|t|**	**Trtd**	**Ctrl**	**Bias**	**|bias|**	**Test**	**p>t**	**Ttd**	**Ctl**	**bias**	**|bias|**	**Test**	**p>t**
Age																			
2. 25-54	Unmatched	0.811	0.869	-15.9		-5.840	0.000	0.811	0.869	-15.9		-5.840	0.000	0.811	0.869	-15.9		-5.840	0.000
	Matched	0.811	0.827	-4.4	72	-1.670	0.094	0.811	0.817	-1.6	89.8	-0.600	0.547	0.811	0.816	-1.2	92.3	-0.450	0.651
3. 55-64	Unmatched	0.039	0.018	13		4.730	0.000	0.039	0.018	13		4.730	0.000	0.039	0.018	13		4.730	0.000
	Matched	0.039	0.028	6.9	47.1	2.520	0.012	0.039	0.029	6.5	50.3	2.350	0.019	0.039	0.030	5.6	56.5	2.040	0.042
4. +65	Unmatched	0.006	0.005	2		0.740	0.458	0.006	0.005	2		0.740	0.458	0.006	0.005	2		0.740	0.458
	Matched	0.006	0.007	-0.4	78.8	-0.160	0.876	0.006	0.007	-0.5	74.5	-0.190	0.850	0.006	0.007	-0.7	63	-0.270	0.786
Marital Status																			
2. Married	Unmatched	0.678	0.649	6.3		2.340	0.019	0.678	0.649	6.3		2.340	0.019	0.678	0.649	6.3		2.340	0.019
	Matched	0.678	0.685	-1.3	78.6	-0.540	0.588	0.678	0.672	1.3	79.1	0.530	0.599	0.678	0.672	1.3	78.7	0.540	0.593
3. Divorced	Unmatched	0.053	0.043	4.5		1.660	0.097	0.053	0.043	4.5		1.660	0.097	0.053	0.043	4.5		1.660	0.097
	Matched	0.053	0.053	0	100	0.000	1.000	0.053	0.054	-0.7	83.8	-0.270	0.784	0.053	0.055	-1.1	76.4	-0.400	0.691
4. Widowed	Unmatched	0.015	0.032	-11.3		-4.280	0.000	0.015	0.032	-11.3		-4.280	0.000	0.015	0.032	-11.3		-4.280	0.000
	Matched	0.015	0.021	-3.8	66.4	-1.720	0.086	0.015	0.019	-2.4	78.4	-1.140	0.256	0.015	0.019	-2.5	77.8	-1.160	0.245
Educational Level																			
1. Below Primary	Unmatched	0.007	0.005	2.4		0.890	0.375	0.007	0.005	2.4		0.890	0.375	0.007	0.005	2.4		0.890	0.375
	Matched	0.007	0.005	2.1	12.7	0.820	0.410	0.007	0.006	1.6	34.8	0.610	0.545	0.007	0.006	1.4	40.5	0.550	0.582
2. Primary Education	Unmatched	0.107	0.071	12.7		4.670	0.000	0.107	0.071	12.7		4.670	0.000	0.107	0.071	12.7		4.670	0.000
	Matched	0.107	0.103	1.5	88.5	0.540	0.593	0.107	0.100	2.3	81.9	0.850	0.395	0.107	0.102	1.6	87.1	0.600	0.548
3. Secondary Education	Unmatched	0.219	0.173	11.6		4.290	0.000	0.219	0.173	11.6		4.290	0.000	0.219	0.173	11.6		4.290	0.000
	Matched	0.219	0.225	-1.6	86.2	-0.610	0.544	0.219	0.222	-0.7	94.3	-0.250	0.803	0.219	0.221	-0.6	94.7	-0.230	0.814
4. Post-Secondary	Unmatched	0.096	0.091	1.8		0.670	0.500	0.096	0.091	1.8		0.670	0.500	0.096	0.091	1.8		0.670	0.500
	Matched	0.096	0.084	4.4	-140.3	1.760	0.078	0.096	0.097	-0.3	82.9	-0.120	0.904	0.096	0.096	0.1	93.9	0.040	0.965
5. Bachelor's Degree	Unmatched	0.513	0.625	-22.9		-8.490	0.000	0.513	0.625	-22.9		-8.490	0.000	0.513	0.625	-22.9		-8.490	0.000
	Matched	0.513	0.527	-2.9	87.3	-1.140	0.256	0.513	0.519	-1.3	94.1	-0.530	0.599	0.513	0.517	-1	95.7	-0.390	0.698
6. Master's Degree	Unmatched	0.027	0.013	10.1		3.670	0.000	0.027	0.013	10.1		3.670	0.000	0.027	0.013	10.1		3.670	0.000
	Matched	0.027	0.032	-3.4	66.1	-1.120	0.263	0.027	0.025	1.3	86.9	0.460	0.647	0.027	0.026	0.8	92.3	0.270	0.789
7. PhD	Unmatched	0.007	0.005	1.8		0.680	0.497	0.007	0.005	1.8		0.680	0.497	0.007	0.005	1.8		0.680	0.497
	Matched	0.007	0.004	3.7	-102	1.570	0.116	0.007	0.007	-0.9	52.2	-0.320	0.748	0.007	0.008	-1.2	36.9	-0.420	0.674
Number of HH member (continuous)	Unmatched	5.845	5.809	1.4		0.530	0.597	5.845	5.809	1.4		0.530	0.597	5.845	5.809	1.4		0.530	0.597
	Matched	5.845	5.742	4	-184.9	1.660	0.096	5.845	5.880	-1.4	2.7	-0.540	0.588	5.845	5.870	-1	29.8	-0.390	0.696
HH Head (1.yes)	Unmatched	0.059	0.047	5.3		1.940	0.052	0.059	0.047	5.3		1.940	0.052	0.059	0.047	5.3		1.940	0.052
	Matched	0.059	0.067	-3.3	38	-1.200	0.232	0.059	0.060	-0.4	92.6	-0.150	0.884	0.059	0.062	-1.1	79.6	-0.400	0.689
Region																			
2. Makkah	Unmatched	0.138	0.150	-3.4		-1.250	0.210	0.138	0.150	-3.4		-1.250	0.210	0.138	0.150	-3.4		-1.250	0.210
	Matched	0.138	0.142	-1	70.4	-0.400	0.689	0.138	0.139	-0.2	95.2	-0.070	0.948	0.138	0.139	0	98.5	-0.020	0.984
3. Madinah	Unmatched	0.077	0.065	4.7		1.740	0.081	0.077	0.065	4.7		1.740	0.081	0.077	0.065	4.7		1.740	0.081
	Matched	0.077	0.080	-1	79	-0.370	0.708	0.077	0.080	-1	78.5	-0.380	0.701	0.077	0.081	-1.3	71.5	-0.510	0.612
4. Qassim	Unmatched	0.060	0.039	9.9		3.650	0.000	0.060	0.039	9.9		3.650	0.000	0.060	0.039	9.9		3.650	0.000
	Matched	0.060	0.070	-4.3	57.2	-1.480	0.138	0.060	0.060	0.3	96.6	0.120	0.903	0.060	0.061	-0.2	98	-0.070	0.943
5. Eastern Province	Unmatched	0.132	0.119	4		1.490	0.137	0.132	0.119	4		1.490	0.137	0.132	0.119	4		1.490	0.137
	Matched	0.132	0.131	0.4	90.4	0.150	0.881	0.132	0.136	-1	76	-0.370	0.710	0.132	0.134	-0.5	86.7	-0.210	0.836
6. Aseer	Unmatched	0.080	0.085	-1.6		-0.600	0.547	0.080	0.085	-1.6		-0.600	0.547	0.080	0.085	-1.6		-0.600	0.547
	Matched	0.080	0.087	-2.3	-42.9	-0.910	0.362	0.080	0.080	-0.1	96.3	-0.020	0.981	0.080	0.081	-0.1	92.4	-0.050	0.961
7. Tabuk	Unmatched	0.059	0.046	5.6		2.050	0.040	0.059	0.046	5.6		2.050	0.040	0.059	0.046	5.6		2.050	0.040
	Matched	0.059	0.041	7.7	-38.8	3.130	0.002	0.059	0.058	0.3	95.2	0.100	0.920	0.059	0.057	0.7	87.2	0.270	0.787
8. Hail	Unmatched	0.051	0.057	-2.6		-0.960	0.339	0.051	0.057	-2.6		-0.960	0.339	0.051	0.057	-2.6		-0.960	0.339
	Matched	0.051	0.052	-0.3	89	-0.110	0.909	0.051	0.054	-1.5	40.9	-0.610	0.544	0.051	0.054	-1.4	44.3	-0.570	0.567
9. Northern Borders	Unmatched	0.040	0.058	-8.1		-3.040	0.002	0.040	0.058	-8.1		-3.040	0.002	0.040	0.058	-8.1		-3.040	0.002
	Matched	0.040	0.030	4.7	41.8	2.190	0.029	0.040	0.039	0.5	93.8	0.220	0.825	0.040	0.039	0.9	89.1	0.390	0.697
10. Jazan	Unmatched	0.063	0.090	-10		-3.760	0.000	0.063	0.090	-10		-3.760	0.000	0.063	0.090	-10		-3.760	0.000
	Matched	0.063	0.062	0.5	95.2	0.210	0.835	0.063	0.062	0.3	96.6	0.150	0.882	0.063	0.062	0.5	95.2	0.210	0.835
11. Najran	Unmatched	0.027	0.039	-6.6		-2.500	0.013	0.027	0.039	-6.6		-2.500	0.013	0.027	0.039	-6.6		-2.500	0.013
	Matched	0.027	0.024	2	70.6	0.880	0.380	0.027	0.025	1.5	77.8	0.660	0.511	0.027	0.025	1.4	79.3	0.610	0.541
12. Al-Baha	Unmatched	0.040	0.066	-11.7		-4.430	0.000	0.040	0.066	-11.7		-4.430	0.000	0.040	0.066	-11.7		-4.430	0.000
	Matched	0.040	0.036	2	83.1	0.930	0.355	0.040	0.038	1.1	90.6	0.510	0.610	0.040	0.037	1.2	89.4	0.570	0.567
13. Al-Jouf	Unmatched	0.046	0.062	-7		-2.630	0.009	0.046	0.062	-7		-2.630	0.009	0.046	0.062	-7		-2.630	0.009
	Matched	0.046	0.040	2.9	58	1.300	0.192	0.046	0.046	0.1	99	0.030	0.975	0.046	0.045	0.8	87.9	0.370	0.715

Table 0.6 *Statistical Tests for Matching Quality Evaluation*

Matching Algorithm	Pseudo R2 (BM)	Pseudo R2 (AM)	p>Chi2 (BM)	p>Chi2 (AM)	Mean bias (BM)	Mean bias (AM)	Median bias (BM)	Median bias (AM)
Panel A: Female								
NNM	0.037	0.006	0.000	0.320	7.3	2.7	6.3	2.3
RM	0.037	0.001	0.000	0.996	7.3	1.2	6.3	1
KBM	0.037	0.001	0.000	0.999	7.3	1.1	6.3	1
Panel B: Male								
NNM	0.026	0.003	0.000	0.965	6.1	1.5	5.2	1.5
RM	0.026	0.001	0.000	0.969	6.1	1.1	5.2	1.1
KBM	0.026	0.001	0.000	0.993	6.1	1.1	5.2	0.7

Source: Author's computation based on LFS (2019 and 2022). Note: BM refer to before matching, and AM refer to after matching.

3. Diagnostics of the Propensity Score Model

Before estimating the treatment effects, we need to conduct various diagnostic checks to evaluate the performance of the propensity score model and ensure the robustness of the treatment assignment for the analysis of the 2019 legal reforms on female labour force participation (FLFP) in Saudi Arabia.

i. Common Support Evaluation

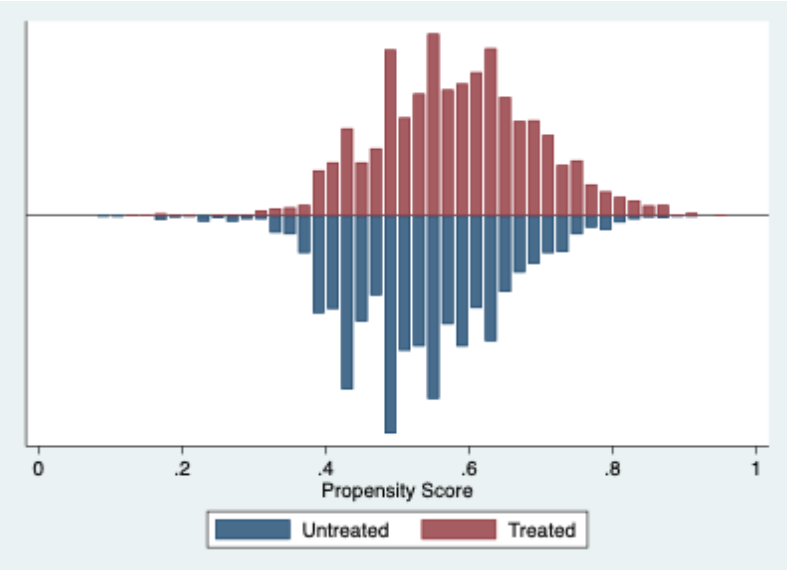
Figure 4.6 illustrates the distribution of propensity scores for the treated and untreated groups, with ***Panel A*** representing the female sample and ***Panel B*** the male sample. The x-axis denotes the propensity scores, ranging from 0 to 1, while the y-axis shows the frequency of individuals within each propensity score range. The treated group is displayed in red in the upper half, and the untreated group in blue in the lower half. The figure demonstrates substantial overlap between the treated and untreated groups, thereby validating the Common Support Assumption (CSA), a first condition for reliable Propensity Score Matching (PSM).

The overlap indicates that for most treated individuals, there exist untreated counterparts with similar propensity scores. This alignment ensures that valid comparisons can be made between these groups, mitigating concerns about selection bias and enhancing the credibility of the estimated treatment effects (Caliendo & Kopeinig, 2008). The extent of this overlap reflects the success of the matching procedure in balancing observable covariates between treated and untreated groups, providing a robust foundation for causal inference (Rosenbaum & Rubin, 1983). In ***Panel A***, the female sample exhibits a broad and consistent overlap in propensity scores, particularly in the mid-range of the distribution. This indicates that the matching process has effectively paired treated and untreated females, facilitating accurate comparisons of labour force participation outcomes. Similarly, ***Panel B***, which focuses on the male sample, displays a comparable pattern of overlap, although the distribution appears slightly more concentrated

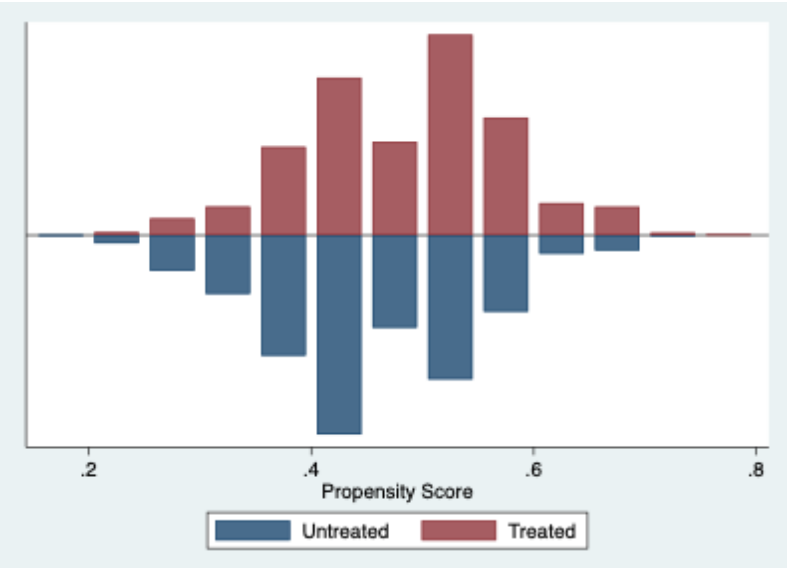
in specific propensity score ranges. This concentration may reflect differences in the observable characteristics of the male sample, which the matching process accounts for. Overall, the observed overlap between the treated and untreated groups in both panels highlights the robustness of the matching process in creating comparable groups. The alignment supports the validity of the PSM approach and underlines its effectiveness in reducing bias in estimating the impact of the 2019 legal reforms on labour force participation. These results are consistent with previous studies demonstrating the utility of CSA in ensuring reliable estimation in observational data analyses (Austin, 2011; Heckman et al., 1997).

Figure 0.6 *Distribution of Propensity Scores: Common Support Assumption*

Panel A: Female Sample



Panel B: Male Sample

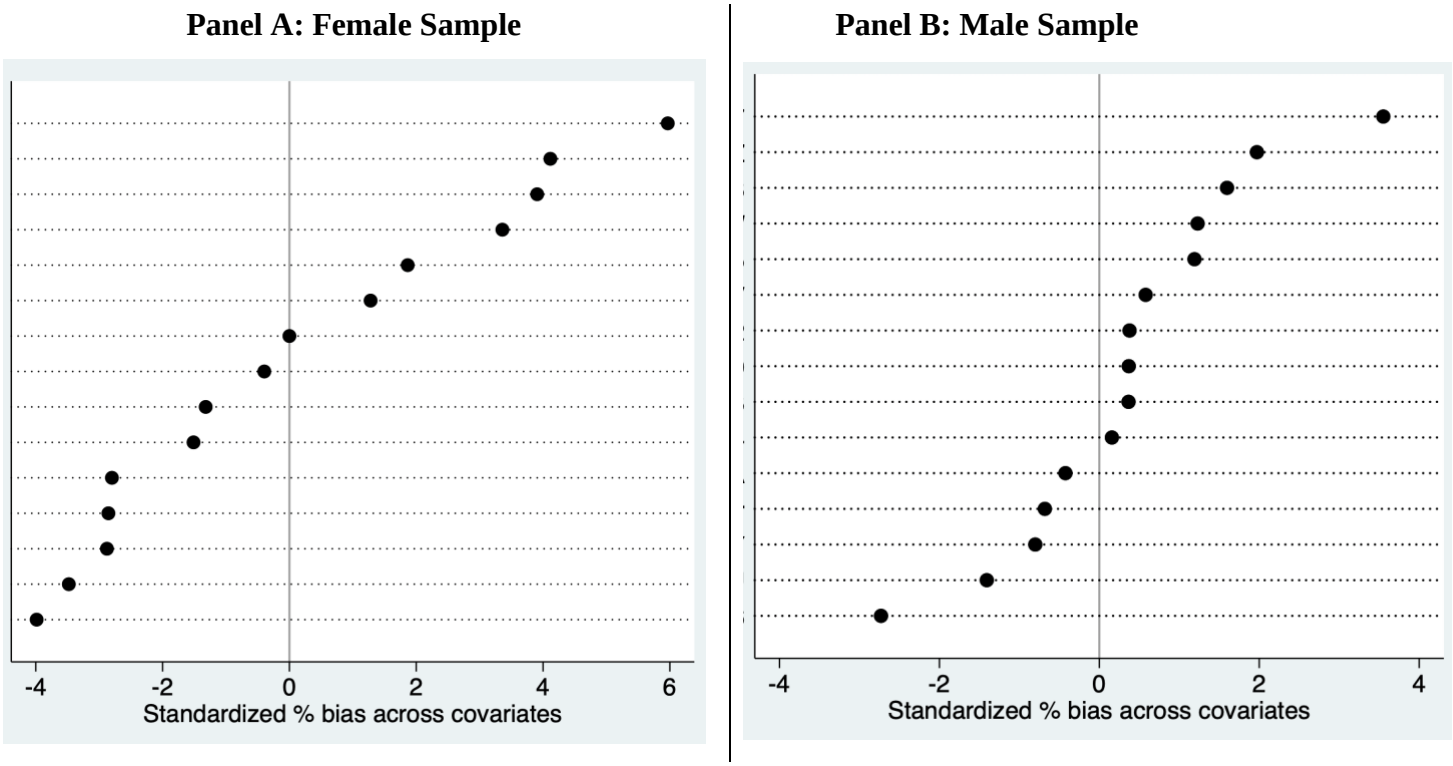


Source: Author's computation based on LFS (2019 and 2022).

ii. Covariate Balance Assessment- SMD

Figure 4.7 displays the standardized mean differences across covariates for both female (***Panel A***) and male (***Panel B***) samples, comparing the pre-reform and post-reform groups before and after propensity score matching. The x-axis represents the standardized percentage bias across covariates, with 0 indicating perfect balance between the treated (post-reform) and control (pre-reform) groups. Achieving a value close to zero suggests a reduction in bias and improvement in covariate balance between the two groups.

Figure 0.7 *Standardized Mean Differences Across Covariates*



Source: Author's computation based on LFS (2019 and 2022). Note: Standardized Mean Differences Across Covariates: Male and Female Samples Before and After Matching.

In the female sample **(*Panel A***), the majority of covariates cluster around zero following matching, indicating a substantial improvement in balance. While a few covariates display biases slightly exceeding 4%, they remain below 6%, indicating that matching has significantly improved covariate balance between the treated and control groups. Despite slightly higher bias for a few variables in the female sample compared to the male sample, the standardized biases overall remain within an acceptable range, underscoring the success of the matching procedure. Similarly, the male sample **(*Panel B*)** shows that most covariates achieve standardised mean differences near zero after matching, with no variable exceeding a bias of 4%. This suggests that the propensity score matching procedure effectively reduced pre-existing differences

between the pre-reform and post-reform groups, ensuring that the analysis of labour outcomes for males is less likely to be confounded by these baseline characteristics. In both panels, the reduction in standardized biases after matching indicates that the propensity score matching process has been successful in aligning the covariates between the pre- and post-reform groups. This ensures that differences in employment outcomes can be more confidently attributed to the effect of the 2019 legal reforms, rather than to baseline differences between the groups.

In addition to the diagnostics, the core assumptions of PSM were examined. The Common Support Assumption (CSA) was validated through Figures 4.5 and 4.6, which show substantial overlap in propensity scores between treated and control groups. The Conditional Independence Assumption (CIA) is plausibly satisfied, given the rich set of covariates (e.g., age, education, marital status, household size, region) included in the estimation, which are strongly associated with both treatment assignment and labour force participation. The Stable Unit Treatment Value Assumption (SUTVA) is likely to hold, as the reform was applied uniformly across the population, without inter-individual spillover effects.

4. Estimation of the Treatment Effects

Following the matching process and the diagnostics tests, the estimation of the treatment effects was conducted by comparing the employment outcomes between matched treated and control groups. Specifically, the Average Treatment Effect on the Treated (ATET) and the Average Treatment Effect (ATE) for overall employment, as well as sector-specific outcomes for both men and women. This provides a detailed understanding of the broader implications of the 2019-legal reform on Saudi labour outcomes.

The result in **Table 4.7** shows that the reforms' impact on women was more profound, as they were the primary beneficiaries of the legal changes. At ***Panel A***, The ATET shows a significant 10.5% increase in overall female employment, with the ATE showing a similar 10.7% increase. These results underscore the effectiveness of the reforms in promoting female labour force participation, aligning with the objectives of Vision 2030 to enhance women's economic involvement. In terms of sectoral outcomes, women experienced substantial gains in the private sector, where employment surged by 22.7%. This sharp increase highlights the private sector's responsiveness to the reforms, as companies actively worked to integrate more women into their workforces. In contrast, female employment in the government sector decreased by 12.3%, indicating a potential shift of women away from traditional public sector roles towards more diverse and dynamic private sector opportunities. Moreover, sectors traditionally dominated by men, such as construction and trade, saw significant increases in female employment, with

respective gains of 2.9% and 6.6%. These results demonstrate the reforms' success in opening up previously male-dominated sectors to female workers. An unexpected finding was the decline in female employment in the education sector, where employment dropped by 12.7%. Historically, education has been a stronghold for female employment in Saudi Arabia. However, this decline may indicate a shift in female employment preferences, with more women taking advantage of new opportunities in sectors such as trade and services, which saw marked increases in female participation. Similarly, the result in **Table 4.7, *Panel B*** shows men, although the 2019 reforms were primarily focused on enhancing female labour market participation, have a notable positive spillover effect on male employment. The ATET shows that male employment increased by 2.2%, while the ATE indicates a 1.5% increase.

The results in ***Panel B***, suggest that while the reforms did not target men directly, they nonetheless contributed to an expansion in male employment through broader economic restructuring and increased demand in certain sectors, which was a key goal of Vision 2030. Sectoral results reveal interesting patterns for male employment. Employment in the private sector rose by 3.8%, which reflects the growth of the private sector and its absorption of additional labour demand following the reforms. Conversely, male employment in the government sector saw a small decline, though this was not statistically significant. Sectors such as construction and trade witnessed notable increases, with male employment rising by 2.2% and 0.9%, respectively. These gains are likely a result of sectoral growth driven by broader economic changes associated with the reforms. However, certain sectors like agriculture and mining showed slight declines in male employment. In conclusion, the 2019 legal reforms had a significant impact on the Saudi labour market, particularly in terms of promoting female employment. The reforms led to substantial gains in female participation, particularly in the private sector, while also generating positive, albeit smaller, spillover effects on male employment.

Table 0.7 *The Effect of 2019-Legal Reform on Labour Outcomes – PSM Results*

Employment Status	
	Employed (1)
Panel A: Female	
ATET	0.105***
	(0.015)
ATE	0.107***
	(0.013)
Panel B: Male	
ATET	0.022***
	(0.006)
ATE	0.015***
	(0.005)

Sector		
	Government (2)	**Private (3)**
Panel A: Female		
ATET	-0.123***	0.227***
	(0.016)	(0.015)
ATE	-0.103***	0.208***
	(0.014)	(0.013)
Panel B: Male		
ATET	-0.016	0.038***
	(0.01)	(0.009)
ATE	-0.003	0.019**
	(0.009)	(0.008)

Economic Activities										
	Agriculture and Mining (4)	**Manufac-turing and Utilities (5)**	**Construct-ion (6)**	**Trade and Transport-ation (7)**	**Accommod-ation and Food Services (8)**	**Financial and Real-Estate Activities (9)**	**Education (10)**	**Health and Social Work (11)**	**Public Administ-ration and Defense (12)**	**General Services (13)**
Panel A: Female										
ATET	-0.017***	0.029***	0.066***	0.051***	0.039***	0.004	-0.127***	-0.013	0.005	0.047***
	(0.005)	(0.006)	(0.006)	(0.011)	(0.005)	(0.003)	(0.016)	(0.009)	(0.01)	(0.007)
ATE	-0.017***	0.024***	0.061***	0.052***	0.038***	0.005	-0.114***	-0.011	0.011	0.038***
	(0.004)	(0.006)	(0.006)	(0.009)	(0.005)	(0.003)	(0.013)	(0.008)	(0.008)	(0.006)
Panel B: Male										
ATET	-0.013***	-0.003	0.022***	0.002	0.009***	-0.009**	-.041***	-0.005	0.032***	0.014**
	(0.005)	(0.005)	(0.004)	(0.007)	(0.003)	(0.004)	(0.007)	(0.005)	(0.009)	(0.006)
ATE	-0.023***	-0.002	0.023***	-0.004	0.009***	-0.01***	-.033***	-0.005	0.028***	0.017***
	(0.004)	(0.005)	(0.004)	(0.006)	(0.003	(0.003)	(0.006	(0.004)	(0.009)	(0.005)

Note: Treatment effects were estimated using Stata's "teffects psmatch" command, which accounts for estimated propensity scores and provides robust standard errors. Kernel-Based Matching (KBM) was used as the primary matching algorithm due to its superior performance in balancing covariates. Robust *Standard errors are in parenthesis. ***p < 0.01, **p < 0.05, and *p < 0.1.*

5. Sensitivity Analysis

Finally, the sensitivity analysis evaluates the robustness of the estimated treatment effects to potential unobserved confounding factors. Using the Rosenbaum bounds[19], this step tests whether the results remain significant even in the presence of hidden biases that may influence both treatment assignment and employment outcomes. If the results hold under varying assumptions about unobserved confounders, it enhances the credibility of the causal inference derived from the analysis. **Table 4.8** presents the results of this analysis, showing the Mantel-Haenszel bounds for different levels of Gamma (Γ), which represents the odds of differential treatment assignment due to unobserved factors. At Γ = 1, where no hidden bias is assumed, the Mantel-Haenszel statistic (Q_mh+ and Q_mh-) demonstrates a significant treatment effect, with a p-value of 1.10E-15. This indicates that, under the assumption of no unobserved variables, the treatment effect on labour outcomes is highly significant. As Γ increases, the sensitivity of the treatment effect to potential hidden biases is assessed. Even at Γ = 1.5, where unobserved variables are assumed to increase the odds of treatment assignment by 50%, the p-value remains significant (0.000442). This confirms that the treatment effect is significant and unaffected by potential hidden biases within this range of Gamma values.

Table 0.8 *Sensitivity Analysis using Rosenbaum Bounds*

Gamma	Q_mh+	Q_mh-	p_mh+	p_mh-
1	7.92361	7.92361	1.10E-15	1.10E-15
1.05	7.36238	8.49008	9.00E-14	0
1.1	6.82903	9.03247	4.30E-12	0
1.15	6.32167	9.55395	1.30E-10	0
1.2	5.8378	10.0564	2.60E-09	0
1.25	5.37529	10.5414	3.80E-08	0
1.3	4.93225	11.0103	4.10E-07	0
1.35	4.50705	11.4645	3.30E-06	0
1.4	4.09825	11.9051	0.000021	0
1.45	3.70458	12.333	0.000106	0
1.5	3.3249	12.7492	0.000442	0

Note: Gamma : odds of differential assignment due to unobserved factors.
Q_mh+ : Mantel-Haenszel statistic (assumption: overestimation of treatment effect).
Q_mh- : Mantel-Haenszel statistic (assumption: underestimation of treatment effect).
p_mh+ : significance level (assumption: overestimation of treatment effect).
p_mh- : significance level (assumption: underestimation of treatment effect).

[19] DiPrete and Gangl (2004) introduced the rbounds ado-file, enabling sensitivity analysis for continuous outcome variables. However, the mhbounds command used in this chapter is specifically designed for binary outcome variables (Rosenbaum, 2002; Becker & Caliendo, 2007).

4.5.4 Heterogeneity Analysis

The heterogeneity analysis provides a detailed understanding of how the 2019 legal reforms affected female employment across different demographic and household characteristics. By examining variations based on education, household size, marital status, household headship, and region, the analysis highlights the diverse ways in which these reforms have influenced women's participation in the labour market.

The results in **Table 4.9** reveal significant variations in the impact of the reforms by educational attainment. Women with no education experienced a negative and statistically insignificant effect (-7.3%), indicating uptake to new opportunities among this group. Conversely, women with primary and secondary education witnessed significant increases in employment, with rises of 8.9% and 23.3%, respectively. These findings indicate that the legal reforms made a substantial difference for women who had the skills but were previously excluded from the labour market due to systemic barriers, such as restrictive norms or legal constraints, rather than a lack of qualifications. Similarly, women with post-secondary education and bachelor's degrees showed positive employment effects of 5.9% and 10.0%, respectively, reflecting the broader inclusivity of the reforms across educational strata. However, for women with postgraduate qualifications, the positive but statistically insignificant results indicate that the reforms may have provided limited incremental benefits, likely due to their pre-existing higher employment rates. These findings underline the importance of considering educational background when evaluating the effectiveness of labour market interventions.

Table 0.9 *Heterogeneity Analysis- Education*

	No Education b/se	**Primary Education b/se**	**Secondary Education b/se**	**Post-Secondary b/se**	**Bachelor's Degree b/se**	**Higher Education b/se**
Post	-0.073	0.0898*	0.2331***	0.0593*	0.0995***	0.1203
	(0.0616)	(0.0362)	(0.0282)	(0.0297)	(0.0159)	(0.0667)
Constant	0.6121	0.7448***	0.5763***	0.4378***	0.3196***	0.8400***
	(0.3866)	(0.0962)	(0.0558)	(0.0879)	(0.0415)	(0.1189)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Region-FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	118	545	1115	528	3153	151
R-sqr	0.17	0.11	0.12	0.16	0.1	0.14

Note: Female Sample using before-and-after analysis employs linear regression with clustered standard errors shown in parentheses. Statistical significance levels are denoted as follows: * p<0.05, ** p<0.01, *** p<0.001. The dependent variable is women's employment status. Controls include individual characteristics (age, and marital status), household characteristics (relationship to the household head and household size), and regional fixed effects (FE) across Saudi Arabia's 13 administrative regions.

The analysis of household size, as shown in **Table 4.10**, underscores how household dynamics influenced the reforms' impact. Women from smaller households (1–2 members) experienced an 8.5% increase in employment, while those in medium-sized households (3–5 and 4–8 members) reported slightly higher increases of 10.9% and 9.6%, respectively. Notably, women in the largest households (9+ members) exhibited the most pronounced employment gains, at 22.6%. These findings suggest that household size may affect labour force participation through multiple mechanisms. On one hand, larger households may face heightened economic pressures, compelling women to seek employment to contribute to household income. On the other hand, larger households may also benefit from the availability of additional adult members to share domestic responsibilities, thereby facilitating women's participation in the labour market. This dual interpretation highlights the nuanced relationship between household composition and female labour force participation, suggesting that both economic necessity and domestic support play significant roles in enabling women's engagement in the workforce following the reforms.[20]

Table 0.10 *Heterogeneity Analysis- Household Size*

Number of HH Member	**1--2** **b/se**	**3--5** **b/se**	**4--8** **b/se**	**9 & up** **b/se**
Post	0.0853*	0.1091***	0.0968***	0.2265***
	(0.0418)	(0.0190)	(0.0184)	(0.0306)
Constant	0.7615***	0.6370***	0.6015***	0.5045***
	(0.1135)	(0.0634)	(0.0825)	(0.0778)
Controls	Yes	Yes	Yes	Yes
Region-FE	Yes	Yes	Yes	Yes
Observations	436	2275	2150	749
R-sqr	0.15	0.12	0.12	0.22

Note: Female Sample using before-and-after analysis employs linear regression with clustered standard errors shown in parentheses. Statistical significance levels are denoted as follows: * p<0.05, ** p<0.01, *** p<0.001. The dependent variable is women's employment status. Controls include individual characteristics (age, education, and marital status), household characteristics (relationship to the household head), and regional fixed effects (FE) across Saudi Arabia's 13 administrative regions.

The marital status analysis, presented in **Table 4.11**, highlights significant disparities in employment effects based on women's family responsibilities and flexibility. Never-married women experienced the highest employment increase, at 23.7%, reflecting their greater flexibility and fewer household responsibilities, which likely enabled them to take advantage

[20] Data on the number of children or other adult women in the household is unavailable, limiting further analysis of household composition effects.

of the new opportunities provided by the reforms. Married women also benefited significantly, with a 7.6% rise, indicating the reforms' success in encouraging workforce participation among this group. However, divorced women experienced a smaller, statistically insignificant increase of 3.2%, while widowed women saw a decline of 12.7%. These results suggest that divorced and widowed women, particularly those facing age-related constraints or societal norms, may have been less able to leverage the opportunities created by the reforms. These findings emphasize the need for targeted policies to address the unique barriers faced by these groups.

Table 0.11 *Heterogeneity Analysis- Marital Status*

	Never Been Married b/se	**Married b/se**	**Divorced b/se**	**Widowed b/se**
Post	0.2373***	0.0763***	0.0324	-0.1269*
	(0.0249)	(0.0138)	(0.0572)	(0.0562)
Constant	0.4067	0.5084***	1.2187***	0.2758
	(0.3197)	(0.0601)	(0.1541)	(0.1418)
Region-FE	Yes	Yes	Yes	Yes
Observations	1481	3732	271	126
R-sqr	0.14	0.092	0.21	0.41

Note: Female Sample using before-and-after analysis employs linear regression with clustered standard errors shown in parentheses. Statistical significance levels are denoted as follows: * p<0.05, ** p<0.01, *** p<0.001. The dependent variable is women's employment status. Controls include individual characteristics (age and education), household characteristics (relationship to the household head and household size), and regional fixed effects (FE) across Saudi Arabia's 13 administrative regions.

Household headship also emerged as an important factor influencing the impact of the reforms, as shown in **Table 4.12**. Women who were not household heads experienced a significant 12.3% increase in employment, suggesting that this group may have faced fewer structural barriers to workforce entry or been more directly impacted by the legal reforms. In contrast, women identified as household heads showed no significant changes in employment. This disparity may reflect the differing challenges faced by these groups. Non-head women may have benefitted more directly from the removal of legal and institutional barriers, as they were perhaps less encumbered by familial responsibilities or societal expectations. Household heads, on the other hand, may have been constrained by additional obligations, such as caregiving or managing household dynamics, which could limit their capacity to engage in employment. Additionally, societal norms and expectations surrounding household leadership may have created further obstacles for these women, particularly in balancing their dual roles as primary decision-makers and potential labour market participants.

Table 0.12 *Heterogeneity Analysis- Household Head*

HH Head	**YES** **b/se**	**NO** **b/se**
Post	-0.0305	0.1238***
	(0.0385)	(0.0121)
Constant	0.9511***	0.5186***
	(0.0967)	(0.0482)
Region-FE	Yes	Yes
Observations	303	5307
R-sqr	0.12	0.1

Note: Female sample using before-and-after analysis employs linear regression with clustered standard errors shown in parentheses. Statistical significance levels are denoted as follows: * p<0.05, ** p<0.01, *** p<0.001. The dependent variable is women's employment status. Controls include individual characteristics (age, education, and marital status), household characteristics (household size), and regional fixed effects (FE) across Saudi Arabia's 13 administrative regions.

The regional analysis, presented in Table 4.13, reveals significant variation in the impact of the 2019 reforms across Saudi Arabia's regions. This variation reflects the interplay between region-specific characteristics and the effectiveness of policy implementation. Women in the Western and Southern regions experienced the most substantial increases in employment, at 13.5% and 16.2%, respectively. This dynamic response can be attributed to several factors. The Western region, which includes Jeddah and Makkah, is among the most urbanised and economically active areas in Saudi Arabia. It benefits from a diverse industrial composition and robust commercial and tourism-related activities. These sectors appear to have been particularly responsive to the reforms, providing greater employment opportunities for women. Similarly, the Southern region, although less urbanised, may have experienced growth due to targeted development initiatives or expanded opportunities in agriculture, manufacturing, or other regional industries that benefitted from enhanced female participation in the labour market. Furthermore, socio-cultural norms in these regions may have been more conducive to integrating women into the workforce, particularly in response to the legal and institutional changes introduced by the reforms. In contrast, the Eastern region exhibited no significant changes in female employment, highlighting the presence of structural or socio-economic barriers unique to this area. The Eastern region, a hub for Saudi Arabia's oil and energy industries, is a highly industrialised area traditionally dominated by male employment due to the technical and physically demanding nature of these sectors. Despite the reforms, these entrenched sectoral characteristics may have constrained opportunities for integrating women into the workforce. Additionally, the Eastern region may have faced slower shifts in socio-cultural norms or lacked sufficient region-specific policy initiatives to promote female

employment in industries beyond oil and energy. These structural limitations likely curtailed the effectiveness of the reforms in this region, underscoring the importance of tailored approaches to address regional disparities in employment outcomes.

Table 0.13 *Heterogeneity Analysis- Region*

	Central	**Western**	**Eastern**	**Southern**	**Northern**
	b/se	**b/se**	**b/se**	**b/se**	**b/se**
Post	0.1075***	0.1357***	0.051	0.1628***	0.1185***
	(0.0265)	(0.0210)	(0.0289)	(0.0273)	(0.0308)
Constant	0.4682***	0.3830***	0.6770***	0.5098***	0.4577***
	(0.1063)	(0.0812)	(0.1191)	(0.0881)	(0.0849)
Controls	Yes	Yes	Yes	Yes	Yes
Region-FE	Yes	Yes	Yes	Yes	Yes
Observations	1167	1798	710	1065	870
R-sqr	0.069	0.1	0.043	0.13	0.14

Note: Female sample using before-and-after analysis employs linear regression with clustered standard errors shown in parentheses. Statistical significance levels are denoted as follows: * p<0.05, ** p<0.01, *** p<0.001. The dependent variable is women's employment status. Controls include individual characteristics (age, education, and marital status), household characteristics (relationship to the household head and household size), and regional fixed effects (FE) across Saudi Arabia's 13 administrative regions.

Overall, the heterogeneity analysis highlights the nuanced effects of the 2019 legal reforms on women's employment in Saudi Arabia. The findings demonstrate that the reforms were particularly effective for women with moderate education levels, larger households, and those in the Western, Southern, Northern, and Central regions. However, the results also reveal persistent challenges for specific groups, such as highly educated women, widows, and residents of the Eastern region, who may require targeted interventions to ensure equitable employment opportunities. These insights emphasize the importance of considering demographic and contextual factors in evaluating the impact of legal reforms, offering valuable guidance for policymakers aiming to enhance gender equality and economic inclusion in the labour market.

4.6 Discussion

This chapter offers a comprehensive analysis of the 2019 legal reforms in Saudi Arabia, focusing on their impact on women's labour force participation across different sectors and demographic groups. Grounded in Feminist Legal Theory (MacKinnon, 1987) and Human Capital Theory (Becker, 1964), the findings demonstrate that these reforms significantly increased female employment, aligning with the goals of Saudi Arabia's Vision 2030 to diversify the economy and enhance women's economic inclusion. The results reveal that the reforms not only improved female employment in traditionally female-dominated sectors but also facilitated entry into male-dominated industries, such as construction, manufacturing, and trade. This outcome underscores the transformative role of well-implemented legal reforms in breaking structural barriers, consistent with Feminist Legal Theory. By dismantling restrictions such as male guardianship for employment and travel, the reforms removed systemic barriers that had historically limited women's access to economic opportunities. Additionally, from a Human Capital Theory (Becker, 1964) perspective, the significant employment gains in traditionally male-dominated sectors such as construction and trade highlight the economic benefits of removing structural barriers. By enabling women to utilise their education, skills, and qualifications more effectively, these reforms unlocked previously untapped human capital, contributing to national productivity and economic diversification.

The before-and-after analysis indicates a substantial rise in female employment, with FLFP increasing by approximately **12%** post-reform. However, while this approach captures temporal shifts, it remains vulnerable to sample composition differences between pre- and post-reform periods. The Propensity Score Matching (PSM) method addresses this concern by controlling for observable characteristics, confirming a significant **10.5%** increase in female employment. This slightly lower estimate suggests that some of the observed gains in the before-and-after analysis may reflect compositional differences rather than the direct impact of the reforms. Nonetheless, the consistency between the two methods reinforces the robustness of the findings.

When contextualised within the broader global and Saudi literature, this chapter both confirms and diverges from existing research. The observed positive impact of legal reforms on female employment aligns with the findings of Hallward-Driemeier and Gajigo (2015), who demonstrated that family law reforms in Ethiopia significantly increased women's labour force participation in reforming areas compared to non-reforming ones. Similarly, studies such as

Blau and Kahn (2013) have shown that anti-discrimination laws in OECD countries have been instrumental in improving women's employment outcomes, particularly in terms of pay equity and job opportunities. Within the Saudi Arabian context, and in comparison, with prior literature, this chapter builds on and extends the findings of Parveen (2021) and Rizvi and Hussain (2021), who explore the broader impacts of Saudi Arabia's recent reforms on women's empowerment. Parveen (2021) identifies significant shifts in Saudi women's workforce participation and highlights emerging roles for women in sectors like retail, aviation, and military, areas that were previously restricted due to societal norms. Similarly, Rizvi and Hussain (2021) emphasize the transformative potential of Vision 2030 reforms in granting women greater autonomy, such as the right to drive and travel independently, and reducing gender barriers to workforce participation. Both studies emphasize the qualitative shift in gender norms due to legal reforms. However, this chapter quantitatively assesses these reforms' impact, specifically examining sectoral shifts using Propensity Score Matching (PSM). This methodological approach allows for a more granular analysis, revealing which sectors are driving changes in women's employment. This chapter fills that gap, revealing significant variations in how different sectors have responded. The Saudi context adds a unique dimension to this narrative by highlighting the significant shifts in traditionally male-dominated sectors, such as Construction and Trade & Transportation, where female employment saw remarkable improvements.

The observed increase in female employment in sectors traditionally dominated by men, such as construction and trade, is particularly noteworthy. This development highlights the capacity of well-designed and effectively implemented legal reforms to foster new economic opportunities for women, even within industries where they have historically been underrepresented. Nonetheless, despite these positive trends, certain areas of concern are evident. Although female labour force participation has risen markedly, from 19% in 2005 to 35% in 2022 (GASTAT, 2022), much of this expansion has been concentrated in precarious, low-wage sectors, including manufacturing, retail, and trade. This pattern aligns with Aldossari and Chaudhry's (2024) findings, suggesting that many women may be entering insecure roles previously filled by unskilled migrant workers, rather than accessing higher-quality positions with more promising long-term career trajectories.

Critics argue that such reforms may be more focused on enhancing Saudi Arabia's international reputation rather than substantively improving women's rights and opportunities within the labour market (Aldossari & Chaudhry, 2024; Ikran, 2019). This perspective is further supported by the heterogeneity analysis by education level presented in this chapter. Women

with primary and secondary education backgrounds experienced significant increases in employment, with gains of 8.9% and 23.3%, respectively. These outcomes reinforce Aldossari and Chaudhry's (2024) assertion that the reforms have disproportionately benefited women with lower levels of education, thus raising questions regarding the overall quality and sustainability of the employment opportunities that have emerged. Future qualitative research should examine the nature of these employment prospects in greater depth, paying particular attention to wage disparities and job security in the sectors where women's labour market participation has increased most substantially. Such inquiry would provide deeper insight into whether these reforms are genuinely contributing to sustainable and equitable labour market outcomes for women, or merely redirecting them into insecure, low-paid roles.

An interesting result from the analysis is the positive impact of the reforms on male employment, despite the fact that the legal changes were primarily aimed at women. This spillover effect can be explained by broader labour market dynamics. As more women entered the workforce, particularly in sectors requiring both male and female employees, overall labour demand increased, creating new employment opportunities for men (Jadwa Investment, 2020). Evidence for this spillover effect is presented in **Figure 4.A4** in the appendices, which illustrates Saudi Arabia's unemployment rate by gender from 2016 to 2024. Following the implementation of the reforms in August 2019, marked by the red vertical line, male unemployment decreased significantly, falling from approximately 7.5% in 2019 to below 5% by 2024. This decline reflects broader improvements in the labour market and highlights how the reforms indirectly influenced male employment. These spillover effects highlight the interconnected nature of labour markets and suggest that legal reforms aimed at one group can have broader economic implications for others. To ensure a robust identification of the reform's effects, it is essential to clarify that no other concurrent reforms specifically targeted men during this period. This assertion strengthens the claim that the observed spillover effects are indeed linked to the broader economic and labour market restructuring triggered by the 2019 legal reforms aimed at women. Future research should continue to monitor these dynamics to fully understand the long-term implications of the 2019 legal reform for both men and women in Saudi Arabia.

However, this chapter also highlights certain limitations that should be addressed in future research. One significant limitation is that while PSM effectively reduces selection bias and helps create comparable treatment and control groups, it does not account for unobserved confounders that may affect labour force participation. Thus, although this chapter demonstrates a significant association between the 2019 legal reforms and increased FLFP, it

cannot claim definitive causality. Second limitation found in this chapter is the lack of variables capturing social norms and attitudes in the Labour Force Surveys (LFS). Including such variables would have allowed for a more comprehensive analysis by controlling for the impact of social norms on women's labour force participation. Measuring opinions and attitudes towards gender roles, for example, would provide deeper insights into the socio-cultural barriers that persist despite legal reforms. Additionally, the chapter is limited to data from two waves of the LFS (2019 and 2022) due to the challenges associated with obtaining additional data. While I acknowledge and express gratitude to the General Authority for Statistics (GASTAT) for providing access to the Labour Force Survey (LFS) data for 2019 and 2022, my request for additional years of data has not been approved. Having access to a longer time series of data would have allowed for a more comprehensive and longitudinal analysis of the reforms' impact. The inclusion of more data points would enable the tracking of long-term trends and provide insights into whether the initial gains observed in this chapter are sustained or amplified over time. Future research could greatly benefit from additional years of data, which would allow for a more robust evaluation of the 2019 legal reforms' long-term effects on female employment in Saudi Arabia.

4.7 Conclusion

This Chapter examined the impact of the 2019 legal reforms on women's labour force participation (FLFP) in Saudi Arabia, focusing on two key questions: (1) How have the 2019 legal reforms influenced women's participation in the workforce? and (2) Which sectors or economic activities have experienced the most significant shifts in female employment following these reforms? Drawing on data from the 2019 and 2022 Labour Force Surveys (LFS) and employing both before-and-after analysis and Propensity Score Matching (PSM), the findings indicate a substantive increase in women's employment, with FLFP rising by 10.5 percentage points. This outcome aligns with the objectives of Vision 2030, underscoring the efficacy of targeted legal reforms in enhancing women's economic participation within a traditionally conservative context. The results also reveal notable changes in women's employment patterns. Female participation expanded not only in male-dominated sectors, such as Construction and Trade & Transportation, but also in traditionally female-oriented industries, including Manufacturing and Retail. These shifts demonstrate the reforms' capacity to diversify women's employment opportunities, fostering greater economic inclusivity. Moreover, the private sector exhibited the strongest growth, reflecting its responsiveness to the legal changes, while the decline in Education suggests evolving preferences among women who

are increasingly exploring emerging fields. Importantly, the reforms had spillover effects on male employment, albeit to a lesser extent, suggesting broader economic restructuring and increased demand across sectors.

Interpreting these findings through the lens of feminist legal theory and human capital theory indicates that the 2019 reforms not only addressed enduring structural barriers to women's employment, but also activated previously untapped human capital, thereby contributing to national economic growth. Nevertheless, the analysis is constrained by data limitations and the absence of variables capturing social norms, restricting a more nuanced understanding of the socio-cultural dynamics underpinning FLFP. Future research should address these gaps, placing greater emphasis on the quality and long-term sustainability of the employment opportunities engendered by the reforms.

Appendices

Table 4.A1 *Legal Reforms and Women progress - Saudi Arabia*

Year	Area	Legal Progress
2019	**Travel and Identity**	Women over the age of 21 may obtain a passport and travel abroad without the permission of a male relative. Women can now travel outside of the country without a male guardian. Women may register as a "head of household" and are identified as such on family ID cards and papers, giving them the right to legally act on their children's behalf. Women may register the births of their children. Women have equal authority to register cases of marriage and divorce. Women may claim their own place of residency.
2019	**Employment and Discrimination**	Women received increased protection from employment discrimination. Women's retirement age is the same as men's retirement age (60 years of age). Women may not be fired for pregnancy.
2019	**Legal Reforms**	Amendments to travel documents rules: Article 2 - A passport shall be issued to any Saudi citizen who applies for it. The Minister of Interior has the authority to issue temporary passports or travel documents to non-Saudis when needed. Article 3 - Women may now apply for and receive passports independently. Article 4 - Passports and travel documents shall be issued for those under custody and minors whose guardians have deceased. Article 30 - The place of residency of a woman is where she resides. Article 33 - Those responsible to report new births include the mother or father of the newly born and the closest relatives of the newly born who are 18 years or older. Article 47 - The husband or wife may report cases of marriage, divorce, or remarriage. Article 50 - The husband or wife may request obtaining family records from the Civil Affairs Directorate. Article 53 - Those entrusted to report cases of death include the closest male or female relative of the deceased spouse or any of his/her relatives who are 18 years or older. Article 91 - The head of the household in regards to enforcing these rules is the father or mother of minor children.
2019	labour **Law**	Definitions - A labourer: any person, male or female, who works for an employer and under their management and supervision for a wage. Article 3 - All citizens have equal rights to work without discrimination based on gender, disability, age, or any other form of discrimination. Article 74 - The employee reaches the retirement age, which is 60 years for both males and females. Article 155 - The employer may not terminate or issue a notice of termination for a female worker during pregnancy or maternity leave.

Source:
https://www.saudiembassy.net/sites/default/files/Factsheet%20on%20Progress%20for%20Women%20in%20Saudi%20Arabia.pdf

Table 4.A2 *Economic Activities (ISIC, Rev.4 Sections)*

Merged Sector Group	Sector Group	Economic Activities (ISIC, Rev.4 Sections)	Definition
Agriculture and Mining	Agriculture, Forestry, and Fishing	**Section A:** Crop and animal production, hunting and related service activities, forestry and logging, fishing and aquaculture.	Activities related to the cultivation of plants, raising animals, and harvesting products from forests and bodies of water.
	Mining and Quarrying	**Section B:** Mining of coal and lignite, extraction of crude petroleum and natural gas, mining of metal ores, other mining and quarrying.	Extraction of minerals occurring naturally as solids, liquids, or gases.
Manufacturing and Utilities	Manufacturing	**Section C:** Manufacture of food products, beverages, tobacco products, textiles, wearing apparel, leather and related products, wood and products of wood and cork, paper and paper products, printing and reproduction of recorded media, coke and refined petroleum products, chemicals and chemical products, pharmaceuticals, rubber and plastic products, non-metallic mineral products, basic metals, fabricated metal products, computer, electronic and optical products, electrical equipment, machinery and equipment, motor vehicles, trailers, other transport equipment, furniture, other manufacturing, repair and installation of machinery and equipment.	Production of goods through processing raw materials and components.
	Electricity, Gas, Steam, and Air Conditioning Supply	**Section D:** Electric power generation, transmission and distribution, manufacture of gas; distribution of gaseous fuels through mains, steam and air conditioning supply.	Generation, transmission, and distribution of electricity, gas, and steam.
	Water Supply; Sewerage, Waste Management, and Remediation Activities	**Section E:** Water collection, treatment and supply, sewerage, waste collection, treatment and disposal activities, materials recovery, remediation activities and other waste management services.	Provision of water, sewerage, waste management, and related services.
Construction	Construction	**Section F:** Construction of buildings, civil engineering, specialized construction activities.	Erection of buildings and infrastructure projects.
Trade and Transportation	Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	**Section G:** Wholesale and retail trade and repair of motor vehicles and motorcycles, wholesale trade, except of motor vehicles and motorcycles, retail trade, except of motor vehicles and motorcycles.	Sale and repair of motor vehicles and trade of goods in wholesale and retail settings.
	Transportation and Storage	**Section H:** Land transport and transport via pipelines, water transport, air transport, warehousing and support activities for transportation, postal and courier activities.	Provision of transportation of passengers and goods, and storage services.
Accommodation and Food Services	Accommodation and Food Service Activities	**Section I:** Accommodation, food and beverage service activities.	Provision of lodging and food services to customers.
Information and Communication	Information and Communication	**Section J:** Publishing activities, motion picture, video and television programme production, sound recording and music publishing activities, programming and broadcasting activities, telecommunications, computer programming, consultancy and related activities, information service activities.	Production and distribution of information and cultural products, and telecommunication services.
Financial and Real Estate Activities	Financial and Insurance Activities	**Section K:** Financial service activities, except insurance and pension funding, insurance, reinsurance and pension funding, except compulsory social security, activities auxiliary to financial services and insurance activities.	Provision of financial services, including banking, insurance, and pension funding.
	Real Estate Activities	**Section L:** Real estate activities.	Buying, selling, renting, and operating real estate.
Professional and Administrative Services	Professional, Scientific, and Technical Activities	**Section M:** Legal and accounting activities, activities of head offices; management consultancy activities, architectural and engineering activities; technical testing and analysis, scientific research and development, advertising and market research, other professional, scientific and technical activities, veterinary activities.	Specialized professional, scientific, and technical services.
	Administrative and Support Service Activities	**Section N:** Rental and leasing activities, employment activities, travel agency, tour operator and other reservation service and related activities, security and investigation activities, services to buildings and landscape activities, office administrative, office support and other business support activities.	Support services for daily business operations.
Public Administration and Defence	Public Administration and Defence; Compulsory Social Security	**Section O:** Public administration and defense; compulsory social security.	Activities of governmental organizations and social security programs.
Education	Education	**Section P:** Education.	Provision of education at various levels.
Health and Social Work	Human Health and Social Work Activities	**Section Q:** Human health activities, residential care activities, social work activities without accommodation.	Provision of health care and social assistance.
Arts, Entertainment, and Recreation	Arts, Entertainment, and Recreation	**Section R:** Creative, arts and entertainment activities, libraries, archives, museums and other cultural activities, gambling and betting activities, sports activities and amusement and recreation activities.	Provision of cultural, entertainment, and recreational activities.
Other Services	Other Service Activities	**Section S:** Activities of membership organizations, repair of computers and personal and household goods, other personal service activities.	Miscellaneous service activities not classified elsewhere.
	Activities of Households as Employers; Undifferentiated Goods- and Services-Producing Activities of Households for Own Use	**Section T:** Activities of households as employers of domestic personnel, undifferentiated goods- and services-producing activities of private households for own use.	Services provided by households, including domestic work and production for own use.
	Activities of Extraterritorial Organizations and Bodies	**Section U:** Activities of extraterritorial organizations and bodies.	Activities of international organizations, such as the United Nations, and their agencies.

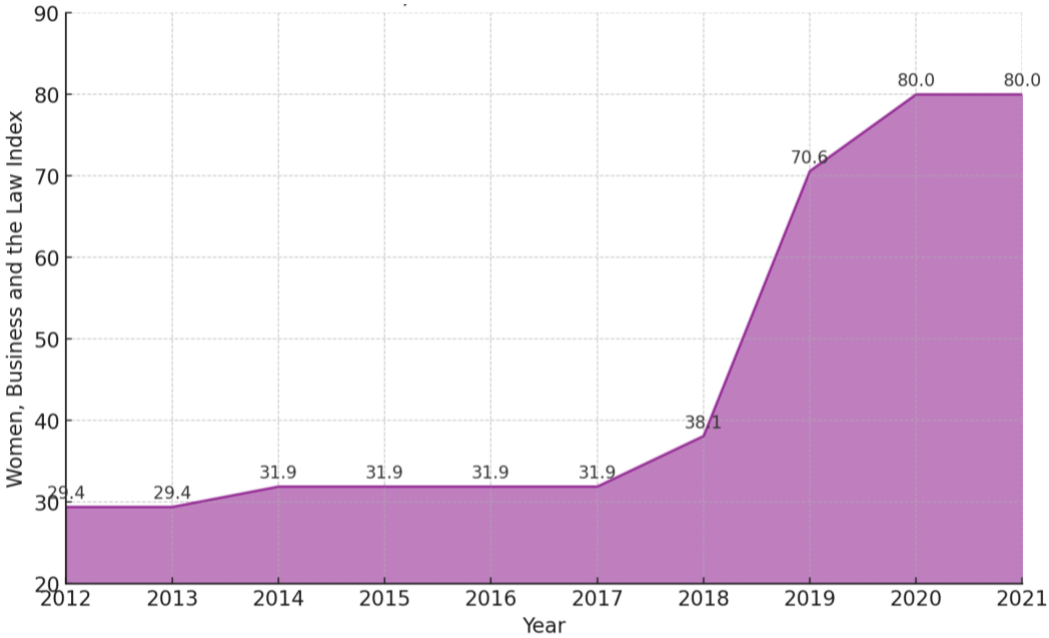
Source:https://www.stats.gov.sa/sites/default/files/the_national_classification_of_economic_activities_aug-2019_isic4.pdf

Table 4.A3 *Covid-19 Implemented Measures by Saudi Government*

Category	Measures Implemented
Health Measures	- Development of dedicated health facilities to deal with COVID-19.
	- Provision of 80,000 beds and 8,000 ICU beds.
	- Establishment of 20 laboratories for PCR testing, with a daily capacity of conducting over 14,000 tests.
	- Suspension of Umrah and significant limitation on Hajj pilgrimages to prevent large gatherings.
	- Provision of adequate personal protective equipment (PPE) to healthcare workers and the population.
	- Regular media campaigns to provide updates and information to the public.
Social Protection	- Implementation of social protection measures such as the General Authority of Awqaf community fund and Ramadan Aid aimed at vulnerable segments of society.
	- Distribution of food aid packages through the Saudi Food Bank, including via the UN-Network on Migration in KSA.
	- Exemption from VAT on housing for eligible segments.
	- Launch of online education platforms to continue educational activities despite school closures.
Economic Measures	- Investment of more than 7% of GDP to alleviate the economic impact of COVID-19.
	- Fiscal support of USD 61 billion, including unemployment insurance for private-sector employees and supportive regulations for private and non-Saudi workers.
	- Saudi Arabian Monetary Authority (SAMA) reduced the policy rate and provided liquidity to support the banking sector and SMEs.
	- Provision of financial and fiscal stimulus, including financial assistance to small and medium-sized enterprises (SMEs) to protect jobs and minimize social costs.
Public Services & Awareness	- Increased efforts to raise public awareness through social media campaigns, closures of markets, and enhanced cleaning and sterilization services by the Ministry of Municipalities & Rural Affairs.
	- Availability of internet services to support online education and other remote activities during the pandemic.
	- Targeted messages to the public about COVID-19 updates via telecom services.

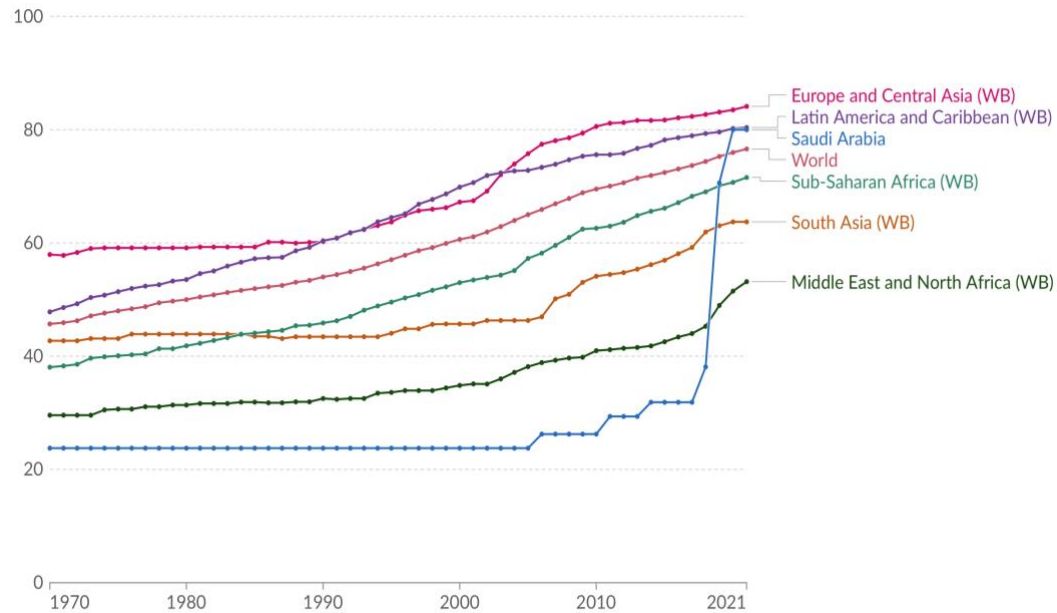
Source: UN in KSA, Socio-Economic impact of COVID-19 in the Kingdom of Saudi Arabia and how to Build Back Better, Diagnostics paper, November 2020, https://saudiarabia.un.org/sites/default/files/2020-12/Socio-Economic%20impact%20of%20COVID-19%20in%20the%20Kingdom%20of%20Saudi%20Arabia%20and%20how%20to%20Build%20Back%20Better%2C%20Diagnostics%20paper%2C%20UN%20in%20KSA%2C%20November%202020.pdf.

Figure 4.A1 *Women, Business and the Law Index for Saudi Arabia*



Source: World Bank (2024).

Figure 4.A2 *Women, Business and the Law Index*



Source: World Bank (2024).

Figure 4.A3 *Employment Rate in Saudi Arabia (2016-2024)*

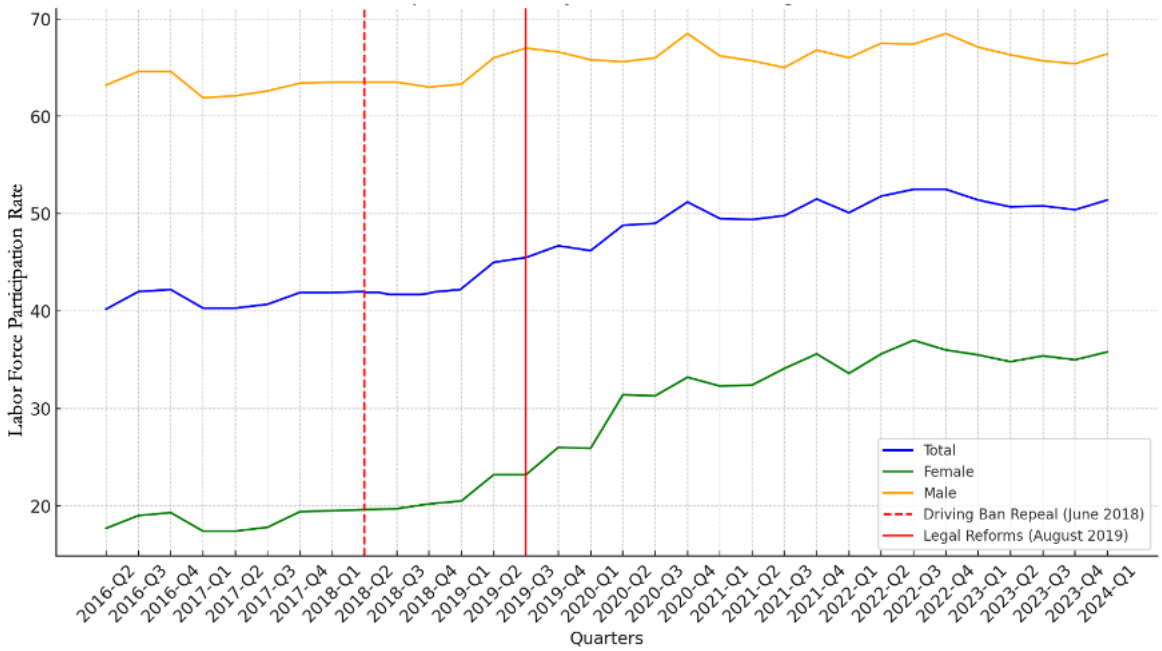
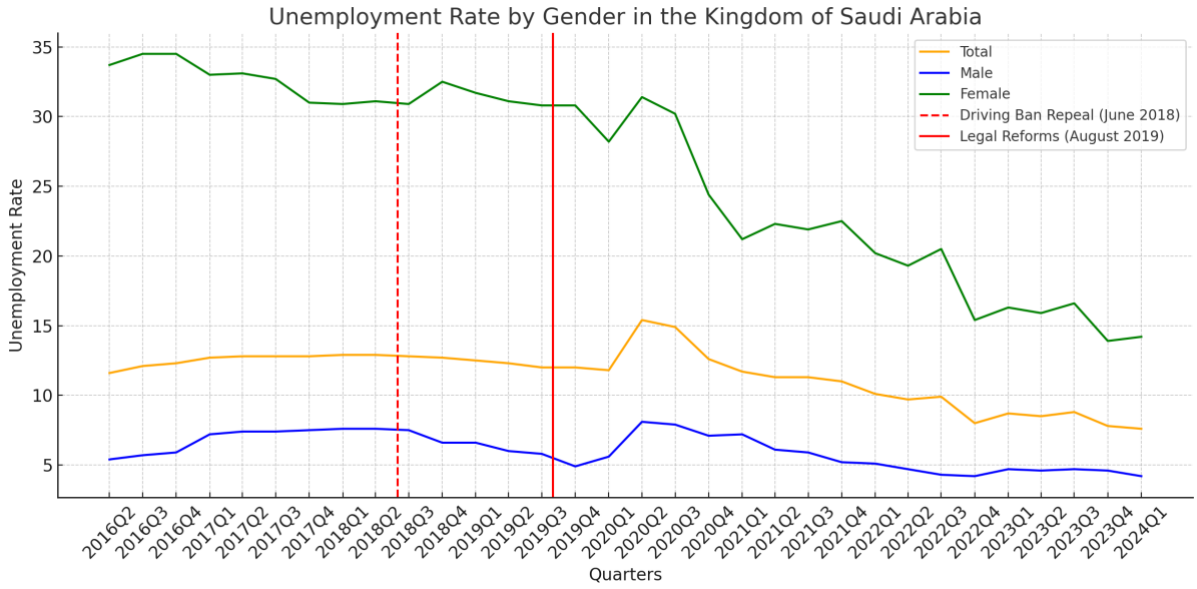


Figure 4.A4 *Unemployment Rate in Saudi Arabia (2016-2024)*



Source: Labour Force Survey (LFS) conducted by the General Authority for Statistics (GASTAT).

Chapter 5

Conclusion

This thesis has explored the multifaceted challenges and opportunities related to women's employment and empowerment in the Middle East and North Africa (MENA) region, focusing specifically on Egypt and Saudi Arabia. By examining the timing of childbirth, the effects of maternal employment on child health, and the impact of legal reforms on female labour force participation, this thesis offers a comprehensive analysis of women's economic roles in these contexts. The findings highlight the significant interplay between socio-cultural norms, economic policies, and individual choices, offering valuable insights for policymakers aiming to promote gender equality and economic development.

The first paper (chapter 2) investigated how the timing of childbirth affects women's employment in Egypt. Using robust econometric methods like Propensity Score Matching (PSM) and the Two-Stage Residual Inclusion (2SRI) technique, the research addressed potential endogeneity issues. The results revealed that early motherhood significantly reduces women's chances of participating in the labour market, especially in formal wage employment. Women who became mothers before the age of 20 were notably less likely to be employed compared to those who delayed childbirth. Each additional year of delayed motherhood increased the likelihood of employment, underscoring the economic benefits of postponing childbirth. These findings align with Becker's theory of family specialisation, which suggests that individuals within a household allocate their time based on comparative advantage. In the Egyptian context, early motherhood often leads women to specialise in domestic roles, limiting their opportunities for education and skill development, and reinforcing the "motherhood penalty" in the labour market. Life course theory also supports these results, indicating that the timing of life events like childbirth can disrupt career trajectories, especially in societies where early marriage and childbearing are common. Education emerged as a critical factor moderating the impact of early motherhood on employment. Higher educational attainment significantly improved employment prospects, particularly in wage employment. However, even educated women who became mothers early faced diminished employment opportunities, suggesting that education alone is insufficient to overcome the barriers posed by early motherhood. Structural

challenges, such as limited access to childcare and persistent gender norms, continue to hinder women's full participation in the workforce.

The second paper (chapter 3) examined the relationship between maternal employment and child health outcomes in Egypt, focusing on indicators like stunting and wasting. The analysis used data from multiple rounds of the Egypt Demographic and Health Surveys and employed both Linear Probability Models and 2SLS methods to strengthen the findings. The results indicated that maternal employment is associated with an increased likelihood of adverse child health outcomes, particularly stunting. This suggests that while employment may provide additional income, the reduced time available for childcare can negatively affect children's nutritional status. Becker's time allocation theory provides a theoretical framework for these findings, proposing that the net effect of maternal employment on child health depends on the balance between the positive income effect and the negative time substitution effect. The study found that younger children, especially those under two years old, are more vulnerable to the negative impacts of maternal employment, highlighting the importance of maternal care during early childhood. The type of maternal employment also played a role; for instance, mothers employed in service occupations were associated with lower stunting rates in their children, possibly due to better income levels, whereas those in physically demanding jobs did not show significant associations with child health.

The third paper (chapter 3) focused on the impact of the 2019 legal reforms in Saudi Arabia on women's employment across different sectors. By applying Before-and-After analysis and Propensity Score Matching to data from the 2019 and 2022 Labour Force Surveys, the research found that these reforms significantly increased female labour force participation. Notably, women's employment improved not only in traditionally female-dominated sectors but also in male-dominated industries like construction and trade. This shift suggests that legal reforms can effectively challenge traditional gender roles and open new opportunities for women. The Saudi case illustrates how targeted legal reforms, as part of broader economic diversification efforts under Vision 2030, can facilitate women's entry into various sectors of the economy. However, concerns remain regarding the quality of employment opportunities available to women. Much of the employment growth has occurred in low-wage, precarious sectors, raising questions about job security and long-term career prospects. An unexpected finding was the positive spillover effect of the reforms on male employment, despite the legal changes primarily targeting women. This suggests that increasing female labour participation

can have broader economic benefits, potentially stimulating overall labour demand and leading to job creation for both genders.

Collectively, these papers emphasise the need for comprehensive policies that address both structural barriers and socio-cultural norms to enhance women's economic participation. Promoting delayed motherhood through access to family planning and education can improve women's employment prospects. Supporting working mothers with affordable childcare, flexible work arrangements, and protective labour laws can mitigate the negative impacts of employment on child health. Ensuring that women have access to quality employment opportunities is crucial for sustainable economic empowerment. Addressing deeply rooted gender norms requires concerted efforts, including public awareness campaigns and community engagement initiatives that challenge traditional perceptions of gender roles. Involving men in these conversations is essential to foster a more inclusive environment that supports women's empowerment. To conclude, this thesis contributes significantly to understanding women's empowerment in the MENA region, demonstrating that access to education, employment, and supportive policies are foundational but insufficient alone. Achieving meaningful gender equality requires sustained policy efforts that address deep-rooted socio-cultural dynamics. By shedding light on the complex interplay of these factors, this thesis offers valuable insights for policymakers to advance gender equality and inclusive economic growth across the MENA region.

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