Why is Fertility on the Rise in Egypt? The Role of Women's Employment Opportunities

By Caroline Krafft[1,2]

Abstract

Can declining employment opportunities for women reverse the fertility transition? This paper presents evidence that the demographic transition has not just stalled but in fact reversed in Egypt. After falling for decades, fertility rates increased. The paper examines the drivers of rising fertility rates, with a particular focus on the role of declining public sector employment opportunities for women. Estimates show the effect of public sector employment on the spacing and occurrence of births using discrete-time hazard models. The paper then uses the results to simulate total fertility rates. The models address the potential endogeneity of employment by incorporating woman-specific fixed effects, incorporating local employment opportunities rather than women's own employment, and using local employment opportunities as an instrument. Results indicate that the decrease in public sector employment, which is particularly appealing to women, may have contributed to the rise in fertility but is unlikely to be its main cause.

Keywords: Fertility, Female labor supply, Employment and fertility, Egypt, Middle East and North Africa

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1 Introduction

Can declining employment opportunities for women reverse the fertility transition? Past research has focused on how social and economic factors could speed or stall the demographic transition (Bongaarts, 2006; Schultz, 2008; Strulik & Vollmer, 2015). This paper demonstrates that the fertility transition has not just stalled but even started reversing in Egypt, where fertility rates have risen. Previous research has ruled out measurement problems or changes in timing of births as causes of rising fertility (Al Zalak & Goujon, 2017; Radovich, El-Shitany, Sholkamy, & Benova, 2018). Increases in education in Egypt should also be leading to a decrease in fertility (Ali & Gurmu, 2018). Yet fertility is increasing and the relationship between fertility and education has disappeared, potentially due to reduced employment opportunities for women. A number of studies have suggested that reduced employment for women may lead to rising fertility (Al Zalak & Goujon, 2017; Goujon & Al Zalak, 2018; Olmsted, 2003; Radovich, El-Shitany, Sholkamy, & Benova, 2018); however, this hypothesis had not been rigorously tested. This paper rigorously tests whether the changing landscape of employment opportunities for women, namely the decline of the public sector as an employer, has contributed to rising fertility in Egypt.

Rising fertility in Egypt has coincided with major changes in the structure of the economy, and in particular changes in the types of employment available. The share of employment in the public sector has declined substantially, while informal private sector employment has increased. Informal and private sector employment opportunities are substantially less appealing to women than public sector jobs (Nassar, 2003). In part due to the changing structure of the economy, female employment has decreased in recent years. This decline in female employment is particularly surprising given that factors associated with higher participation, such as female education, have been increasing (Assaad, Hendy, Lassassi, & Yassin, 2018; Assaad & Krafft, 2015a, 2015b).

That changes in the structure of employment may have increased fertility in Egypt is consistent with economic theories that recognize that one of the costs of children is an opportunity cost—the value of parents' time. If, for women, employment opportunities decrease, then the opportunity cost of childbearing will decrease, potentially increasing fertility. However, at the same time household income will fall, and the net effect of these income and price effects is theoretically ambiguous (Becker, 1960; Schultz, 1997). The global evidence to date on the impact of employment on fertility is primarily focused on rising relative wages increasing women's employment and decreasing fertility (Galor & Weil, 1996; Heckman & Walker, 1990; Schultz, 1985). A few studies also directly examine the impact of increasing employment opportunities for women on their fertility (Fang, Eggleston, Rizzo, & Zeckhauser, 2013; Jensen, 2012).

In contrast to the literature, this paper investigates, for the case of Egypt, how childbearing responds to women's economic opportunities decreasing, specifically public sector employment declining. The results show that the decline in public sector employment contributed to the recent stall and increase in fertility but is unlikely to be its sole cause. Public sector work has a particularly important impact on third and fourth births, a key margin for the stall and recent increase in fertility. The paper also presents a novel methodological contribution, demonstrating how to apply instrumental variables in settings where both the endogenous variable and the outcome are nonlinear. Models for work and fertility are just one potential application of this new method.

2 Theories and Evidence on Fertility and Work

2.1 Theories of Fertility

Demographic transition theories provide the over-arching framework for understanding long-term trends in fertility and their relationship with social and economic forces, such as increases in female labor force participation (Bloom, Canning, Fink, & Finlay, 2009; Canning & Schultz, 2012; Kim, 2010; Kirk, 1996). Fertility transitions depend on changes in household decisions about childbearing. A household decides how many children to have by solving a utility maximization problem, with children as a source of utility (Becker, 1960; Willis, 1973). The cost of children is characterized as a function of (the mother's) time, as well as more explicit costs (Schultz, 1973; Willis, 1973). Changes in the cost of a mother's time have both income and substitution effects, such that the direction of the relationship between wages or employment opportunities and childbearing is theoretically ambiguous (Becker, 1960; Schultz, 1997).[3]

2.2 Empirical Evidence on Fertility and Work

One key strand of the literature linking women's employment and fertility theorizes that it is growth in women's wages (relative to men's) that increases their employment and thus decreases fertility (Galor & Weil, 1996; Heckman & Walker, 1990; Mukhopadhyay, 1994; Rosenzweig & Evenson, 1977; Schultz, 1997). However, there continue to be debates about the (female) income and fertility relationship and whether the results are robust (Ahn & Mira, 2002; Kögel, 2004; Martínez & Iza, 2004). The papers that estimate the causal effect of women's work on fertility suggest that women's employment decreases fertility to date by 0.5 (Fang, Eggleston, Rizzo, & Zeckhauser, 2013) or fertility intentions by 0.35 (Jensen, 2012).

[3] See Krafft (2016) for the derivation of this ambiguous result and a discussion of its applicability to Egypt.

The reverse case, when the market value of women's time declines, has not been rigorously investigated, to the best of the author's knowledge. Researchers have, however, hypothesized that declining employment opportunities for women contribute to fertility increases, historically, in Chile (Weeks, 1970), and more recently, in Egypt (Al Zalak & Goujon, 2017; Goujon & Al Zalak, 2018; Olmsted, 2003; Radovich, El-Shitany, Sholkamy, & Benova, 2018).

2.3 Division of Labor, Employment, and Childbearing in Egypt

The sexual division of labor within Egyptian households is such that women's primary responsibilities are attending to husband, children, and home (Hoodfar, 1997). Public sector jobs are much easier to reconcile with marriage and childbearing responsibilities than private sector employment (Assaad, Krafft, & Selwaness, 2017). Young women particularly value public sector benefits such as increased job security and pensions, as well as the shorter hours and lighter workload (Barsoum, 2015).

Structural adjustment programs and economic reforms have changed the employment opportunities available to women in Egypt (Nassar, 2003). Starting in the 1980s, there was a phase-out of the policy that had guaranteed public sector jobs to all secondary and higher education graduates. Substantial decreases in labor force participation rates for educated women followed these reforms. Olmsted (2003) wondered whether the structural adjustment programs in Egypt, because they substantially reduced employment opportunities for women and the opportunity costs of having children, might cause stagnation or even an increase in fertility rates. Egypt's recent increase in fertility has revived this question.

A variety of potential explanations for Egypt's increase in fertility have been explored in the literature. Al Zalak & Goujon (2017) and Radovich et al. (2018) variously investigate possible data quality, measurement, displacement, and tempo effects in the DHS and confirm good data quality and at least a stall in fertility. Education in Egypt has been linked to reduced (not increased) fertility (Ali & Gurmu, 2018), although convergence in fertility rates across education levels could be due to education no longer translating into employment (Goujon & Al Zalak, 2018; Radovich, El-Shitany, Sholkamy, & Benova, 2018).

The rise in fertility remains a substantial puzzle to researchers, with speculation around multiple causes, including female employment (Al Zalak & Goujon, 2017; Courbage, 2015; Goujon & Al Zalak, 2018; Radovich, El-Shitany, Sholkamy, & Benova, 2018; Social Research Center - The American University in Cairo, 2012; Vignoli, 2006). This paper investigates this previously untested potential cause, looking at the impact of changing employment opportunities on fertility in Egypt.

3 Methods

3.1 Describing Fertility

There are two common measures that underlie calculations of fertility rates, one based on recent childbearing across ages (age-specific fertility rates) and one based on parity (births to date) and duration-specific birth probabilities (the parity progression ratio) (Ní Bhrolcháin, 1992). Age-specific fertility rates (ASFRs) represent the annual probability of childbearing at a specific age or in a specific age bracket (e.g. 15-19). Estimated age-specific fertility rates can be summed to calculate the total fertility rate (TFR) (Palmore & Gardner, 1994). This approach assumes that women will bear children at the current ASFRs throughout their childbearing years.

An alternative measure of the total fertility rate that can be used to assess lifetime fertility is based on the parity progression ratio (PPR) (Retherford, Ogawa, Matsukura, & Eini-Zinab, 2010). Estimates of the conditional probability of birth i+1 after birth i can be multiplied to estimate the unconditional probability of each birth and summed to the TFR. This approach takes into account that women's childbearing decisions are driven by number of births to date and time elapsed since their preceding births, more so than women's current ages (Retherford, Ogawa, Matsukura, & Eini-Zinab, 2010). Because the comparator statistics for time trends, from the Demographic and Health Survey (DHS), are based on ASFRs (El-Zanaty & Way, 2009), equivalent TFR measures are reported for this paper's descriptive statistics.[4] Multivariate models include parity and duration since last birth (but control for age) and thus are more akin to the TFR based on the PPR.

3.2 Discrete-Time Survival Analysis Using the Logit Model

Modeling fertility is not straightforward, as many women have not yet completed their childbearing (are right-censored). The timing and occurrence of childbearing, accounting for right censoring, is best modeled using discrete time survival analysis (Van Hook & Altman, 2013). Because it is amenable to the incorporation of fixed effects (Allison, 2009), one of this paper's identification strategies, the discrete-time logit model is used to estimate the probability of a birth occurring at a point in time (year). This approach estimates a proportional odds model and odds ratios (Retherford, Ogawa, Matsukura, & Eini-Zinab, 2010).

The dependent variable underlying these models is essentially the duration, in years, between sequential births (giving birth once married, having a second birth after a first, etc.) and the occurrence of sequential births. Having a birth at a particular time (duration or interval since last birth), t, can be denoted as T_t. The hazard function, h_{it}, is then (Jenkins, 1995):

$$h_{it} = \Pr\,(T_t | T_t \geq t) \qquad (1)$$

[4] Retherford, Ogawa, Matsukura, and Eini-Zinab (2010) show that estimates of TFR using ASFRs are similar but not identical to estimates of TFR using PPR. The different methods and assumptions are expected to generate slightly different estimates.

The hazard function accounts for right censoring (women who have not (or not yet) had a birth). The logit estimates the relationship between this hazard and covariates, X_{it}, as (Jenkins, 1995):

$$\log\left(\frac{h_{it}}{1-h_{it}}\right) = \theta(t) + \beta X_{it} \tag{2}$$

The term $\theta(t)$ is a series of dummies for the different durations (years) since last birth (or marriage, if no births have yet occurred), fully interacted with parity (births to date, or being married with no births). The $\theta(t)$ represent the baseline hazards. The estimated coefficients, β, can be exponentiated to generate odds ratios, the relationship between a one-unit increase in a covariate and the odds of giving birth. The analyzed data are structured so that an observation is specific to a person-parity-year (duration or interval). This also facilitates the inclusion of time-varying covariates, such as employment opportunities changing over time.

3.3 Instrumenting for Own Employment

Although the logit model can allow for a rich set of covariates, employment is likely to be endogenous. A potential instrument for women's own employment is urban/rural-governorate level employment opportunities (in a woman's place of birth, which is less likely to suffer from location endogeneity). The preferred approach for instrumenting in inherently non-linear settings, including duration models, is an instrumental variables control function approach, also called two-stage residual inclusion (2SRI) (Carlin & Solid, 2014; Terza, Basu, & Rathouz, 2008; Terza, Bradford, & Dismuke, 2008; Wooldridge, 2014, 2015). This approach estimates the same first stage as two-stage least squares (2SLS). Then, rather than including the predicted value of the endogenous variable in the second stage, as in 2SLS, 2SRI instead includes the observed value of the endogenous variable and the residual from the first stage. Hence the name "residual inclusion."

A further complication arises in that the endogenous variable of interest is a binary variable for public sector work. Estimating the first stage equation for a binary variable using a non-linear estimator is not recommended (Angrist & Pischke, 2009). Instead, a two-part first stage can be implemented using first a non-linear and then subsequently a linear model (Adams, Almeida, & Ferreira, 2009; Angrist & Pischke, 2009; Wooldridge, 2002). Specifically, the first stage is initially predicted based on a probit model. Then the predicted values of public sector work are used as an instrument in essentially estimating the first stage again, now using an OLS linear probability model, and it is the residuals from *this* equation along with the observed values of the endogenous variable which are used in estimating the non-linear outcome. This approach is referred to as "three stage residual inclusion" (3SRI) and has subsequently been used in other doubly non-linear applications such as examining the relationship between work and age at marriage (Krafft & Assaad, 2017).

Public sector employment on an annual governorate-urban/rural basis merits some discussion as to its merits as an instrument. Local government employment is centrally set (Assaad, 1997) and cannot be modified by individuals, so the instrument cannot be manipulated. It is possible that public sector employment is correlated with other factors that matter for fertility, such as the local availability of health services and general economic development, but these conditions are controlled for to generate conditional exogeneity. Additionally, there are 38 unique combinations of urban/rural and governorate and 21 years of annual local measures used, which provide variation in the instrument, an important element of identification.

3.4 Incorporating Fixed Effects Using the Conditional Logit Model

Identification of the effect of own employment on fertility can also potentially be achieved using a survival analysis woman fixed effect model to difference out unobserved characteristics on the woman level (Allison, 2009; Wooldridge, 2002). Fixed effect (conditional) logits for individual women are estimated over different parities and durations. This method removes unobserved characteristics that are constant for women over time, such as fixed preferences for children, other goods, and leisure/work.

Using own employment in a fixed effects model will likely not overcome problems of reverse causality. However, variation in local employment opportunities can be considered exogenous after absorbing any time-invariant characteristics of women (and their birth locales) into a fixed effect. Essentially, a reduced form of the instrumental variable model can be estimated using government employment opportunities directly along with woman fixed effects, in addition to the 3SRI model that instruments for employment directly.

3.5 From Multivariate Methods to Fertility Estimates

Survival models produce hazard estimates that can be used to simulate changes in total fertility rates (Van Hook & Altman, 2013). Predicted hazards, a_{jk}, are simulated for the probability of having a birth at each duration (interval, in years) from the previous birth (or marriage), k, and parity, j. For each parity and duration since last birth, the conditional probabilities a_{jk} are multiplied by the proportion b_{jk} at risk of birth j at duration k (years since last birth (or marriage)), to produce an unconditional probability, c_{jk}:

$$c_{jk} = a_{jk} b_{jk} \tag{3}$$

Since the models are specifically for the duration from marriage to the first birth, etc., the proportion at risk initially for a first birth is the proportion who ever marry. The proportion at risk for b_{j0} after the first birth is the sum over k of c_{j-1k}, for example the group at risk of a third birth is the share of women who ultimately have a second birth.

The b_{jk} at risk evolve within a parity based on the probability of progressing from one parity to the next at each duration:

$$b_{jk} = b_{jk-1} - c_{jk-1} \tag{4}$$

The parity-specific TFR can then be calculated as the sum of c_{jk} over all durations (Van Hook & Altman, 2013):

$$TFR_j = \sum_k c_{jk} \tag{5}$$

After this calculation has been sequenced across each of the parities, then the overall TFR can be calculated as (Retherford, Ogawa, Matsukura, & Eini-Zinab, 2010; Van Hook & Altman, 2013):

$$TFR = \sum_j \sum_k c_{jk} \tag{6}$$

This is the sum of the probabilities of births across all possible births and durations over the reproductive lifetime. The simulated TFRs can incorporate covariates, x, into the predicted hazards, a_{jk}, as a_{jkx} for different profiles. Standard errors are generated around the TFR estimates for different profiles using bootstrapping (Van Hook & Altman, 2013).

4 Data

This paper uses the Egypt Labor Market Panel Survey (ELMPS), a household survey with three rounds to date: 1998, 2006, and 2012. The 2006 and 2012 rounds include both previous round households, split households, and a refresher sample. In 2012, the sample totaled 12,060 households and 49,186 individuals. Each round includes a detailed work history for all individuals 15-64 who ever worked, and the 2006 and 2012 rounds include detailed fertility data for ever-married women. The rounds are nationally representative at the time of fielding, and the data include weights that account for sample attrition processes.[5]

4.1 Outcomes

Fertility histories are used to identify the timing and number of births for descriptive measures of fertility. Birth history data are available for women aged 18-49 in 2012 and 16-49 in 2006. For the multivariate models, only the 2012 round is used to have the greatest time span of years incorporated.[6] The birth history data and the date of first marriage are used to construct the length of birth intervals (durations) in years.

4.2 Covariates

A key advantage of the ELMPS data are their inclusion of full labor market histories, unlike the DHS data, which include only employment status in the 12 months preceding the survey (Ministry of Health and Population, El-Zanaty and Associates, & ICF International, 2015). ELMPS labor market histories include information on the start year of each status and the sector of employment (public/private).[7] An individual work history measuring participation in the public sector is constructed annually based on the 2012 data. Since local employment opportunities are themselves of interest and, as an instrument, may address endogeneity problems, individuals' participation in public sector work is also aggregated into annual means at the urban/rural and governorate level based on place of birth for individuals 25-39. Labor market

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[5] See Assaad and Krafft (2013) for additional information on the ELMPS. Weights are used with this paper's descriptive statistics. Regressions do not use sampling weights since sampling is unrelated to the dependent variable and in such a case unweighted methods are preferred (Deaton, 1997; Winship & Radbill, 1994).
[6] Comparisons of annual fertility rates for the early 2000s indicate relatively comparable data for that period across the ELMPS 2006 and ELMPS 2012.
[7] Data quality is always a concern for surveys, particularly when relying on retrospective data. Assaad, Krafft, and Yassin (2018) exploit the panel nature of the ELMPS to validate the retrospective data. The key covariate (public sector employment) performs well in these checks. Consistency of reporting across panel and retrospective data for public sector jobs was in the range of 85-89% (Assaad, Krafft, & Yassin, 2018). Additionally, Assaad and Krafft (2013) validate the 2012 data against other labor force surveys and censuses.

histories for the six years (from ELMPS 2012) to eight years (from ELMPS 2006 and 1998) from the date of each survey backwards in time are used to generate annual means, to minimize recall bias while providing a substantial time span of data.

All models include a fully interacted set of parity and duration since last birth or marriage dummies, which account for duration and parity dependence. A number of other covariates are included in the analyses. See Appendix 1, Table 6 for summary statistics on the covariates. Since age has an important relationship with fertility, time-varying age groups are incorporated into the analyses. Time-varying calendar year (grouped) controls are included categorically, and are also interacted with age groups.[8] Due to the perfect multicollinearity between age, period (calendar year) and (birth) cohort (age + birth cohort = calendar year), birth cohort controls cannot be included (Biørn, Gaure, Markussen, & Røed, 2013; Kye, 2012).

The categorical educational attainment of women themselves is incorporated and referred to as "own education." Place of birth is controlled for, as a fully interacted set of birth governorate and urban/rural dummies. As measures of socio-economic status, the woman's parents' education levels are included in the analyses. Note that "mother's education" therefore refers to the education of a woman's mother, as distinct from her "own education." Because son preference has been linked historically to childbearing in Egypt (Yount, Langsten, & Hill, 2000), an additional (time-varying) control is included for whether the woman has borne any sons.

An additional set of controls attempts to measure access to health care, especially family planning. Unfortunately, access to family planning is not readily measured directly—the common measure of family planning prevalence conflates both supply and demand for family planning. As a proxy for access to family planning, prenatal care coverage is used. Data were

[8] Single calendar years are also included in the IV models since they include annual estimates of employment.

compiled from Egyptian DHSs for 1992, 2000, 2003, 2005, 2008, and 2014 on prenatal care coverage on a governorate and urban/rural level for births in the five years preceding each survey. Linear interpolation was used to generate trends in years between DHS surveys.

Another set of controls on the governorate level measures mean life expectancy, adult (15+) literacy, and the GDP per capita (which was translated into real 2012 Egyptian pound (LE) terms using the CPI (World Bank, 2013)). These data were from the Egyptian Human Development Reports (HDRs) for 1995, 1998/1999, 2003, 2004, 2005, 2008, and 2010 (Institute of National Planning, 1995, 2000; UNDP & Institute of National Planning, 2003, 2005, 2008, 2010; UNDP & Institute of National Planning Egypt, 2004). These characteristics control for general health and socio-economic conditions that might affect childbearing decisions. Linear interpolation was used to generate local trends in years without data.[9]

4.3 Time Period Analyzed

Given the restricted universe of fertility histories (ages 18-49) and local labor market histories (back to 1991), the main analysis is limited to the period 1991 to 2011. The oldest women with fertility histories, age 49, would have been 28 in 1991, which is above the 75th percentile for age at first birth. The time frame therefore provides the largest time window possible with reliable coverage of fertility and labor market histories. Women enter this data once they have married, so long as they married between 1991 and 2011. Restricting the analysis to women who married in 1991 or thereafter essentially restricts the data to entry cohorts into motherhood, which are ideal for survival analysis.

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[9] Throughout the paper, although descriptive statistics are presented for the mean observed values of the incorporated continuous variables, all the continuous variables (prenatal care, life expectancy, adult literacy, GDP per capita, and local public sector employment) are shifted to have a mean of zero in the multivariate analyses (the observed mean is subtracted from the observed values). This allows the baseline hazard across parities and births to be a more meaningful reference value.

5 Descriptive Patterns of Fertility and Employment

5.1 Trends in Fertility

An important initial result of the analysis is that fertility has stalled and even risen recently in Egypt. Figure 1 presents fertility trends in Egypt, including the TFR calculated from the 2012 ELMPS. In 1980, the TFR was quite high, at 5.3, and declined rapidly, falling to 3.3 by 1997. However, starting in 1998 fertility rose (TFR of 3.4) and this trend continued in 2000 (TFR of 3.5). Then, over the period 2000-2008 TFR declined steadily from 3.5 to 3.0. The 2006 round of the ELMPS found a TFR of 3.0, consistent with the 2005 DHS (TFR of 3.1) and 2008 DHS (TFR of 3.0). However, the 2012 ELMPS indicates a substantial rise in fertility, to a TFR of 3.5. The trend of rising fertility was confirmed in the 2014 DHS, which also found a TFR of 3.5 (Ministry of Health and Population, El-Zanaty and Associates, & ICF International, 2015).[10] New estimates from 2018 (not shown), a TFR of 3.1, indicate fertility may be declining again or fluctuating around a continued stall (Krafft, Assaad, & Keo, 2019).

The ASFRs underlying the TFRs also present a number of important trends (Figure 2 and Appendix 1, Table 7). The general decline in fertility over 1980-2000 was driven by particularly steep declines in ages 25-44, with smaller decreases at the youngest ages, consistent with women rapidly having a first child after marriage (which typically occurs in the 20-24 age bracket, as discussed below). The results for the ELMPS rounds of 2006 and 2012 are generally consistent with the DHS surveys. The recent uptick in fertility from 2008-2012 included substantial increases for age groups 20-39. One point where the results of the 2012 ELMPS and 2014 DHS diverge is in terms of which age group had the sharpest increase. Whereas the 2012 ELMPS finds a particular increase for ages 30-34 and 35-39, the DHS 2014 finds a smaller increase at

[10] See Krafft (2016) for details on how crude birth rates (CBRs) have been evolving as well. CBRs are available annually and, starting in 2007, began to rise substantially and track quite closely with the TFRs, corroborating their trends.

these ages, and a larger increase for ages 20-24 than the 2012 ELMPS. The 2014 DHS result for 20-24 year-olds may be due to sampling variability; the retrospective data for ASFRs at ages 20-24 from the 2014 DHS are much higher than observed patterns (Ministry of Health and Population, El-Zanaty and Associates, & ICF International, 2015). Radovich et al. (2018) note a rise in 2013 in the ASFR at age 30-34 as well. While higher fertility at 20-24 may be preponement (a point that cannot be determined at this time), increases at older ages are more likely to lead ultimately to higher completed fertility.

5.2 Trends in Employment

This paper investigates whether one of the factors contributing to fertility patterns, especially the stall and then rise in fertility, is diminishing economic opportunities for women in Egypt. Figure 3 demonstrates the declining availability of public sector employment by showing the share of the population aged 25-39[11] in each year working in the public sector (Appendix 1, Table 8 provides the underlying statistics). There has been a steady decline in public sector work over the 1991-2011 period, from 24% in 1991 to 15% in 2011. Men experienced a more rapid decline, from 33% to 19% over the period. Public sector work for women declined later than for men; it was flat at 15-16% in the 1990s but fell through the 2000s to 10% by 2008-2011. The decline for women coincided with the initial stall and fluctuations in fertility that started in 1997-2000, shown in Figure 1. The similar timing of the public sector decline and the fertility stall is suggestive evidence that the decline of public sector work may have contributed to the fertility stall and subsequent fluctuations, including the recent increase.

[11] Ages 25-39 are used to capture employment during peak fertility years. Ages 20-24 are not included since many of those employed in the public sector are university graduates and would still be in school and then job hunting in this age range.

The women who are most likely to be impacted by declining public sector employment opportunities are those with secondary and higher education, who used to benefit from the jobs guarantee. Figure 4 shows women's employment rates in 1998, 2006, and 2012, based on the ELMPS waves, by age and education level. The figure also shows the percentage of all women (including the non-employed) working in the public sector (Table 9, in Appendix 1, shows these statistics by five-year age group). Less educated women generally have low employment rates, below 20%, and negligible employment in the public sector. For more educated women, employment has declined over time, with the decline in employment tracking the decline in the public sector. As others have noted, as public sector employment opportunities have dried up, women, and especially married women, have left employment; the private sector has not acted as a viable substitute (Assaad, Hendy, Lassassi, & Yassin, 2018; Assaad, Krafft, & Selwaness, 2017).

Historically, the large group of vocational secondary graduates had high rates of employment, almost entirely in the public sector. In 1998, employment rates were nearly 60% around age 35 and peaked above 60% at age 45. However, younger generations lacked public sector employment opportunities, with employment rates for vocational secondary graduates dropping to around 40% at age 35 in 2006 and around 20% at age 35 in 2012, closely tracking the decline in the public sector. Post-secondary institute graduates (a smaller group) and university graduates also experienced decreases in employment, although somewhat less so for university graduates, who have retained higher rates of employment in the public sector. As educated women had decreased employment in the public sector and overall, they correspondingly had increased inactivity and unemployment rates (Assaad & Krafft, 2015a). In 2012, these economic challenges were further exacerbated by the global financial crisis and the economic downturn following the 2011 revolution in Egypt (Assaad & Krafft, 2015b, 2015a).

The decline in (public sector) employment and rise in non-employment, whether inactivity or unemployment,[12] changed the opportunity costs of time for women and may affect their fertility.

5.3 Patterns of Fertility by Characteristics

Fertility differentials and changes over time can illustrate whether declining employment opportunities may, potentially, be linked to the rise of fertility in Egypt. Table 1 shows the relationship between TFRs and different characteristics of women and how these relationships have varied from 2006 to 2012. A key characteristic of interest is whether women ever worked in a public sector job. In 2006, the TFR for women who had worked in the public sector was 2.6, compared to 3.0 for those who had not. In 2012, the rate had risen for both groups, but the gap remained; those women who had ever worked in the public sector had a TFR of 3.2, compared to 3.5 for those who had not. The rise in TFR for both groups suggests that although the decline in public sector work may be one factor contributing to rising TFRs, it is not the only factor.

Typically, education reduces fertility, potentially due to increases in women's opportunity costs (Bongaarts, 2003; Cygan-Rehm & Maeder, 2013; Dreze & Murthi, 2001; Ferre, 2009). This relationship has been demonstrated rigorously for Egypt as well (Ali & Gurmu, 2018) and appears to hold in the pattern of TFRs for 2006 in Table 1. Thus, given rising educational attainment in Egypt, we would expect falling fertility overall, the opposite of what is occurring.

Looking at the evolution of the relationship between fertility and education over time, it is notable that vocational secondary graduates—a sizeable group that previously had guaranteed public sector employment and experienced a particularly large decrement in opportunities across

[12] This paper focuses on public sector employment rather than unemployment since unemployment is much more difficult to detect accurately in retrospective data than public sector employment (Assaad, Krafft, & Yassin, 2018). The effects of unemployment are also more challenging to causally identify.

generations (Figure 4)—also had a very large increase in TFR from 2006 to 2012, from 3.1 to 3.9.[13] The erosion of the link between education and fertility is confirmed by trends in the DHS as well (El-Zanaty & Way, 2001; Ministry of Health and Population, El-Zanaty and Associates, & ICF International, 2015; Radovich, El-Shitany, Sholkamy, & Benova, 2018). One key reason for the rise in fertility among the educated may be education no longer translating into government employment opportunities.

Geographically, fertility in Egypt is highest in rural areas, and in Upper Egypt (which is generally poorer and less educated). Fertility rose in both urban and rural areas and in all regions, suggesting at least some nation-wide trend. Although the sample size at this level is limited, it is notable that the governorates with large increases in fertility included Alexandria, Cairo, and its surrounding region. These are areas that had, historically, had lower fertility rates. Relatively smaller increases occurred in Upper Egypt. The pattern also aligns with the localities that had—but lost—more public sector employment. For instance, Cairo and Alexandria both went from 32-33% of individuals employed in the public sector in 1991 to 16-17% in 2011 (Appendix 4, Figure 10).

5.4 Trends in Age at Marriage and Family Planning

Two other possible explanations for shifting fertility patterns are changing ages at marriage and changes in family planning. After a trend towards marrying slightly later, women in Egypt have more recently reverted to marrying at slightly earlier ages (Krafft & Assaad, 2017).[14] When the timing of marriage and births shifts, this can cause shifts in TFR (tempo

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[13] General secondary graduates also had a large increase, however, this small group (6% of women ages 15-64 in 2012) is primarily composed of students who are enrolled in higher education and thus neither married nor bearing children. When restricting the analysis of general secondary to non-students, their TFR was nearly constant, 3.9 in 2006 and 4.0 in 2012.

[14] Marriage is nearly universal in Egypt (Salem, 2015).

effects) that do not reflect underlying changes in completed fertility (how many children women ultimately have) (Bongaarts & Feeney, 1998; Conesa, 2000). Figure 5 explores this possibility and shows median age at (first) marriage, along with the median age at first birth, second birth, and third birth, by women's year of birth, for women ages 15-49. The figure accounts for censoring (women who have not yet married or had a particular birth) in calculating these medians. Although there was an increase in the median age at marriage followed by a slight decrease, the shift is relatively small (less than a year). Median age at first birth closely tracks marriage trends. The fluctuations in second and third birth, although showing some potential recent age decreases, are no larger than historical fluctuations. The descriptive pattern of fairly stable trends in timing of childbearing has been confirmed in other analyses; using the DHS data from 1988-2014, Al Zalak and Goujon (2017) test for tempo effects (shifts in mean age of childbearing as drivers of fluctuations in TFR). They find no tempo effects and a stable mean age at birth.

Family planning changes are also unlikely to be key drivers of fertility shifts. The prevalence of family planning has remained stable (El-Zanaty & Way, 2009; Ministry of Health and Population, El-Zanaty and Associates, & ICF International, 2015). However, there have been policy changes around family planning. In 2004, USAID began shifting responsibility for contraceptive supply onto the Egyptian government, with the government taking full responsibility by 2007 (USAID, 2011). Subsequently, families have been shifting away from more effective to less effective methods, specifically from IUDs to the pill (Ministry of Health and Population, El-Zanaty and Associates, & ICF International, 2015). There remains some unmet need for family planning in Egypt (12% as of the 2008 DHS and 13% as of the 2014 DHS). There has also been a rise in the total wanted fertility rate, from 2.4 as of the 2008 DHS to 2.8 as of the 2014 DHS (Ministry of Health and Population, El-Zanaty and Associates, & ICF

International, 2015). The reasons for this preference for additional children are likely to be complex, but one potential factor is women's lack of employment opportunities.

6 Multivariate Models of the Relationship between Fertility and Employment

6.1 Fertility over Time and across Ages

Although the descriptive patterns suggest a rise in fertility over time, an important question is whether these differences are significant – and for whom. Figure 6 presents the hazards, for all married women (not restricted by year of marriage), from a model fully interacting time-varying age groups and calendar year groups, using ELMPS 2012.[15] In Appendix 1, Table 10 shows the predicted hazards from this model for each combination of age and year group. Note that hazards for the older age groups can only be estimated in more recent years since the fertility module only includes women 18-49. The results show that hazards had been flat or declining for most groups through 2005-2009, with the exception of those under age 20, an increasingly select group with larger standard errors. The increase in 2010-2011 was largest for the age 30-34 year-old group, with some age groups (e.g. ages 25-29) having significantly smaller increases. The results suggest that fertility has recently risen, particularly for women aged 30-34, a group of increasingly educated women with decreased employment opportunities.

6.2 Baseline Hazards of Fertility

Turning now to our analysis sample (women married since 1991), baseline hazards are visualized in Figure 7. The figure is based on a model that includes only a fully interacted set of parities and years (durations or intervals) since last birth or marriage, in order to illustrate key

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[15] Figure 9, in Appendix 1, shows the results interacting age groups and single calendar years, which are quite noisy.

points about timing across parities.[16] Hazards are highest immediately following marriage. Hazards rise in the second year after the first birth and peak in the third year, with a 0.52 hazard of having a second child at that point (if that point is reached). Hazards of a third birth show a less steep increase over time, increasing from year 1 to 2 and 3 but peaking at a hazard of 0.25 before declining slowly. Hazards for the 4th, 5th, and 6th birth onward follow relatively similar trajectories, with hazards peaking a little later, four years after the last birth, and never rising above a 0.16 hazard. These interactions between parity and time since last birth or marriage are incorporated into all of the models but not presented in detail hereafter. Using the methods for simulating fertility based on hazard models discussed above, this sample of women entering matrimony from 1991-2011 has a TFR of 3.8, consistent with fertility patterns over this period (Figure 1).

6.3 Models of Fertility and Public Sector Employment

The first model for the relationship between fertility and a woman working in the public sector is presented in Table 2, specification 1. The results presented for the model are odds ratios. When greater than 1, they mean a greater odds (hazard) of birth, and when less than one they mean a lower odds (hazard) of birth. Transformed standard errors (based on the delta method) are also presented and can be used as rough tests of whether odds ratios significantly deviate from 1. In specification 1 (with no controls), the odds ratio of 0.827 for public sector work means that the estimated odds of a woman who is working in the public sector giving birth that year are 82.7% of the estimated odds for a woman who is not working in the public sector.

[16] Throughout, fifth and higher order parities are coded as a single category for estimation, as are intervals of 10 years and longer.

In specification 2 (Table 2), controls are added and the odds ratio for a woman being engaged in public sector work rises to 0.944 and becomes statistically insignificant.

Public sector work has potentially differential effects across births. Almost everyone has a birth right after marriage and then fairly promptly a second birth. The majority of women who have second births go on for a third birth (83%) and most of those (67%) continue on for a fourth birth. Thus, there might be differential impacts of public sector work on different parities, with greater scope for an impact on later parities. This possibility is tested in specification 3, where a woman being engaged in public sector work is interacted with parity. There are higher but statistically insignificant odds ratios for progressing from marriage to a first birth and from a first birth to a second birth when women work in the public sector. Since having fewer than two children is very rare (less than 6% of married 35-49 year-olds have fewer than two children as of DHS 2014 (Ministry of Health and Population, El-Zanaty and Associates, & ICF International, 2015)), higher odds suggest accelerated timing, more so than prevalence, of first and second births. There are lower and statistically significant odds of progressing from a second to third birth (0.831) and from a third to a fourth birth (0.665) when women work in the public sector. The odds ratios of going from a fourth to a fifth birth are slightly greater, but statistically insignificant. For the few women who work in the public sector and progress to their fifth birth, the odds ratio of a sixth birth and above is significantly higher (1.974). Thus, the evidence suggests that on what is a particularly relevant margin currently in Egypt, whether to move from two to three children or three children to four, public sector work is associated with reduced fertility.

This finding of work affecting primarily later births also explains why changes in the structure of employment, which started in the late 1980s and early 1990s, substantially preceded changes in fertility in Egypt, which plateaued in the 2000s and then began to rise.[17] Table 3 further illustrates this point by showing the timing of life events for two profiles, based on the probabilities underlying the simulations for specification 3 of Table 2. The "median woman" is presented, in terms of the point in time when the simulations predict 50% of women would give birth. Both profiles graduated from school in 1990. The "public sector job" profile obtained a public sector job in 1991 and retained that job thereafter (as is typical in Egypt (Assaad, Krafft, & Selwaness, 2017; Selwaness & Krafft, 2018; Yassine, 2015)). The "no public sector job" profile did not obtain a public sector job at any time.

Both women married in 1992, and both had their first child a year later, in 1993. Their second birth was three years later, in 1996, for both women. The first differences appear in the timing of the third birth, which is one year earlier (2000 versus 2001) for the woman without a public sector job. Both profiles still ultimately have this third child. However, the woman with the public sector job does not ever have a fourth child, while, in 2009, the woman with no public sector job has her fourth child. The effect of obtaining a public sector job on fertility lags whether or not a woman obtains that job by 18 years. This is consistent with the fertility decline stalling in Egypt starting in the 2000s, substantially after structural reform, and the fertility decline even reversing more recently, as an increasing share of women who did not obtain public sector jobs reached later parities.

[17] Shifting religious values over time or across generations are another potential explanation. Unfortunately, religious affiliation is available for only a subset of women (married and 18-39 in 2012), precluding the calculation of a TFR. Models of childbearing estimated for the subset of women with religion data and adding interactions between years and religion are noisy but suggest that fertility has been rising for Muslim women to a greater extent than Christian women.

6.4 Models of Fertility Accounting for Spouses and Sons

Family composition may play an important role in fertility decisions; women do not make these decisions in isolation. Appendix 2 demonstrates that the relationship between women's public sector work and fertility persists even after controlling for spouse characteristics, including spouse's public sector work. Appendix 3 undertakes a further investigation of the interaction between parity, public sector work, and having a son. The impact of public sector work is concentrated on women who already have multiple children, including a son.

6.5 Models of Fertility Incorporating Fixed Effects

Women who work in the public sector may be different in unobservable ways from other women. To account for this possibility, in Table 4, specification 4 adds fixed effects to specification 3.[18] A similar pattern to specification 3 is found. Lower odds ratios for giving birth after the second, especially third, and fourth birth are found. Only the odds ratio for moving from the third to fourth birth is statistically significant (0.594), but magnitudes are similar to the model without the fixed effects. The odds ratio for moving from the fourth to fifth birth is less than one, but insignificant, and the odds ratio for the fifth birth and above (1.279) is insignificant and is much smaller than in specification 3, where it was significant and high (1.974).

6.6 Models of Fertility Incorporating Local Employment Opportunities

An additional set of models are estimated for the impact of local public sector employment opportunities, rather than own public sector employment, on fertility. Local public sector employment opportunities are in percentage point terms, and so are on a different scale

[18] The effects of various covariates, such as women's own public sector employment, can be identified only from those women with variation in these characteristics, since fixed effects estimates are based on within-woman variation. Among the women who are observed working in the public sector at some point in the time period analyzed, 33% varied over time in their public sector status.

than the binary variable for women's own public sector employment. Variation in local public sector work is illustrated in Appendix 4. These models are presented as specification 5 (in Table 4). Interacting public sector employment opportunities with births, there is little difference for moving from marriage to first birth or first birth to second. There are significantly lower odds ratios for moving on from the second to third birth (0.982), third to fourth birth (0.963) and fourth to fifth birth (0.958). For the highest order births, the odds ratio is 1.023 and statistically insignificant. This suggests that local employment opportunities are affecting women's fertility—presumably through their own employment.

6.7 Models of Fertility Using Instrumental Variables

As an alternative to using local employment opportunities in the fixed-effects models, women's public sector employment is directly instrumented. In Appendix 5, Table 13 presents the marginal effects from the probit model for a woman working in the public sector in a given year, the first stage of the three-stage residual inclusion model. Public sector local employment opportunities are included in the current year and lagged one and two years. Each percentage point increase in local opportunities increases the probability of a woman working in the public sector by 0.1% (p-value of 0.004). The one-year and two-year lags have an insignificant negative effect. The instruments together have a p-value of 0.008 and a chi-square of 11.72. Thus, the instruments are moderately strong in the first stage. In the second part of the two-part first stage, using the OLS linear probability model, the instruments have an F-statistic of 254.50 and a p-value of <0.001. Other covariates are as expected; for instance, compared to illiterate women, secondary and especially university educated women are significantly more likely to work in the public sector.

In the final stage of the three-stage residual inclusion model, both the parity-interacted actual values of women's public sector employment and the parity-interacted residuals from the two-part first stage are included in the equation. Table 5 presents this hazard model. Public sector work predicts higher odds ratios for going from marriage to first birth and first to second birth, but these are insignificant. Public sector work predicts lower odds of going from the second, third, and fourth births to subsequent births, and the interaction with the third birth is significant (odds ratio 0.407). There is an odds ratio greater than 1, but insignificant, for the interaction of public sector work and moving on from the fifth birth. After accounting for the endogeneity of public sector work, a similar relationship between work and fertility as observed in other models persists; women are less likely to give birth to a fourth child if they work in the public sector.

The residual interactions indicate that those who have unobservable characteristics, captured by the residual, that make them more likely to work in the public sector are in fact slower in progressing from marriage to first birth and first birth to second but more likely to progress from the second birth to the third, along with subsequent births. The residual's interaction with having had a second, third, or fourth birth is statistically significant. That the unobservable characteristics that make women more likely to work in the public sector also cause higher fertility merits discussion. One explanation may be that couples with moderately conservative values about women's roles accept women working only in the public sector and also have higher fertility preferences, whereas couples with less conservative values accept women working in the private sector as well (and thus, women are somewhat less likely to work in the public sector). Observed relationships between socio-economic background and women's work provide suggestive evidence of this potential link (Assaad & Krafft, 2014).

6.8 Fertility Simulations

Based on the estimated models, this section simulates total fertility rates for different profiles. Profiles are identical except for variation in public sector employment.[19] For all models, results are simulated over a full set of parity and birth interval interactions to estimate total fertility rates. The simulations thus embed multiple decades of time (1991-2011), as likewise illustrated by the two "median" profiles presented in Table 3. Figure 8 presents the results of these simulations. For the model incorporating a single public sector effect (specification 2), fertility is estimated to be 3.73 with a public sector job and 3.88 without a public sector job, a 0.15 difference in childbearing. After fully interacting public sector work and parities (specification 3), the difference is larger, 0.24; fertility is predicted to be 3.65 with a public sector job and 3.89 without. In the parity-interacted fixed effects model (specification 4) fertility shifts from 2.78 for the public sector employee to 3.02 for a woman who is not employed in the public sector, an effect of approximately 0.24. For the 3SRI model, fertility shifts from 3.33 if a woman works in the public sector to 3.92 if she does not, a difference of 0.59. Simulating the impact of local employment opportunities on fertility shows a similar pattern (specification 5 in Figure 8). When public sector employment in the governorate and residence of birth is 10 percentage points above the mean (similar to the change over the period of study, see Figure 3) fertility in specification 5 is estimated at 2.79, while when simulating at the mean public sector employment rate fertility is 2.93, a 0.14 difference.

Since the simulations generate different absolute levels, it is also helpful to compare relative changes. The simulations imply 0.4% to 4.8% increases in fertility from a ten percentage point decrease in public sector employment. Relative to the 16.7% change in fertility from 2006-

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[19] For all of the simulations, individuals' characteristics, aside from public sector employment, are as observed in the sample. In the 3SRI models, the residual is assumed to be zero.

2012 (3.0 to 3.5), from 2.4% to 28.6% of the increase in fertility could be related to shifting public sector employment opportunities. As a point of comparison, we note that approximately a quarter of Sweden's fertility transition was due to women's relative wages rising, similar to the high end of our estimates (Schultz, 1985).

Whether these differences in fertility are statistically significant can be assessed based on bootstrapped standard errors. Two of the differences are statistically significant at $p<0.05$ ($p=0.016$ for specification 4, the parity-interacted fixed effects model and $p<0.001$ for specification 5, local employment opportunities with fixed effects). The remaining p-values range from 0.106 to 0.159. Overall, these potential differences in fertility are suggestive of changes in women's employment opportunities contributing to rising fertility. The significant results in the multivariate models, generally at the margin of going on from a third to a fourth birth, indicate important dynamics related to public sector employment opportunities. However, these changes are unlikely to be the sole driver in the recent fertility shift in Egypt, especially since the change in public sector employment opportunities will have impacted only a fraction of women.

7 Discussion and Conclusions

This study contributes important evidence that fertility rose in Egypt. While fertility had reached a low of a 3.0 TFR in 2008, fertility in Egypt had risen to 3.5 by 2012. It is likely that a variety of different factors are contributing to the rise in fertility, but one potential cause, and the focus of this paper, is the decline in employment opportunities for women, specifically in the public sector. In order to test the relationship while addressing endogeneity, this paper used fixed-effects in discrete-time duration models. The paper also contributed a new method, 3SRI, for estimating instrumental variable models in inherently non-linear settings, such as duration models with an endogenous binary variable.

Public sector employment was found to be consistently important (and statistically significant) at the margin of going on from a third to a fourth birth. The impact of local employment opportunities, which are beyond women's control and thus avoid potential issues of simultaneity or reverse causality, further suggested an important relationship between public sector employment opportunities and women's fertility. Instrumental variable estimates corroborate the findings of the other models. The effects are related to women's own employment (not her spouse's) and are contingent on having a son (see Appendices 2 and 3). Overall, the evidence presented in this paper suggests that declining opportunities for women can have an effect on fertility, but are unlikely to be the sole driver of recent fertility increases in Egypt.

The causes of the rise in fertility in Egypt are the subject of debate and discussion (see e.g. Al Zalak & Goujon, 2017; Courbage, 2015; Goujon & Al Zalak, 2018). Measurement problems or changes in timing of marriage and births have already been ruled out (Al Zalak & Goujon, 2017). Explaining the rise in fertility requires understanding why fertility has been converging across education levels (Radovich, El-Shitany, Sholkamy, & Benova, 2018). This paper demonstrated that the increase in fertility has been particularly large for vocational secondary graduates, who lost the most in terms of falling public sector employment opportunities. Although this paper demonstrated that employment plays an important role in fertility, rigorous investigation of additional potential causes of the fertility rise is also warranted. Changes in wanted fertility (Ministry of Health and Population, El-Zanaty and Associates, & ICF International, 2015) may reflect changing family size preferences, the causes of which merit further investigation. Health policy changes may be reducing access to the most effective forms of contraception, contributing to additional unplanned births (Ministry of Health and Population, El-Zanaty and Associates, & ICF International, 2015; USAID, 2011).

This finding extends the literature on the potentially offsetting impacts of price and income effects from changing economic opportunities on childbearing (Schultz, 1997). These relationships between economic opportunities and childbearing are typically empirically estimated as how rising wages and increasing opportunities for women can decrease fertility (Fang, Eggleston, Rizzo, & Zeckhauser, 2013; Galor & Weil, 1996; Heckman & Walker, 1990; Jensen, 2012; Mukhopadhyay, 1994; Rosenzweig & Evenson, 1977; Schultz, 1985). This paper examines the opposite case. Specifically, as economic opportunities that are particularly appealing to women decline, so that the value of market work is substantially reduced, women may substitute into childbearing.

This result is an unintended consequence of the attempt to shift from a public-sector led model of employment to a private-sector, market-oriented paradigm. In the wake of structural reform, women have fewer employment opportunities. Diminishing opportunities are due in part to the failure of the private sector to replace public sector jobs with high-quality, formal private sector jobs with protections and benefits (Assaad & Krafft, 2015b; Gatti, Angel-Urdinola, Silva, & Bodor, 2014). Women choose to leave (or never enter) the labor force rather than undertake the informal jobs that are available (Amer, 2015; Assaad & Krafft, 2014, 2015b; Hendy, 2015). This paradigm could potentially be changed with appropriate labor market reforms (Assaad & Krafft, 2014; Krafft & Assaad, 2015).

Whether Egypt can successfully integrate women into the labor force and again progress in its demographic transition is a question with crucial implications for Egypt's society and economy. While new 2018 data shows fertility decreased to a TFR of 3.1 (Krafft, Assaad, & Keo, 2019), Egypt has not achieved lower fertility than at the start of the stall. The "broken social contract," including the loss of public sector employment opportunities, contributed to the Arab Spring (Devarajan & Ianchovichina, 2018). The pressures of the youth bulge on institutions such as the education system and labor market were severe (Assaad & Krafft, 2015a; Elbadawy, 2015; Youssef, Osman, & Roudi-Fahimi, 2014). The "echo" of the youth bulge resulting from the youth bulge forming families along with higher fertility rates is sure to again place pressures on health and education systems as well as on the labor market (Krafft & Assaad, 2014). These findings also raise an important question about global population policies and labor markets; can increasing access to employment for women contribute to other countries completing their fertility transitions?

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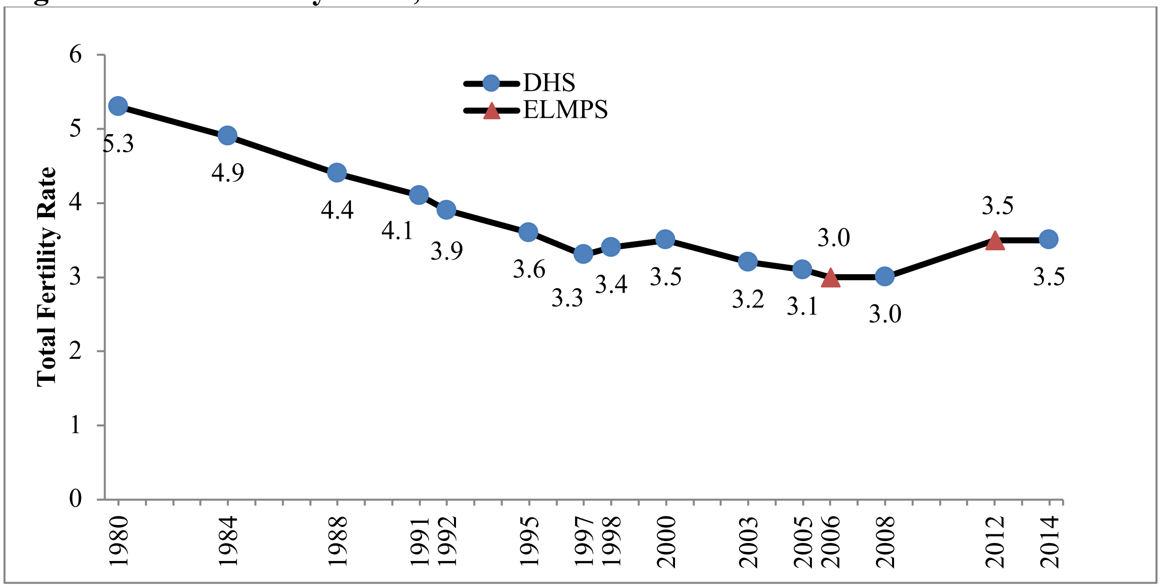
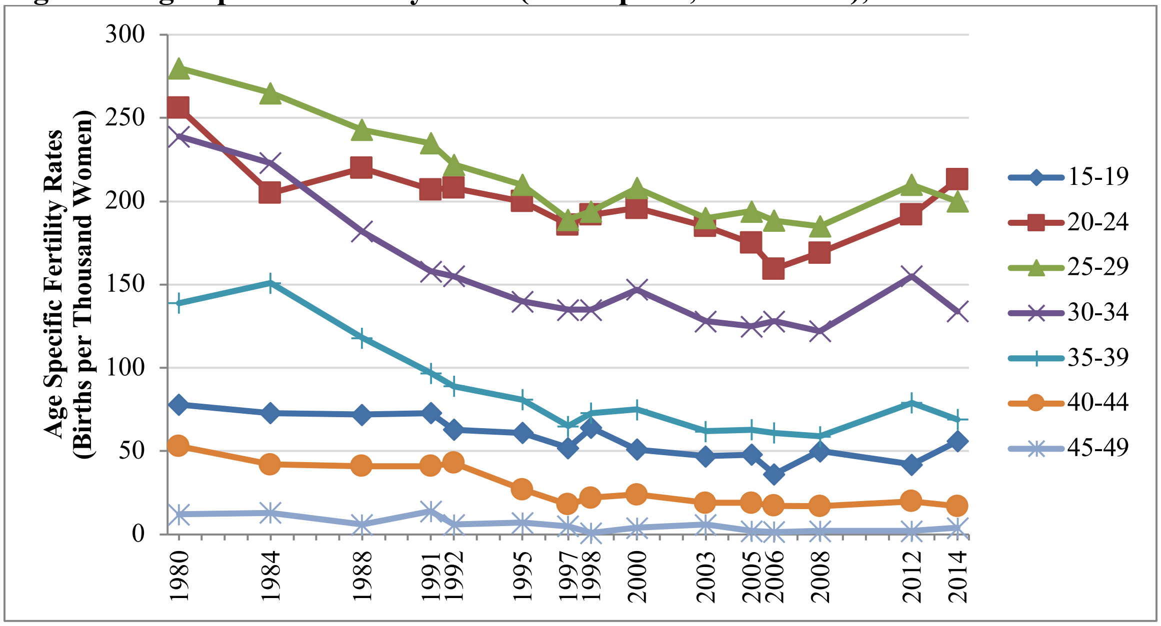
Figures

Figure 1. Total Fertility Rates, 1980-2014



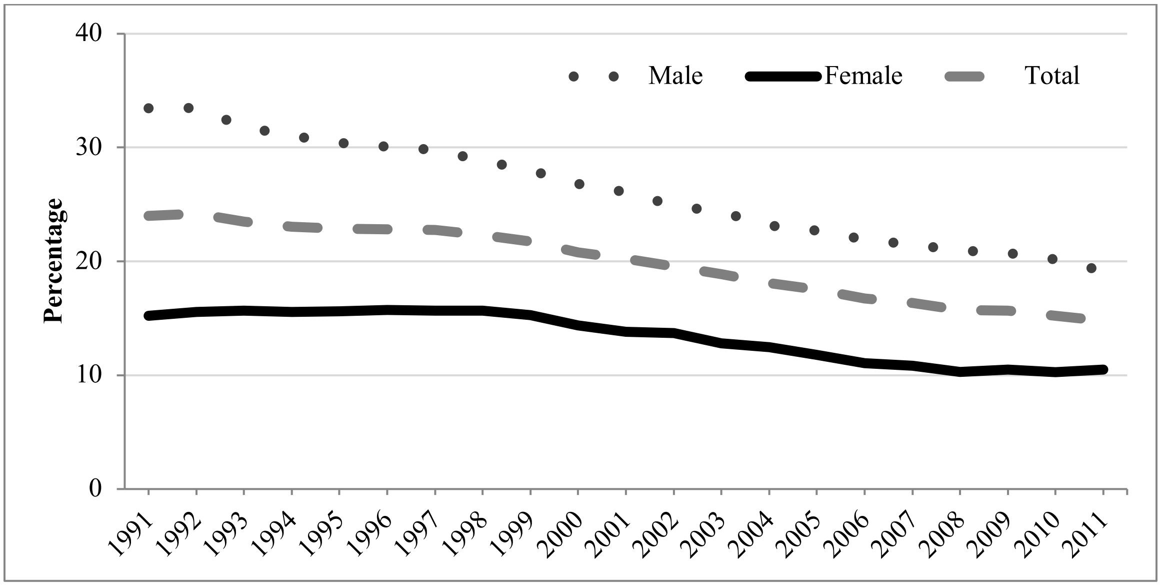
Notes: TFRs for 1980, 1984, and 1991 are 12 months preceding the survey. TFRs for 2012 and 2006 are three years preceding the survey, remainder are 1-36 months preceding the survey.
Source: TFRs for 1980-2005 and 2008 are from El-Zanaty & Way (2009) and are primarily Demographic and Health Survey statistics. TFR for 2014 is from the 2014 Demographic and Health Survey (Ministry of Health and Population, El-Zanaty and Associates, & ICF International, 2015). TFRs for 2012 and 2006 based on author's calculations from the ELMPS 2012 and ELMPS 2006.

Figure 2. Age-Specific Fertility Rates (births per 1,000 women), 1980-2014



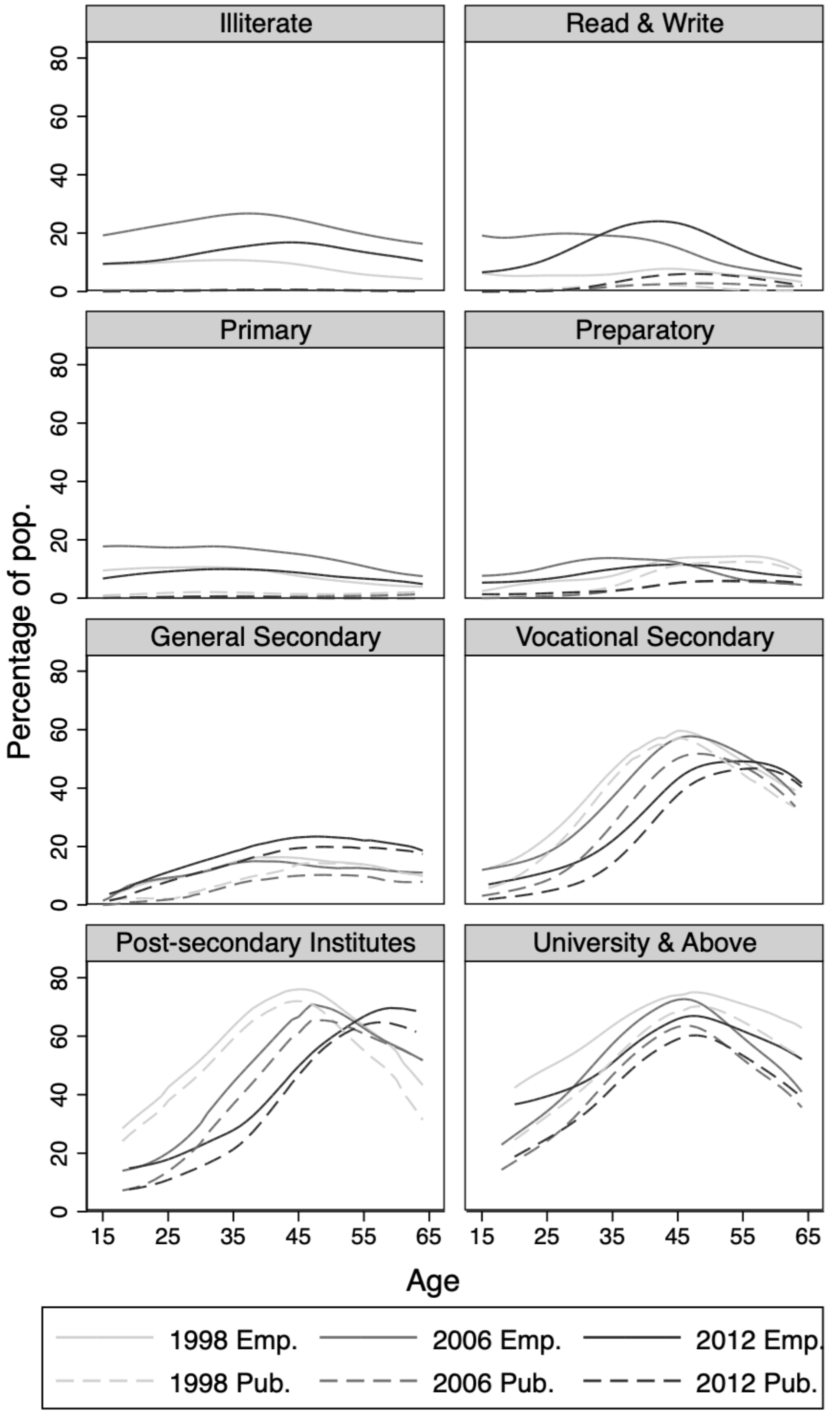
Notes: ASFRs presented in Table 7. ASFRs for 1980, 1984, and 1991 are 12 months preceding the survey. ASFRs for 2012 and 2006 are three years preceding the survey, remainder are 1-36 months preceding the survey.
Source: ASFRs for 1980-2005 and 2008 are from El-Zanaty & Way (2009) and are primarily Demographic and Health Survey statistics. ASFRs for 2014 is from the 2014 Demographic and Health Survey (Ministry of Health and Population, El-Zanaty and Associates, & ICF International, 2015). ASFRs for 2012 and 2006 based on author's calculations from the ELMPS 2012 and ELMPS 2006.

Figure 3. Percentage of Population Employed in the Public Sector, 1991-2011, by Sex, Ages 25-39



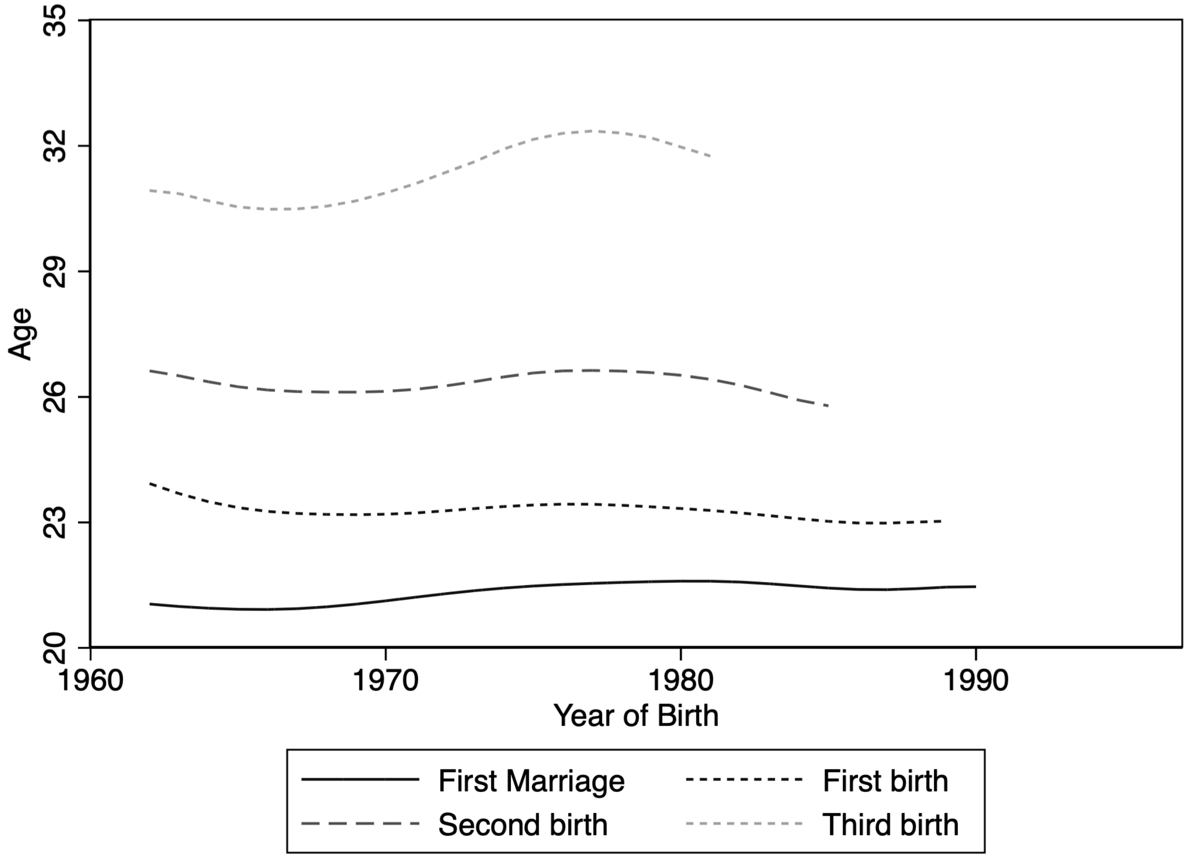
Source: Author's calculations based on ELMPS 2012.
Note: Age 25-39 sample is for the year in question, not necessarily the age in 2012.

Figure 4. Employment Rate (Percentage) and Percentage of the Population Employed in the Public Sector by Education and Age, Women Aged 15-64, 1998, 2006, and 2012



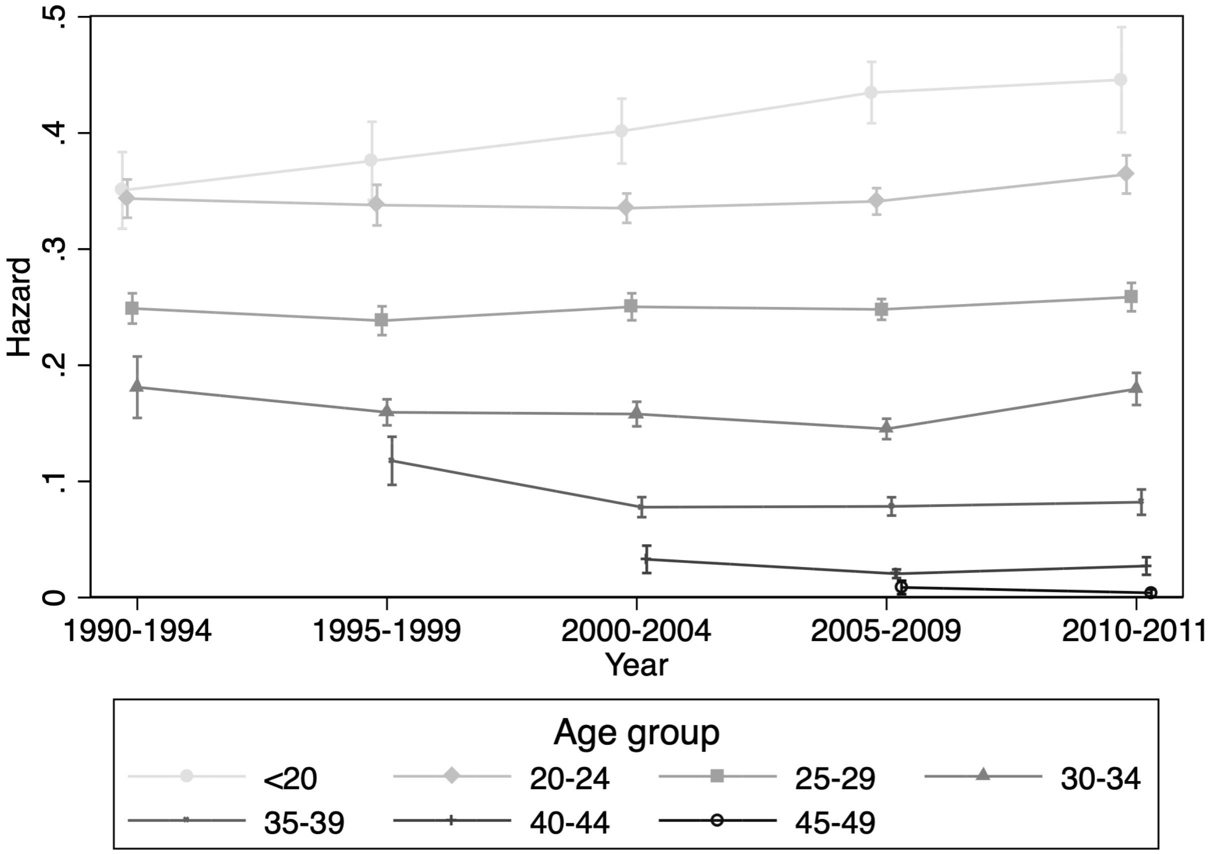
Source: Author's calculations based on ELMPS 1998, 2006, and 2012.
Note: Emp. denotes the employment rate (employment to population ratio). Pub. denotes the percentage of women employed in the public sector as a share of the population (public sector to population ratio).

Figure 5. Median Age at First Marriage and Median Age at First, Second, and Third Births by Year of Birth, Women Ages 15-49



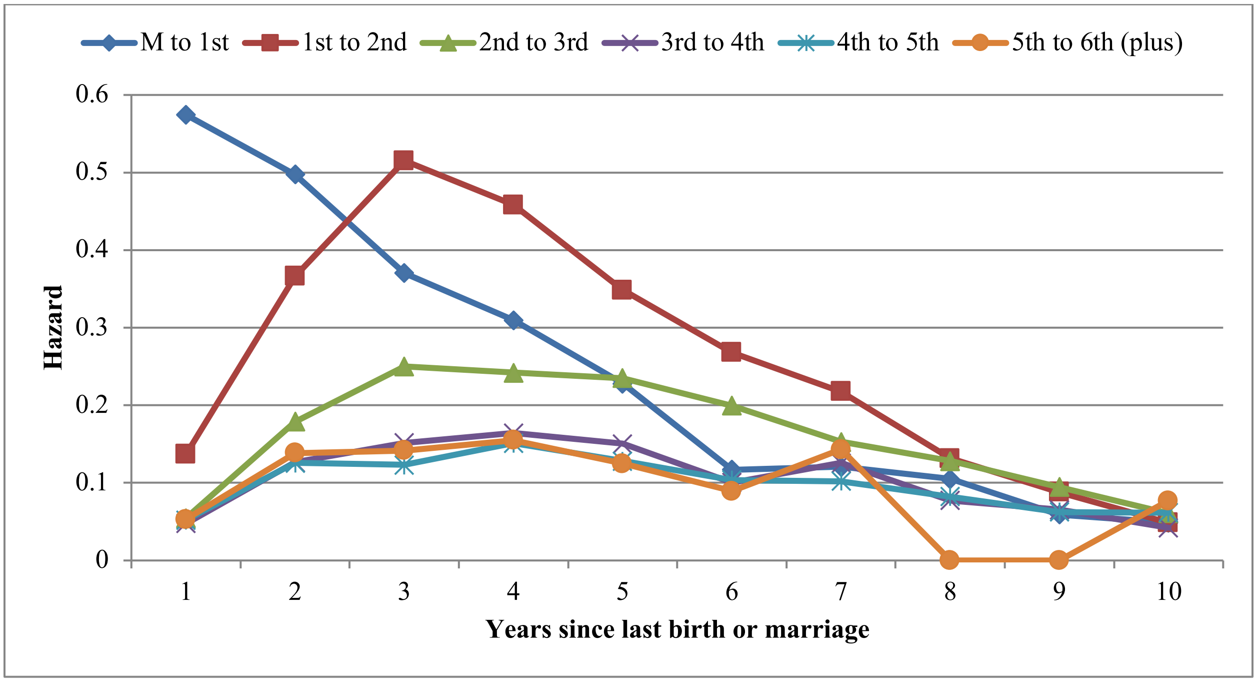
Source: Author's calculations based on ELMPS 2012.
Notes: Lowess smoothed with bandwidth 1. Censoring (women who never married or never had a particular birth) accounted for in calculating medians.

Figure 6. Hazards for Discrete-Time Survival Analysis Model for Births, Age Groups and Grouped Calendar Years Model, Full 1990-2011 Sample



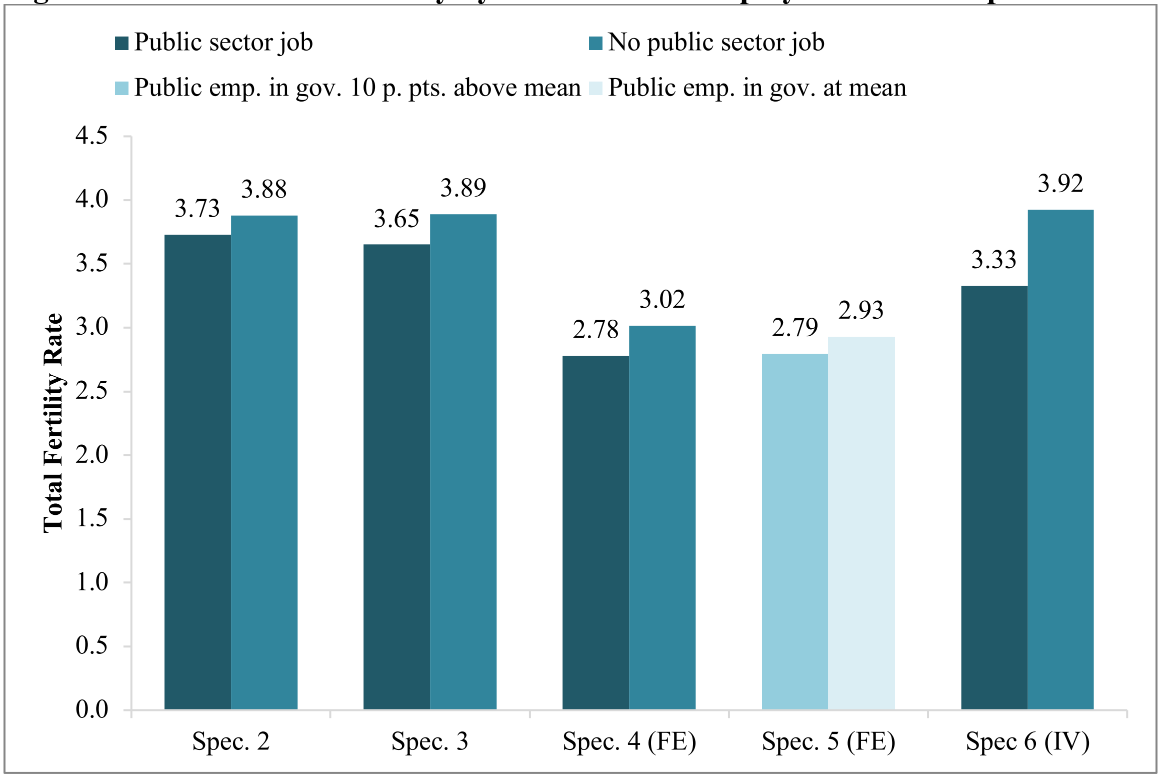
Source: Author's calculations based on ELMPS 2012.
Notes: See Table 10 for hazards. Bars show 95% confidence intervals.

Figure 7. Baseline Hazard of Next Birth by Years Since Last Birth or Marriage and Parity, Women Married between 1991 and 2011



Source: Author's calculations based on ELMPS 2012.
Notes: Based on discrete-time hazard (logit) model with no additional covariates.

Figure 8. Simulations of Fertility by Public Sector Employment across Specifications



Source: Author's calculations based primarily on ELMPS 2012.
Notes: Based on discrete-time hazard models (logit and conditional logit models in Table 2, Table 4, and Table 5). Whether the differences in fertility were statistically significant was assessed based on bootstrapped standard errors. P-values for the significance of the differences in fertility were: 0.159 (Spec. 2); 0.106 (Spec. 3); 0.016 (Spec. 4); <0.001 (Spec. 5); 0.113 (Spec. 6).

Tables

Table 1. Total Fertility Rate by Women's Characteristics in 2006 and 2012

	TFR 2006	TFR 2012	Percentage 2006	Percentage 2012
Ever worked in public sector				
No	3.0	3.5	89.6	88.9
Yes	2.6	3.2	10.4	11.1
Own Educational Attainment				
Illiterate	3.5	4.0	32.2	25.1
Read & write	3.0	3.0	3.6	2.5
Primary	3.0	3.7	6.9	8.0
Preparatory	3.2	3.5	8.3	10.6
General Secondary	2.1	3.2	6.2	6.8
Vocational Secondary	3.1	3.9	28.0	28.7
Post-secondary Inst.	2.7	2.9	3.8	3.1
University & Above	2.7	3.2	10.9	15.2
Quintiles of household wealth				
Poorest	3.1	3.9	18.8	17.9
Second	3.2	3.5	20.7	20.4
Third	3.0	3.6	20.8	21.1
Fourth	2.9	3.6	19.7	20.6
Richest	2.5	2.9	20.0	20.0
Urban/Rural				
Urban	2.6	3.2	43.7	42.8
Rural	3.2	3.7	56.3	57.2
Region				
Greater Cairo	2.6	3.1	13.2	18.0
Alex. & Suez Canal Cities	2.5	2.8	8.1	7.9
Urban Lower	2.7	3.4	10.5	9.9
Urban Upper	2.6	3.5	11.9	7.2
Rural Lower	2.9	3.5	32.0	31.7
Rural Upper	3.6	4.0	24.3	25.2
Governorate				
Port-Said	1.5	2.2	0.7	0.6
Kafr-Elsheikh	2.3	3.2	3.9	5.2
Qena	2.4	3.9	4.0	4.4
Alex.	2.4	2.9	5.9	5.0
Cairo	2.6	2.9	11.5	13.3
Gharbia	2.8	3.2	5.8	5.7
Sharkia	2.8	3.4	7.6	6.4
Kalyoubia	2.8	3.6	6.0	5.7
Behera	2.9	3.3	7.2	6.3
Damietta	2.9	3.9	1.6	3.0
Giza	2.9	4.2	8.4	5.8
Fayoum	3.0	4.1	3.3	3.2
Menoufia	3.0	3.2	4.6	3.3
Suez	3.1	3.1	0.8	1.2
Dakahlia	3.1	3.5	7.0	5.2
Menia	3.2	3.8	5.6	5.3
Aswan	3.2	3.1	1.7	3.0
Ismailia	3.2	3.7	1.3	3.9
Luxur	3.7	3.8	0.8	0.7

	TFR 2006	TFR 2012	Percentage 2006	Percentage 2012
Asyout	3.9	4.0	4.7	4.4
Suhag	4.0	4.0	4.9	4.8
Beni-Suef	4.0	3.9	2.8	3.7
Total	3.0	3.5	100.0	100.0

Source: Author's calculations based on ELMPS 2012 and ELMPS 2006.
Note: Because public sector workers are required to have a secondary degree (i.e. be at least 18), the ASFR for the 15-19 age group was inestimable for those who worked in the public sector and treated as zero.

Table 2. Discrete-Time Survival Analysis Models (Logit) for Births
Dependent Variable: Hazard (in year) of a birth.
Coefficients have been transformed into odds ratios. Standard errors in parentheses.

	Spec. 1	Spec. 2	Spec. 3
Working in public sector	0.827***	0.944	
	(0.032)	(0.042)	
Public sector work interacted with parity			
Marriage			1.055
			(0.074)
First birth			0.996
			(0.071)
Second birth			0.831*
			(0.070)
Third birth			0.665**
			(0.096)
Fourth birth			1.015
			(0.208)
Fifth birth and above			1.974*
			(0.531)
Have a male child (Not yet omitted)			
Yes		0.743***	0.743***
		(0.023)	(0.023)
Education (illiterate omitted)			
Read and Write		0.977	0.975
		(0.062)	(0.062)
Primary		0.879**	0.879**
		(0.042)	(0.042)
Preparatory		0.914	0.914
		(0.051)	(0.051)
General Secondary		1.097	1.102
		(0.096)	(0.097)
Vocational Secondary		0.987	0.989
		(0.031)	(0.031)
Post-Secondary Institutes		1.023	1.027
		(0.065)	(0.065)
University & Above		1.150**	1.158**
		(0.055)	(0.056)
Governorate characteristics			
Life Expectancy (years)		0.970*	0.971*
		(0.014)	(0.014)
Adult Literacy		0.999	0.999
		(0.003)	(0.003)
GDP per capita (thousand LE)		1.003	1.003
		(0.005)	(0.005)
Prenatal care		0.999	0.999
		(0.002)	(0.002)
Parity and years since last birth	Yes	Yes	Yes
Mother's and father's education	No	Yes	Yes

	Spec. 1	Spec. 2	Spec. 3
Birth gov. and urban interactions	No	Yes	Yes
Age group and cal. year group ints.	No	Yes	Yes
N	57112	56685	56685

Source: Author's calculations based primarily on ELMPS 2012.
Notes: *p<0.05 **p<0.01 ***p<0.001
Standard errors clustered at PSU level.

Table 3. Example of Timing of Life Events, by Year and Public Sector Employment

Year	Public Sector Job	No Public Sector Job
1990	Graduate	Graduate
1991	Public sector job	
1992	Marriage	Marriage
1993	Birth 1	Birth 1
1994		
1995		
1996	Birth 2	Birth 2
1997		
1998		
1999		
2000		Birth 3
2001	Birth 3	
2002		
2003		
2004		
2005		
2006		
2007		
2008		
2009		Birth 4
2010		
2011		
2012		

Source: Author's construction based on median woman (50% point for each parity) and specification 3 in Table 2.

Table 4. Discrete-Time Survival Analysis Models with Women Fixed Effects (Conditional Logit) for Births

Dependent Variable: Hazard (in year) of a birth.
Coefficients have been transformed into odds ratios. Standard errors in parentheses.

	Spec. 4	Spec. 5
Public sector emp. interacted with parity		
Marriage	1.113	
	(0.202)	
First birth	0.991	
	(0.162)	
Second birth	0.768	
	(0.123)	
Third birth	0.594*	
	(0.121)	
Fourth birth	0.709	
	(0.227)	
Fifth birth and above	1.279	
	(0.598)	
Public sector local emp. (percentage) interacted with parity		
Marriage		0.993
		(0.006)
First birth		0.999
		(0.005)
Second birth		0.982**
		(0.006)
Third birth		0.963***
		(0.008)
Fourth birth		0.958**
		(0.013)
Fifth birth and above		1.023
		(0.024)
Have a male child (Not yet omitted)		
Yes	0.551***	0.551***
	(0.028)	(0.028)
Governorate characteristics		
Life Expectancy (years)	1.373***	1.369***
	(0.030)	(0.030)
Adult Literacy	1.041***	1.042***
	(0.004)	(0.004)
GDP per capita (thousand LE)	1.024***	1.021**
	(0.007)	(0.007)
Prenatal care	1.005	1.004
	(0.003)	(0.003)
Mother's and father's education	Yes	Yes
Parity and years since last birth	Yes	Yes
Age group and cal. year group ints.	Yes	Yes
N	53600	53600

Source: Author’s calculations based primarily on ELMPS 2012.
Notes: *p<0.05 **p<0.01 ***p<0.001
Standard errors clustered at PSU level.

Table 5. Three-Stage Residual Inclusion Discrete-Time Survival Analysis Model (Third Stage Logit) for Births

Dependent Variable: Hazard (in year) of a birth.
Coefficients are odds ratios. Bootstrapped standard errors in parentheses.

Public sector work interacted with parity	
Marriage	1.504
	(0.417)
First birth	1.360
	(0.318)
Second birth	0.752
	(0.194)
Third birth	0.407**
	(0.136)
Fourth birth	0.591
	(0.273)
Fifth birth and above	2.200
	(1.567)
Residual for public sector work interacted with parity	
Marriage	0.658
	(0.195)
First birth	1.046
	(0.279)
Second birth	1.760*
	(0.500)
Third birth	3.090*
	(1.392)
Fourth birth	3.473*
	(2.167)
Fifth birth and above	1.293
	(1.343)
Have a male child (Not yet omitted)	
Yes	0.744***
	(0.022)
Education (illiterate omitted)	
Read and Write	0.964
	(0.063)
Primary	0.881*
	(0.045)
Preparatory	0.920
	(0.054)
General Secondary	1.107
	(0.098)
Vocational Secondary	0.994
	(0.038)
Post-Secondary Institutes	1.020
	(0.076)
University & Above	1.124
	(0.096)
Governorate characteristics	

Life Expectancy (years)	0.971
	(0.030)
Adult Literacy	1.003
	(0.004)
GDP per capita (thousand LE)	1.000
	(0.005)
Prenatal care	0.999
	(0.002)
Parity and years since last birth	Yes
Mother's and father's education	Yes
Birth gov. and urban interactions	Yes
Age group and cal. year group ints.	Yes
Single years	Yes
N	57144

Source: Author's calculations based primarily on ELMPS 2012.
Notes: *p<0.05 **p<0.01 ***p<0.001
Bootstrapping undertaken with clustering on the PSU level.

Appendices
Appendix 1. Descriptive Statistics and Models

Table 6. Sample Characteristics

	Percentage
Educational Attainment	
Illiterate	28.5
Read and Write	2.8
Primary	8.4
Preparatory	6.2
General Secondary	1.8
Vocational Secondary	35.4
Post-Secondary Institutes	3.6
University & Above	13.2
Mother's Level of Education Attained	
Illiterate	81.4
Reads & Writes	8.2
Less than Sec.	5.4
Secondary	3.2
Post-Secondary Institutes	0.5
University	1.3
Father's Level of Education Attained	
Illiterate	55.8
Reads & Writes	19.7
Less than Sec.	11.5
Secondary	7.3
Post-Secondary Institutes	1.3
University	4.3
Birth Residence	
Urban	39.3
Rural	60.7
Birth Governorate	
Cairo	11.1
Alex.	4.9
Port-Said	0.5
Suez	0.7
Damietta	3.2
Dakahlia	6.0
Sharkia	7.3
Kalyoubia	5.9
Kafr-Elsheikh	5.7
Gharbia	6.1
Menoufia	3.8
Behera	6.2
Ismailia	3.4
Giza	4.9
Beni-Suef	4.0
Fayoum	3.7

	Percentage
Menia	5.4
Asyout	4.5
Suhag	5.1
Qena	4.9
Aswan	2.5
Have a son	
No	43.8
Yes	56.2
Public sector employment	
No	90.5
Yes	9.5
Age group	
<20	6.0
20-24	27.9
25-29	31.8
30-34	21.0
35-39	9.5
40-44	3.1
45-49	0.7
Total	100.0

	Means	Standard Deviations
Governorate characteristics		
Public employment rate	18.2	6.3
Life expectancy (years)	70.5	2.2
Adult literacy rate (percentage)	69.1	11.8
GDP per capita (in thousands of 2012 LE)	14.8	3.7
Prenatal care (percentage)	71.7	16.6
N	57,144	

Source: Author's calculations based primarily on ELMPS 2012.
Notes: An observation is woman-parity-years since last birth

Table 7. Age-Specific Fertility Rates (births per 1,000 women), 1980-2014

Age group:	15-19	20-24	25-29	30-34	35-39	40-44	45-49
1980 EFS	78	256	280	239	139	53	12
1984 ECPS	73	205	265	223	151	42	13
1988 DHS	72	220	243	182	118	41	6
1991 EMCHS	73	207	235	158	97	41	14
1992 DHS	63	208	222	155	89	43	6
1995 DHS	61	200	210	140	81	27	7
1997 DHS	52	186	189	135	65	18	5
1998 DHS	64	192	194	135	73	22	1
2000 DHS	51	196	208	147	75	24	4
2003 DHS	47	185	190	128	62	19	6
2005 DHS	48	175	194	125	63	19	2
2006 ELMPS	36	159	189	128	61	17	2
2008 DHS	50	169	185	122	59	17	2
2012 ELMPS	42	192	210	155	79	20	2
2014 DHS	56	213	200	134	69	17	4

Notes: Graphed in Figure 2. ASFRs for 1980, 1984, and 1991 are 12 months preceding the survey. ASFRs for 2012 and 2006 are three years preceding the survey, remainder are 1-36 months preceding the survey.
Source: ASFRs for 1980-2005 and 2008 are from El-Zanaty & Way (2009) and are primarily Demographic and Health Survey statistics. EFS is the Egyptian Fertility Survey, ECPS is the Egypt Contraceptive Prevalence Survey, EMCHS is the Egypt Maternal and Child Health Survey. ASFRs for 2014 is from the 2014 Demographic and Health Survey (Ministry of Health and Population, El-Zanaty and Associates, & ICF International, 2015). ASFRs for 2012 and 2006 based on author's calculations from the ELMPS 2012 and ELMPS 2006.

Table 8. Percentage of Population Employed in the Public Sector, 1991-2011, by Sex, Ages 25-39

	Male	Female	Total
1991	33.5	15.2	24.0
1992	33.5	15.6	24.2
1993	31.9	15.7	23.5
1994	31.1	15.6	23.0
1995	30.4	15.6	22.9
1996	30.1	15.7	22.8
1997	29.8	15.7	22.7
1998	28.8	15.7	22.3
1999	28.0	15.3	21.7
2000	26.8	14.4	20.8
2001	26.1	13.8	20.2
2002	24.9	13.7	19.6
2003	24.3	12.8	18.9
2004	23.2	12.5	18.1
2005	22.7	11.8	17.5
2006	21.9	11.1	16.7
2007	21.5	10.8	16.3
2008	20.9	10.3	15.7
2009	20.7	10.5	15.7
2010	20.2	10.3	15.2
2011	19.2	10.5	14.8

Source: Author's calculations based on ELMPS 2012.
Note: Age 25-39 sample is for the year in question, not necessarily the age in 2012.

Table 9. Employment Rate (Percentage) and Percentage of the Population Employed in the Public Sector by Education and Age, Women Aged 15-64, 1998, 2006, and 2012

	Employment rate (percentage)			Percentage of the Population Employed in the Public Sector		
	1998	2006	2012	1998	2006	2012
Illiterate						
15-19	10	19	6	0	0	0
20-24	10	17	14	1	0	1
25-29	8	24	10	0	0	0
30-34	12	29	11	1	1	0
35-39	13	29	19	0	1	0
40-44	10	27	20	1	1	1
45-49	9	26	17	0	1	1
50-54	5	20	17	0	0	0
55-59	7	18	10	0	0	0
60-64	6	13	8	0	0	0
Total	9	22	14	1	0	0
Read & Write						
15-19	13	23	7	0	0	0
20-24	0	17	5	0	0	0
25-29	3	14	12	0	0	1
30-34	5	29	14	1	0	0
35-39	11	21	32	5	3	0
40-44	5	18	29	2	5	19
45-49	6	13	26	0	4	9
50-54	10	5	9	1	1	7
55-59	6	7	10	1	3	0
60-64	0	3	2	0	0	2
Total	7	16	14	1	2	3
Primary						
15-19	8	12	3	0	0	0
20-24	7	19	7	1	0	0
25-29	12	21	14	4	0	0
30-34	9	15	13	2	2	2
35-39	12	11	7	6	0	0
40-44	10	23	11	0	2	0
45-49	6	13	9	0	0	0
50-54	7	13	12	1	0	0
55-59	3	7	2	1	2	0
60-64	7	8	4	4	2	0
Total	8	15	7	1	1	0
Preparatory						
15-19	0	3	1	0	0	0
20-24	4	12	10	0	0	4
25-29	3	6	3	1	0	0
30-34	9	17	6	3	3	2
35-39	4	19	13	3	1	2
40-44	5	12	18	5	2	5
45-49	18	9	14	13	9	8
50-54	49	4	8	39	4	8
55-59	5	12	9	5	12	9
60-64	0	0	6	0	0	0
Total	3	6	5	2	1	2
General secondary						

	Employment rate (percentage)			Percentage of the Population Employed in the Public Sector		
	1998	2006	2012	1998	2006	2012
15-19	1	0	1	0	0	0
20-24	0	2	2	0	0	1
25-29	5	10	11	5	0	5
30-34	25	23	18	0	16	16
35-39	0	0	25	0	0	24
40-44	60	14	22	60	14	17
45-49	22	7	30	22	7	23
50-54	15	17	20	15	0	17
55-59	8	20	38	8	20	38
60-64	10	0	0	10	0	0
Total	3	2	5	2	1	3
Vocational secondary						
15-19	9	10	4	2	1	0
20-24	14	15	8	6	4	2
25-29	20	16	12	12	7	4
30-34	33	20	15	29	14	7
35-39	61	40	23	59	24	14
40-44	65	63	28	65	55	19
45-49	66	70	53	64	68	47
50-54	54	74	69	51	67	68
55-59	45	53	67	33	53	64
60-64	11	8	6	11	4	6
Total	28	24	20	22	15	13
Post-secondary						
15-19	-	-	-	-	-	-
20-24	23	17	18	17	8	10
25-29	54	17	16	49	11	6
30-34	57	29	22	55	22	17
35-39	77	55	39	69	51	35
40-44	66	73	33	60	60	26
45-49	84	77	50	67	69	50
50-54	76	74	77	76	74	77
55-59	62	80	74	55	80	74
60-64	9	0	51	0	0	0
Total	51	37	30	46	31	23
University						
15-19	-	-	-	-	-	-
20-24	40	24	24	26	14	13
25-29	46	36	37	26	22	28
30-34	69	52	41	57	41	34
35-39	61	64	56	56	49	46
40-44	77	80	66	66	76	57
45-49	72	75	75	72	64	75
50-54	84	78	70	76	70	61
55-59	75	74	74	75	62	68
60-64	40	0	15	31	0	5
Total	60	47	44	49	36	35

Source: Author’s calculations based on ELMPS 1998, 2006, and 2012.
Notes: “-” for post-secondary and university ages 15-19 denotes that graduation is past these ages and thus statistics are not applicable.

Table 10. Hazards for Discrete-Time Survival Analysis Model for Births, Age Groups and Grouped Calendar Years Model, Full 1990-2011 Sample

Dependent Variable: Hazard (in year) of a birth.

Coefficients have been transformed into hazards. Standard errors in parentheses.

	1990-1994	1995-1999	2000-2004	2005-2009	2010-2011
<20	0.351***	0.376***	0.402***	0.435***	0.446***
	(0.017)	(0.017)	(0.014)	(0.013)	(0.023)
20-24	0.344***	0.338***	0.335***	0.341***	0.364***
	(0.008)	(0.009)	(0.006)	(0.006)	(0.008)
25-29	0.249***	0.238***	0.250***	0.248***	0.259***
	(0.007)	(0.006)	(0.006)	(0.005)	(0.006)
30-34	0.181***	0.159***	0.158***	0.145***	0.180***
	(0.013)	(0.006)	(0.005)	(0.004)	(0.007)
35-39		0.118***	0.078***	0.078***	0.082***
		(0.011)	(0.004)	(0.004)	(0.006)
40-44			0.033***	0.020***	0.027***
			(0.006)	(0.002)	(0.004)
45-49				0.009**	0.004**
				(0.003)	(0.001)

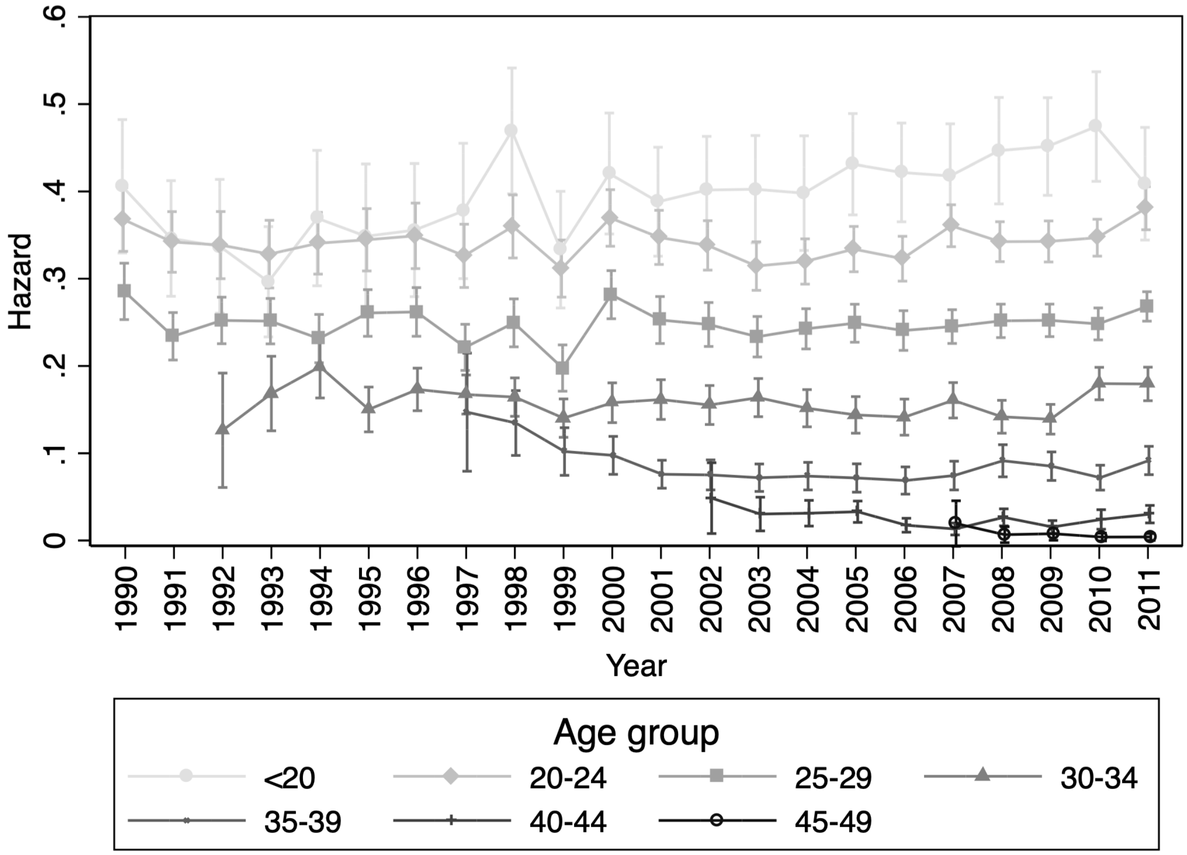
Source: Author's calculations based on ELMPS 2012.

Notes: *p<0.05 **p<0.01 ***p<0.001

N=91662

Standard errors clustered at PSU level.

Figure 9. Hazards for Discrete-Time Survival Analysis Model for Births, Age Groups and Single Calendar Years, Full 1990-2011 Sample



Source: Author's calculations based on ELMPS 2012.
Notes: Based on a fully interacted model of age groups and single calendar years (table not shown). Bars show 95% confidence intervals.

Appendix 2. Models Incorporating Spouse Characteristics

A series of additional analyses are conducted controlling for spouse characteristics. Spouse data are not available for all women, as the husband may not be present due to death, migration, separation, or divorce. Approximately 89% of women included in the sample have a spouse present in the household at the time of the survey. The age group of the spouse at each year, his education (categorically, as with women), and his time-varying employment in the public sector (based on his retrospective labor market history data) are incorporated as controls in this subset of regressions. The regressions with these additional controls can help test the possibility that there are substantial fertility preference differentials among individuals and households who work in the public sector. The results are presented in Table 11. Importantly, the impact of women's public sector work persists with odds ratios across births that are similar to Table 2. The impact on moving from the second to the third birth and the third birth to the fourth birth remains statistically significant. The spouse being employed in the public sector is not statistically significant.[20]

[20] That spouse employment in the public sector is statistically insignificant and relatively small in magnitude compared to the odds ratios for women also suggests that the old-age security rationale for fertility is not driving the impact of public sector work. Having either the husband or the wife in the public sector would secure such a pension.

Table 11. Discrete-Time Survival Analysis Model (Logit) for Births Including Spouse Characteristics

Dependent Variable: Hazard (in year) of a birth.
Coefficients have been transformed into odds ratios. Standard errors in parentheses.

Public sector work interacted with parity	
Marriage	1.012
	(0.077)
First birth	1.016
	(0.081)
Second birth	0.837*
	(0.074)
Third birth	0.680*
	(0.109)
Fourth birth	1.243
	(0.297)
Fifth birth and above	1.419
	(0.479)
Have a male child (Not yet omitted)	
Yes	0.739***
	(0.024)
Education (illiterate omitted)	
Read and Write	0.991
	(0.070)
Primary	0.870**
	(0.046)
Preparatory	0.914
	(0.054)
General Secondary	1.095
	(0.109)
Vocational Secondary	0.993
	(0.040)
Post-Secondary Institutes	0.992
	(0.072)
University & Above	1.121
	(0.069)
Spouse public sector work interacted with parity	
Marriage	1.041
	(0.054)
First birth	1.035
	(0.054)
Second birth	0.951
	(0.052)
Third birth	1.008
	(0.085)
Fourth birth	0.830
	(0.129)
Fifth birth and above	1.374
	(0.342)
Spouse education (illiterate omitted)	

Read and Write	1.120
	(0.066)
Primary	0.975
	(0.043)
Preparatory	0.929
	(0.056)
General Secondary	0.891
	(0.083)
Vocational Secondary	0.954
	(0.040)
Post-Secondary Institutes	0.893
	(0.059)
University & Above	1.026
	(0.055)
Governorate characteristics	
Life Expectancy (years)	0.977
	(0.016)
Adult Literacy	0.999
	(0.003)
GDP per capita (thousand LE)	0.999
	(0.005)
Prenatal care	0.997
	(0.002)
Parity and years since last birth	Yes
Mother's and father's education	Yes
Birth gov. and urban interactions	Yes
Age group and cal. year group ints.	Yes
N	49360

Source: Author's calculations based primarily on ELMPS 2012.
Notes: *p<0.05 **p<0.01 ***p<0.001
Standard errors clustered at PSU level.
Only for sub-sample of women with husbands present in the household.

Appendix 3. Models Incorporating Interactions between Having a Son, Public Sector, and Parity

As well as decisions about fertility depending on how many children the family already has, whether or not the family has a son is an important part of fertility decisions (Sieverding & Hassan, 2016; Yount, Langsten, & Hill, 2000). There may be more discretion for women to not to have third, fourth, or fifth children due to the pull of public sector work if they have already had a son. Table 12 presents an exploration of the potential relationship between public sector work, child sex composition, and parity. Models are presented both without fixed effects (akin to specification 3 in Table 2) and with fixed effects (similar to specification 4 in Table 4). Interactions between public sector work and parity, as well as parity and having a son, along with the three-way interaction between public sector work, parity, and having a son are all presented.

First, as the literature suggests and was true in the other models, having a son reduces the odds of a subsequent birth. The effect is significant for all parities, and increasingly so, suggesting that once they have several children, if women have a son childbearing is more likely to slow or stop. For the main effects of public sector work interacted with parity (the main effects being in the case with no son yet), there are not significant effects and in the model without fixed effects, odds ratios even lose the pattern of decreasing in later parities when the woman is in the public sector. However, for those women who have a son, the impact of public sector work on later births is large, a significant odds ratio of 0.452 for going from the third to fourth birth in the model without fixed effects, and a similar but insignificant odds ratio ($p=0.158$) in the fixed effects model. Essentially, the relationship between public sector work and fertility depends on having already had a few children, including a male child. Since 69% of women have three children and 87% of women with a third child have a son, the majority of women have the potential to have their fertility influenced by work.

Table 12. Discrete-Time Survival Analysis Models for Births with Interactions between Having a Son, Public Sector, and Parity
Dependent Variable: Hazard (in year) of a birth.
Coefficients have been transformed into odds ratios. Standard errors in parentheses.

	Without FE	With FE
Public sector work interacted with parity		
Marriage	1.056	1.109
	(0.074)	(0.202)
First birth	1.081	1.107
	(0.114)	(0.214)
Second birth	0.846	0.750
	(0.126)	(0.171)
Third birth	1.276	0.991
	(0.401)	(0.404)
Fourth birth	1.184	0.611
	(0.545)	(0.433)
Fifth birth and above	1.466	0.416
	(0.948)	(0.388)
Public sector work interacted with parity and having a son		
First birth	0.853	0.808
	(0.119)	(0.167)
Second birth	0.970	1.030
	(0.167)	(0.247)
Third birth	0.452*	0.542
	(0.162)	(0.235)
Fourth birth	0.818	1.194
	(0.434)	(0.914)
Fifth birth and above	1.340	3.340
	(1.003)	(3.303)
Parity interacted with having a son		
First birth	0.844***	0.783***
	(0.036)	(0.048)
Second birth	0.664***	0.464***
	(0.036)	(0.035)
Third birth	0.707***	0.436***
	(0.065)	(0.055)
Fourth birth	0.555***	0.282***
	(0.098)	(0.066)
Fifth birth and above	0.405**	0.058***
	(0.130)	(0.023)
Education (illiterate omitted)		
Read and Write	0.977	
	(0.062)	
Primary	0.878**	
	(0.042)	
Preparatory	0.917	
	(0.052)	
General Secondary	1.105	

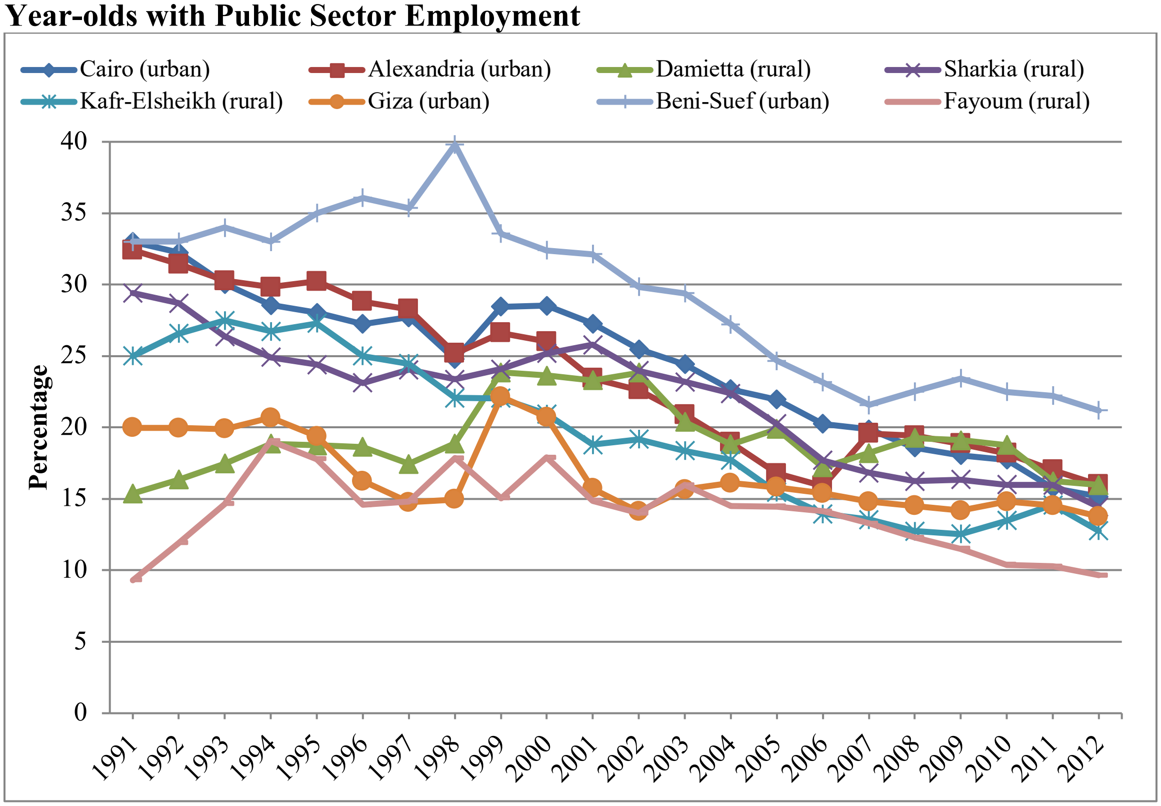
	Without FE	With FE
	(0.097)	
Vocational Secondary	0.991	
	(0.031)	
Post-Secondary Institutes	1.026	
	(0.065)	
University & Above	1.158**	
	(0.056)	
Governorate characteristics		
Life Expectancy (years)	0.971*	1.377***
	(0.014)	(0.030)
Adult Literacy	1.000	1.042***
	(0.003)	(0.004)
GDP per capita (thousand LE)	1.003	1.025***
	(0.005)	(0.007)
Prenatal care	0.999	1.005
	(0.002)	(0.003)
Parity and years since last birth	Yes	Yes
Mother's and father's education	Yes	Yes
Birth gov. and urban interactions	Yes	No
Age group and cal. year group ints.	Yes	Yes
N	56685	53600

Source: Author's calculations based primarily on ELMPS 2012.
Notes: *p<0.05 **p<0.01 ***p<0.001
Standard errors clustered at woman level.

Appendix 4. Variation in Local Employment Opportunities

Figure 10 provides examples of the estimated variation in local employment opportunities over time for eight combinations of governorate and urban/rural. There is a substantial amount of variation in the estimated local employment opportunities over time. Although there is some consistency in overall trends, there are also clearly differences by location. This variation may be caused by where government jobs are allocated across a variety of different ministries and programs, such as the Social Fund for Development, which targets poor areas (with mixed success), or the national Youth Employment Program (Abou-Ali, El-Azony, El-Laithy, Haughton, & Khandker, 2010; De Gobbi & Nesporova, 2005).

Figure 10. Example Urban/rural and Governorate Level Trends in Percentage of 25-39 Year-olds with Public Sector Employment



Source: Author's calculations based on ELMPS 1998, 2006, and 2012.
Note: Age 25-39 sample is for the year in question, not necessarily the age in survey year.

Appendix 5. First Stage of 3SRI Model

Table 13. Probit Marginal Effects (First Stage) for Employment in Public Sector in Year

Dependent Variable: Probability (in year) of public sector employment.

Public sector local emp. (percentage)	
In current year	0.001**
	(0.001)
One year lag	-0.000
	(0.000)
Two year lag	-0.001
	(0.000)
Education (illiterate omitted)	
Read and Write	0.013*
	(0.007)
Primary	0.005
	(0.004)
Preparatory	0.011*
	(0.006)
General Secondary	0.139***
	(0.032)
Vocational Secondary	0.102***
	(0.007)
Post-Secondary Institutes	0.182***
	(0.024)
University & Above	0.306***
	(0.017)
Governorate characteristics	
Life Expectancy (years)	0.002
	(0.005)
Adult Literacy	-0.000
	(0.001)
GDP per capita (thousand LE)	0.000
	(0.001)
Prenatal care	-0.000
	(0.000)
Birth gov. and urban interactions	Yes
Mother's and father's education	Yes
Age group and cal. year group ints.	Yes
Single years	Yes
N	56549

Source: Author's calculations based primarily on ELMPS 2012.
Notes: *p<0.05 **p<0.01 ***p<0.001
Standard errors clustered at PSU level.