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Testing Becker's Q-Q Model and Long-terms Effects on Women Using Data from Egypt

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The tradeoff between child quantity and child quality: testing Becker's Q-Q model and long-terms effects on women using data from Egypt

Hosam Ibrahim*

Abstract

Becker's (1960) seminal work on the economics of fertility introduced the child quantity-quality (Q-Q) tradeoff model. The Q-Q model investigates how households maximize their utility from having children, given expenditure on child-rearing and the opportunity cost of childbearing. The Q-Q tradeoff explains whether the quantity of children significantly determines the quality of children in a household. Using data over a period of 24 years from Egypt, this research tests for the existence and quantifying of the effect of fertility on child welfare, and long-term labor market outcomes for women in a developing country. I find no strong evidence of the existence of the Q-Q tradeoff in Egypt. Fertility does not affect the daughter's education, nor does it affect the daughter's labor force participation. I also find that the availability of nearby public sector jobs is associated with reducing family size but does not increase the probability of the daughter's employment. The results obtained suggest that fertility has no effect on child schooling in Egypt between 1998 and 2018. This research informs recent family planning efforts in Egypt, on the socioeconomic returns of reducing fertility rates and help understand the determinants of gender differentials in human capital investment. The results also provide evidence for whether long-term labor market outcomes for females are affected by family size.

JEL Classifications: J13: Fertility; Family Planning; Child Care; Children; Youth. J16: Economics of Gender; Non-labor Discrimination. J22: Time Allocation and Labor Supply. O12: Microeconomic Analyses of Economic Development.

Keywords: Quantity-Quality Tradeoff; Fertility Decisions; Child Education; Female Employment; Egypt; Becker's Q-Q Model; Family Economics; Development Economics; Gender

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1 Introduction

Building on consumer demand theory, fertility is studied as a microeconomic choice driven by parental preferences, where preferences are shaped by the households' socioeconomic characteristics (Becker 1960; Guinnane 2011). Within this framework, responsiveness of fertility preferences to income changes is detrimental to fertility choices and female labor (Krafft 2020) and marriage (Assaad and Krafft 2015) market outcomes. That is, the higher the income households earn, the less likely they would maximize their utility from having more children, and the more likely they would from having higher quality children (Becker 1960). Similarly, in developing countries, poorer households would experience higher returns to the quantity of children rather than quality (due to prevalent child labor and low returns to education), in turn reducing the cost of fertility. This dilemma is commonly referred to as the child quantity-quality (Q-Q) tradeoff. In exploring fertility as a microeconomic choice, this paper engages in the debate over how household socioeconomic characteristics, particularly in developing countries, shape parental preferences towards family size and child quality, ultimately influencing female labor market outcomes.

This research aims to test and quantify the Q-Q tradeoff in Egypt, hypothesizing that increasing family size inversely affects the quality of child outcomes, namely education, and has consequential long-term impacts on female employment. The Q-Q model is largely affected by parents' income, marriage market dynamics, female employment and female returns to education (Becker 1981; Doepke 2015; T. P. Schultz 1997). Factors that are uniquely different within households in the Middle East and North Africa (MENA), compared to developing countries from other regions. Girls and young women in a country like Egypt are mostly educated not necessarily to enter the labor force, given their increasing levels of education attainment, yet stagnant employment rates (Assaad et al. 2020), a paradox that is yet to be unriddled. I present quasi-experimental evidence on how family size affects the number of child schooling years, gender differentials in human capital investment decisions by parents, and more consequentially the probability of employment for females.

Testing for the existence, and quantifying, of the effect of fertility on such short- *and* long-term outcomes can also explain the influence of fertility on intergenerational mobility and inequality of opportunity for females in education and the labor market. By quantifying the causal effect of family size on child quality, differentials in expenditure on female and male children within the same family can be estimated. If there exists a gender differential in human capital investments (child education) in large families, daughters in such families would grow up with less education and thus worse chances in the labor market, reducing their opportunity cost of childbearing and rearing.

The contribution of this paper is threefold: first, I estimate the effect of one extra child in a family on child schooling; second, I investigate whether this effect is different for girls than for boys; and third, I estimate the effect of parent fertility decisions on the female child's employment. In the repeated-(and pooled)-cross-section sample between 1998 and 2018, I find that on average an increase of one child in a household does not affect child schooling. I also find no gender differentials in child schooling due to family size. Women growing up in larger families, in terms of number of siblings, had no significantly different probabilities of being employed. The results are consistent with other findings in the literature (J. Angrist, Lavy, and Schlosser 2010), where the Q-Q tradeoff does not seem to exist. The results obtained suggest that fertility has no significant effect on child schooling in Egypt between 1998 and 2018. Adding to the debate on whether the Q-Q tradeoff exists in developed or developing countries (Aaronson, Lange, and Mazumder 2014; Åslund and Grönqvist 2010; Black, Devereux, and Salvanes 2005; Cáceres-Delpiano 2006; Hanushek 1992; Mogstad and Wiswall 2016).

Egypt represents a peculiar case where female education attainment has been steadily increasing while female labor force participation has been stagnant (Assaad et al. 2020). Could investment in girls' education be driven by parents' desire to improve their chances in the marriage market? It could be that males looking for potential partners, look to improve the quality of their future children by choosing the most educated female partner they can start a family with. Can that be a determining factor in the quantity-quality tradeoff in this part of the world? The study of family formation and its implications on female employment, within the Q-Q model, can contribute to explaining this paradox. I aim to test these hypotheses by validating the Q-Q model using Egyptian longitudinal data to investigate the relationship between fertility and employment. In addition, modelling the Q-Q tradeoff with longitudinal data will introduce new evidence to test for the existence of gender disparities in parental investment in child education, and could explain changes in the daughter's age at marriage during adulthood.

If the Q-Q tradeoff exists in Egypt, it can influence outcomes in the marriage market. Examining the relationship between fertility decisions by the parents and their daughters' marriage market outcomes as an adult, particularly age at first marriage, can also help explain labor market outcomes for females. In large families, with existing gender differentials in human capital investment, young girls are positioned to potentially early marriages and worse chances in the labor market. That is, given a sizeable Q-Q tradeoff exists, if males are looking for higher quantities of children, they are more likely to have female spouses who are younger and are less educated. This is to ensure that the selected female spouse has a lower opportunity cost to childbearing (as she is less likely to have a higher paying job), and a longer reproductive cycle. In later versions of this paper I aim to extend the analysis to include investigating the effect of fertility on marriage market outcomes.

Considering the political instability in the aftermath of the Arab Spring[i], and economic stagnation due to the Covid-19 pandemic, Egypt is facing major challenges in achieving its development agenda. Studying the determinants of family size informs ongoing government efforts in family planning by quantifying the returns to such policies in terms of human capital. In a developing country with limited fiscal capacity, informing governments on the returns to family planning on health or education can have significant effects on long-term development goals. Along with addressing such questions in Egypt, the proposed research aims to fill the gap of measuring the long-term effects of family size on child education and delve into the potential gender disparities in human capital investment and inequality of opportunity. Results from this research will also instigate further inquiries into how family size during childhood affects female labor force participation and marriage outcomes during adulthood.

The relationship between fertility and human capital formation is highly endogenous and establishing a causal relationship largely depends on measuring an exogenous shock to fertility on education. This exogenous source of fertility variation can also be used to measure long-term effects on marriage and labor market outcomes for females. To identify a causal effect, I use a two-stage least square instrumental variable (TSLS-IV) estimation approach. As an instrument, I use the number of non-singleton children (twins) to predict family size, arguing that it proxies a random shock to fertility, all else equal (J. Angrist, Lavy, and Schlosser 2010; Black, Devereux, and Salvanes 2005; H. Li, Zhang, and Zhu 2008; Mogstad and Wiswall 2016; Rosenzweig and Wolpin 1980).

In the first stage of the IV-TSLS, I obtain an estimate of an exogenous shock to fertility, by estimating the effect of having non-singleton sons and daughters (related to the household head and hereafter referred to as children) on the number of sons and daughters in the household. In the second stage, I first estimate the effect of the predicted exogenous shock (from the first stage) on child education to establish and quantify the Q-Q tradeoff in Egypt. This estimation is also done for both genders, to investigate the existence of any gender differentials. I then change the outcome in the second stage to measure the effect on the probability of female employment in the sample. In this version of the paper, I do this process for the repeated pooled cross-section, and in later version I aim to repeat the estimation using the longitudinal samples of the data.

The two main threats to this identification strategy is first having low sample size (or variation) of non-singleton children, and second is the potential correlation between having non-singleton children and household wealth. The latter threat is mainly due to the cost of in-vitro fertilization (IVF) procedures that may not be affordable to poorer households, and its correlation with having non-singleton children. To address the first threat, I show that there is enough variation across households and years in the probability of having non-singleton children and I also implement robust tests for the relevance of the instrument. However, for the second threat, I find a minimal correlation between household wealth and the probability of having non-singleton children that is not significantly different from zero. To address this potential threat, I control for the natural log of the total wages earned within a household in all model specifications.

In this version of the paper, I present the conceptual framework for modelling the Q-Q tradeoff highlighting the shift from the Malthusian theories on fertility to Becker's model. I then present the research design of the paper, including the data and the empirical framework. I finally present preliminary first- and second-stage results to establish the existence of the Q-Q tradeoff in Egypt, supporting feasibility of such a study, to later be replicated using the longitudinal data.

2 Conceptual framework

Becker's earlier work on the economics of demographic transitions and the non-monotonic relationship between fertility and income has revolutionized the way we analyze fertility choices. This model has been and continues to be a cornerstone in the economic demography literature. Becker's later work (Becker and Lewis 1973; Becker and Tomes 1976; Becker 1981) also helped explain the demographic transition that took place in Western societies. A historical overview of the fertility transition in Western Europe and the US is in Guinnane (2011). The Q-Q model is largely affected by parents' income, the marriage market, female employment and female returns to education (Becker 1981; Doepke 2015; T. P. Schultz 1997). Factors that are uniquely different within households in MENA compared to Western Europe and the US.

Accounting for socioeconomic factors when investigating the determinants of fertility was first introduced by Becker in his seminal paper in 1960. In his early work, Becker's novelty was to introduce the notion that the demand for children can be studied within the framework of consumer durables' demand theories. With the help of consumer choice theory, children can be either a consumption good (increasing utility), a production good (help increase household income after a certain age), or both (Becker 1960; Guinnane 2011). A deciding factor in what households do to maximize their utility from having children, is their quantity- and quality-income elasticity. Children in this model are considered home-produced consumer durables and are normal goods, and thus richer parents have smaller quantity-income elasticity and a larger quality-income elasticity to the demand of children. That is, the higher the income households earn, the less likely they would maximize their utility from children by having more, and the more likely they would from having higher quality children (Becker 1960).

2.1 From Malthus to Becker

Departing from Malthusian theories on fertility, (Becker 1981) sheds more light on how such models fail to explain the sharp decline in fertility in Western Europe and richer countries given resource abundance. The availability of resources can certainly play a role in determining fertility, possibly more so at lower points in the income distribution. It would be however difficult to explain why the demand for children declines in richer households, if not modelling such demand within the framework of the demand for consumer durables. Parents seeking to have children, do so to maximize their utility from this "good", and that utility is not only dependent on the number of children, but rather on the quantity *and* quality of their children. This utility is also a function of other commodities. (Becker 1981) models the utility function of households in terms of child quantity (n), the expenditure on each child – child quality (q), and other consumed commodities (Z) for all other commodities (1, …, m), as follows:

$$U = U(n, q, Z_1, \dots, Z_m) \tag{1}$$

While this model is a more precise depiction of the household utility in terms of children (compared to Malthus which assumes no relevance for child quality), it ignores utility changes during the child's life cycle as well as changes from timings and durations between each birth. For simplification, the budget constraint to the utility function in (1) will be assumed to have constant child quality among all children a family can have. Then this utility is said to be constrained by the following budget:

$$I = p_n n + \pi_z Z \tag{2}$$

Households maximize their utility function in (1), subject to income (I) which in turn is a sum of the products of the cost of childbearing and childrearing (p_n) by the number of children (n), and the amount of commodities (Z) by their associated costs (π_z). With this setup in (1) and (2), the marginal utility conditions would be:

$$\frac{\partial U}{\partial n} \Big/ \frac{\partial U}{\partial Z} = \frac{MU_n}{MU_Z} = \frac{p_n}{\pi_Z} \tag{3}$$

Thus, regardless of child quality, the demand for the number of children (n) is determined by the marginal utility from the number of children relative to the marginal utility from consuming other goods. In other words, with constant income, as the relative price of childbearing increases, the demand for children decreases and the demand for other commodities increase. The determinants in the marginal utility conditions in (3) – cost of childbearing, demand for other commodities, and demand for children – are unmistakably influenced by child and household socioeconomic characteristics as well as other macroeconomic indicators. For example, households with working mothers will expectedly experience higher costs of childbearing. That cost would further increase if the survival of the child required more healthcare expenditure. In developed countries with generous child support, households would incur less costs. There is also other research looking into the feedback from macroeconomic growth and technology and its effect on fertility (Galor 2005b; 2005a; 2012; Galor and Weil 2000)[†]. Further, agricultural households would experience higher returns to the number of children, in turn reducing their associated costs. The size of the effect of agricultural activity within households on the cost of childbearing, can be significantly reduced due to economic reforms and structural transformations (Feng, Cai, and Gu 2013; Krafft 2020).

The utility function in (1) can be modified to account for child quality. Following the same framework from (Becker 1981), the cost of one unit of child quality (p_c) and a measure of child quality (q) can be added to the budget constraint in (2):

$$I = p_c q n + \pi_z Z \tag{4}$$

As such, the utility maximization conditions for (1) subject to (4) would be:

$$\begin{cases} \frac{\partial U}{\partial n} = MU_n = \lambda p_c q = \lambda \pi_n \\ \frac{\partial U}{\partial q} = MU_q = \lambda p_c n = \lambda \pi_q \\ \frac{\partial U}{\partial Z} = MU_Z = \lambda \pi_Z \end{cases} \tag{5}$$

Where now the shadow prices of the number of children (n) and their quality (q) are (π_n) and (π_q), respectively. An important implication of this extended quality model is that the shadow price of child quality (π_q) is affected by both the price of child quality (p_c) and – expectedly – the number of children (n). Meanwhile, the shadow price of child quantity (π_n) is determined by the quality

[†] The model for economic growth was first integrated with fertility in (Barro and Becker 1989).

of children demanded (q) and the cost associated with this quality (p_c). Any exogenous increase in the number of children (n) would increase the shadow price (π_q) of child quality (q), where $\pi_q = p_c n$, thus decreasing the demand for child quality (q). Meanwhile, a decline in the demand for child quality (q), would reduce the shadow price (π_n) of (n), and further increase the demand for the number of children (n), since $\pi_n = p_c q$. The greater the shadow price of child quantity (π_n), the greater the quality of children (q) demanded, and the greater the shadow price of child quality (π_q) the greater the number of children (n) demanded (Becker and Lewis 1973). These adjustments to the household shadow price of child quantity and quality would continue until a new equilibrium is reached. This interaction between child quantity and quality, in the demand for children in (Becker 1981), is what laid the ground for all the empirical research later done on the Q-Q tradeoff.

2.2 Wages and the opportunity cost of children

Another fundamental consideration when studying the household utility and budget constraint in terms of the demand for children, is the interaction between employment (particularly female labor supply) and the budget constraint through wages. (De Tray 1973) generalizes a utility function of the household, while aggregating utility from children into a stock of "child services" (*C*), regardless of the birth duration or the timing of the birth, the household utility function is modelled as:

$$U = U(C, Z) \tag{6}$$

Where (*Z*), denotes the other commodities consumed and produced by the household. Let's assume that this production process of part of (*Z*) is dependent on inputs such as husband's time (t_m), wife's time (t_f), and other market goods or services (*X*). With the efficiency of the production process primarily dependent on the couple's education. Meanwhile, the production of (*C*) is indirectly dependent on the parents' time and other goods and services, it is produced through two home-produced factors, namely child quantity (*N*) and quality (*Q*). Therefore, the production functions of (*C*), (*N*), (*Q*), and (*Z*) can be written as:

$$C = C(N, Q) \tag{7}$$

$$N = N\left(t_{m,N}, t_{f,N}, X_N; \beta, \gamma\right) \tag{8}$$

$$Q = Q\left(t_{m,Q}, t_{f,Q}, X_Q; \beta, \gamma\right) \tag{9}$$

$$Z = Z\left(t_{m,Z}, t_{f,Z}, X_Z; \beta, \gamma\right) \tag{10}$$

Where (β) and (γ) are measures of the husband's and wife's production efficiency, earlier assumed to be education. It is also assumed that there are constant returns to scale in the production of (*C*), (*N*), (*Q*), and (*Z*), and that the income elasticities of the number of children and their quality are equal. Furthermore, it is assumed that households make one lifetime decision on the optimal levels of (*C*), (*N*), (*Q*), and (*Z*). The optimization of the household utility function in (6) is done on the production processes of such goods in (7)-(10) and available resources. That is, optimization subject to the husband's and the wife's time allocated to (*N*), (*Q*), and (*Z*), their respective efficiency (or education), the number of children desired (*N*), the quality of those children (*Q*), market goods and resources, and the amount of available lifetime resources (De Tray 1973).

First, (De Tray 1973) posits a budget constraint for market goods and services (*X*) used in the production of (8)-(10). The expenditure on market goods and services cannot be more than the total available lifetime resources (say total earnings of household members plus any initial endowments). The budget for (*X*) is then:

$$X_c \cdot P_c + X_Z \cdot P_Z \leq Y_m + Y_f + V \tag{11}$$

With (j = *N*, *Q*, and *Z*), then (X_j) and (P_j) are vectors of the amount of goods and services needed for the (jth) production process in (8)-(10) and the per unit price paid for such input. (Y_i) is the lifetime earnings (or wages) for both the husband and the wife (*m* and *f*) and (*V*) is the non-wage initial wealth endowment.

Second, the couples' time is an implicit factor in lifetime earnings (Y_i), and they are constrained in the amount of time allocated to work and household production. Allowing (T_m) and (T_f) to be the time available for the husband and the wife, respectively, for the production of child service (*C*) and commodities (*Z*), both time constraints can then be represented as:

$$\begin{cases} T_m = L_m + t_{m,C} + t_{m,Z} \\ T_f = L_f + t_{f,c} + t_{f,z} \end{cases} \tag{12}$$

Where (L_i) indicates the amount of time allocated to labor by the (ith) household member and ($t_{i,j}$) is the amount of time allocated to the (jth) production process by the (ith) member. Finally, combining both the time and market goods constraints in (10) and (11), the full budget constraint (for the total wealth-*I*) to maximize the utility in (6) can be written as:

$$I = \pi_Z \cdot Z + \pi_C \cdot C = T_m \cdot W_m + T_f \cdot W_f + V \tag{13}$$

Consistently with (Becker 1981), (π_j) is the shadow price of the (j) production process or commodity and (W_i) is the lifetime earnings of both household members. The overall wealth budget constraint in (13) can be used to emphasize the substitution decision households make when choosing between the number of children and their quality, given their wages. More importantly, albeit in its simplest possible form, the relationship in (13) shows how endogenous the demand of children can be to factors such as market wage rates and household and child socioeconomic characteristics. As discussed in (Becker and Lewis 1973; Becker 1981) the effect of the income- and wage-elasticities of the number and quality of children can be ambiguous. This is also shown in the derivation of the percentage change of child service (quantity and quality), based on (13), in the technical appendix of (De Tray 1973).

Becker (1960) explains that in the developed world, fertility declines sharply with increasing income for the poorest households, but only part of that is due to less access or knowledge of birth control. At higher levels of income, the decline of fertility flattens, and starts increasing for the richest households. This non-monotonic relationship between fertility and income was first discussed in (Becker and Tomes 1976). Another detrimental factor in the quantity-quality tradeoff is the expected returns to human capital investment parents, have for their children (Becker, Murphy, and Tamura 1990). This can be seen within black communities in the US (Becker 1975; 1981). At the height of racial segregation, black parents expected less returns to educating their children. With improved returns to human capital investment in black communities, parents would invest more in their children. And as the quality of children increases so would the shadow price of the number of children, in turn reducing fertility (Freeman 1981). Empirical evidence on this argument does support the theory. As black mothers saw better opportunities for their children, they tended to have less children and invest more in their education (Aaronson, Lange, and Mazumder 2014). This ethnic difference in economic prospects and its implication on the Q-Q tradeoff, is more generally applicable to the heterogeneity in the Q-Q tradeoff between poorer and richer households (Becker 1981), and developing and developed countries (T. W. Schultz 1963).

3 Research design

Empirically establishing a causal quantity-quality tradeoff and measuring the size of such effect can be an arduous task. The number of children and child quality are endogenous to household characteristics and the parents' preferences. Having more children can be a financial burden, abating available resources away from investing in a child's education, or equally investing in all children in the same family. Meanwhile, investing more resources in children's education can deter parents from having more children. Thus, most empirical studies causally linking the number of children to child quality build their identification strategy on an exogenous source of variation in fertility. There are two main approaches to achieve this in the Q-Q literature. First, is using exogenous family planning policies (Huang, Lei, and Sun 2020; Huang 2021; B. Li and Zhang 2017; Liu 2014; Qian 2009). Second, is by instrumenting the number of children by using twin births (J. Angrist, Lavy, and Schlosser 2010; Black, Devereux, and Salvanes 2005; H. Li, Zhang, and Zhu 2008; Mogstad and Wiswall 2016; Rosenzweig and Wolpin 1980). Other studies looked in to other sources of exogenous variation such as child height (M. H. Lee 2012) and newborn gender (J. Lee 2008; J. D. Angrist and Evans 1998). In this version of the paper, I use the number of non-singleton children as an exogenous shock to fertility, and in later versions I will supplement the findings by repeating the analysis using the sex composition of current children.

3.1 Data

Using the Egypt Labor Market Panel Surveys (ELMPS), I observe individuals over five rounds of surveys for 20 years (1998 to 2018). The ELMPS provides longitudinal and repeated cross-sectional, nationally representative data and is publicly available through the Open Access Microdata Initiative (OAMDI) from the Economic Research Forum (ERF). The data covers several modules including fertility, labor market, education, gender role attitudes, and agricultural and non-agricultural economic activity for both the refresher sample and the panel sample. The identification strategy employs the number of non-singleton children defined using the month and year of birth of individuals identified as sons and daughters by the household head. Data from the 2022 round of the ELMPS is to be published during October 2024, this data is to be incorporated in the analysis in later versions of the paper. The sample used for analysis in this version of the paper ignores the longitudinal aspect of the data. I treat the entire sample as a repeated cross-section.

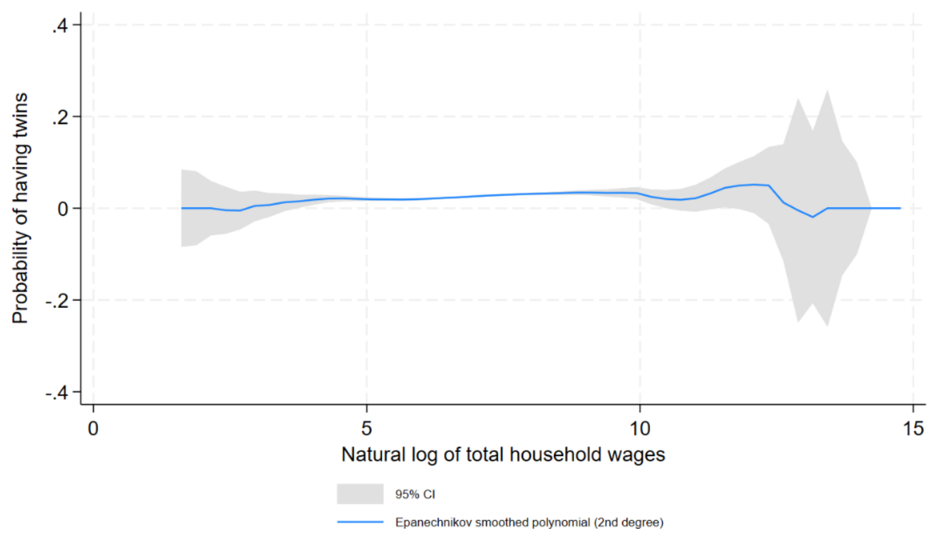
The analysis done in this version of the paper restricts the sample to families with two or more children, as those are the households I expect the instrument to influence (having twins). The unit of analysis in this paper is children of the household head. Using the relationship to the household head variable in the data along with the month and year of birth and the mother's identifier, I am able to identify non-singleton sons and daughters. Table 1 below shows the breakdown of the number of singleton and non-singleton sons and daughters in each of the four rounds in the ELMPS, in all households (not only households with two or more children). Overall, there are 2,227 twins (2.61 percent) out of a total sample size of 85,217 sons and daughters. Notably the number of non-singleton children has been increasing over the years, this could potentially be due to the availability and continuously reduced costs of the IVF technology over the years. Another notable aspect of the data is that the 1998 survey had no fertility module. Thus, there is potential data quality issues in the models using this sample.

Table 1: Non-singleton sons and daughters in the ELMPS

	1998	2006	2012	2018	Pooled
Singletons					
N	12,530	18,063	23,143	29,254	82,990
Mean					
Family size	6.46	5.81	5.28	5.13	5.52
Son/daughter's years of schooling	7.13	7.51	7.16	6.93	7.16
Log of total household wages	5.88	6.44	7.05	7.7	6.94
Twins					
N	197	430	654	946	2,227
Mean					
Family size	6.76	6.36	5.86	5.7	5.97
Son/daughter's years of schooling	6.08	6.36	5.94	6.15	6.13
Log of total household wages	5.78	6.47	7.16	7.75	7.12
All children					
N	12,727	18,493	23,797	30,200	85,217
Mean					
Family size	6.46	5.82	5.3	5.15	5.53
Son/daughter's years of schooling	7.12	7.49	7.13	6.91	7.14
Log of total household wages	5.88	6.44	7.05	7.7	6.94

With only 2.67 percent of the sample being treated, there is potential for the non-singleton instrument to be weak. To address this, I implement weak IV tests to ensure the instrument satisfies the relevance criterion. Another threat to this identification strategy, pertaining to the exclusion restriction, is the correlation between household wealth and the probability of having non-singleton children in the household. This is mainly due to IVF being correlated with having non-singleton children and household wealth. To investigate this relationship, I plot the natural log of the total wages in a household on the probability of having twins. Figure 1 shows the predicted Epanechnikov function for the smoothed polynomial of second degree (i.e., total household wages and its square term). The figure shows that the relationship between household wealth and the probability of having twins is seemingly not significantly different from zero.

Figure 1: Probability of twins and household wealth



To test for the relationship between household wealth and non-singleton children more formally, table 2 shows the OLS estimated regression results of regressing the linear probability of having twins on total household wages in the four rounds of the data and in the pooled sample. The models are estimated controlling for district fixed effects; and the standard errors are robust and clustered at the district level. The results in table 2 show that the relationship between household wealth and having twins in the household is not significantly different from zero.

Furthermore, in the pooled sample, I also present the interacted household wealth variable with the rounds of the survey to test for whether household wealth had any significant association with the linear probability of having twins over time. The coefficients from the estimated regression show that household wealth did not seem to affect the probability of having twins differently over time and is jointly insignificant. The rank of the child also did not seem to affect the probability of having twins in households with six or less children. Similarly, the mother's education and employment status does not seem to influence the probability of having twins, while age and age at first marriage only slightly seem affect the chances of having non-singleton children in the household.

Table 2: Repeated cross-section of twins on household and mother characteristics

	Twins in 1998	Twins in 2006	Twins in 2012	Twins in 2018	Pooled
Child schooling	-0.000	-0.001	-0.001*	-0.001	-0.001**
	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)
Log total HH wages	-0.024	0.012	0.022	-0.002	-0.002
	(0.023)	(0.021)	(0.024)	(0.019)	(0.019)
Log total HH wages squared	0.002	-0.001	-0.001	0.000	0.000
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Mother’s education: read & write	-0.002	-0.018***	-0.002	0.011	-0.003
	(0.006)	(0.005)	(0.008)	(0.012)	(0.004)
Mother’s education: primary	-0.013***	0.003	0.018	-0.015	0.001
	(0.004)	(0.015)	(0.013)	(0.010)	(0.007)
Mother’s education: preparatory	-0.016***	0.049	-0.025*	-0.024**	-0.013
	(0.006)	(0.039)	(0.015)	(0.011)	(0.009)
Mother’s education: secondary	-0.008*	0.011	0.063	-0.008	0.003
	(0.004)	(0.025)	(0.064)	(0.038)	(0.015)
Mother’s education: > intermediate	-0.009	-0.021	0.019	-0.023	-0.002
	(0.007)	(0.014)	(0.039)	(0.023)	(0.018)
Mother’s education: higher institute	-0.013	-0.010			-0.023**
	(0.009)	(0.015)			(0.011)
Mother’s education: university		-0.019			-0.025***
		(0.013)			(0.010)
Mother’s employment: waged irregular job	-0.014	-0.021	0.043	-0.019	0.004
	(0.010)	(0.018)	(0.060)	(0.012)	(0.022)
Mother’s employment: employer	-0.018*	-0.015	-0.001	-0.020	-0.009
	(0.010)	(0.016)	(0.025)	(0.018)	(0.013)
Mother’s employment: self employed	0.054	-0.000	-0.007	-0.006	-0.002
	(0.063)	(0.020)	(0.017)	(0.015)	(0.010)
Mother’s employment: family-non-waged	0.011	0.010	0.002	-0.005	0.002
	(0.021)	(0.019)	(0.016)	(0.012)	(0.008)
Mother’s employment: no job	0.007	0.003			-0.003
	(0.006)	(0.015)			(0.010)
Mother's age	-0.000*	-0.001*	0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Mother's age at first marriage	-0.000	0.001*	0.002***	0.001**	0.001***
	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)
Married mother	-0.007	0.000	0.002	-0.004	-0.001
	(0.007)	(0.006)	(0.006)	(0.010)	(0.004)
Child rank =2	-0.006	-0.005	0.005	-0.000	-0.001
	(0.005)	(0.005)	(0.005)	(0.005)	(0.003)
Child rank =3	-0.005	-0.011**	0.004	-0.001	-0.002
	(0.006)	(0.006)	(0.006)	(0.006)	(0.003)
Child rank =4	-0.003	-0.001	0.007	0.016	0.006
	(0.007)	(0.009)	(0.008)	(0.012)	(0.005)
Child rank =5	-0.013*	-0.011	0.014	0.001	-0.002
	(0.007)	(0.010)	(0.016)	(0.018)	(0.006)
Child rank =6	0.006	-0.016	0.043	-0.029***	0.005
	(0.017)	(0.014)	(0.036)	(0.006)	(0.011)
Child rank =7	-0.017***	-0.029***	0.062	-0.029***	-0.007
	(0.004)	(0.006)	(0.078)	(0.007)	(0.013)
Child rank =8	-0.018***	-0.028***	-0.039***	-0.012	-0.019***
	(0.005)	(0.009)	(0.015)	(0.011)	(0.004)
Child rank =9	-0.020***	-0.018*	-0.079**		-0.019***
	(0.007)	(0.010)	(0.038)		(0.005)
Child rank =10	-0.024**				-0.016***
	(0.011)				(0.005)
Child rank =11	-0.013				-0.015***
	(0.008)				(0.005)
Child rank =12	-0.019**				-0.012**
	(0.010)				(0.006)

Table 2 (continued: Repeated cross-section of twins on household and mother characteristics

	Twins in 1998	Twins in 2006	Twins in 2012	Twins in 2018	Pooled
Child rank =13	-0.025*				-0.009
	(0.013)				(0.007)
Log HH wages X 1998					-0.013
					(0.030)
Log HH wages X 2006					0.015
					(0.028)
Log HH wages X 2012					0.017
					(0.031)
Log HH wages square X 1998					0.001
					(0.002)
Log HH wages square X 2006					-0.001
					(0.002)
Log HH wages square X 2012					-0.001
					(0.002)
Round of the survey=2006					-0.082
					(0.095)
Round of the survey=2012					-0.119
					(0.111)
Round of the survey=2018					-0.040
					(0.102)
Constant	0.104	-0.014	-0.113	0.006	0.053
	(0.069)	(0.070)	(0.088)	(0.077)	(0.070)
Prevalence of twins (%)	0.014	0.021	0.023	0.030	0.023
N	7,107	9,309	10,817	11,729	38,962
R-squared	0.015	0.012	0.017	0.011	0.008

Notes: Robust clustered standard errors at the district level are reported in parentheses. All models include controls for district fixed effects. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

3.2 Empirical framework

There is currently no consensus in the empirical literature causally linking the number of children with child quality outcomes in developed countries, or on the size of such effect if existent (Aaronson, Lange, and Mazumder 2014; J. Angrist, Lavy, and Schlosser 2010; Åslund and Grönqvist 2010; Black, Devereux, and Salvanes 2005; Cáceres-Delpiano 2006; Hanushek 1992; Mogstad and Wiswall 2016). Huang (2021) and H. Li, Zhang, and Zhu (2008), both hypothesize that such mixed findings in richer countries can be attributed to their adequate welfare systems. Currently 28 out of 30 OECD countries provide some sort of tax or transfer incentives to families with children (Mogstad and Wiswall 2016). Furthermore, developed countries typically provide subsidized high-quality education and child support. This in turn can drastically reduce the cost of childbearing and thus potentially eliminating the existence of a Q-Q tradeoff. Also, such government support can drive higher female labor supply as the opportunity cost of childbearing is significantly reduced. In fact, this latter effect can ambiguously influence the tendency to have more children, as child care is a variable cost of working for females, thus invoking both substitution and income effects that often work in opposite signs on the labor supply (Aaronson, Lange, and Mazumder 2014; Doepke 2015). As government support relaxes the household budget constraint in Becker's Q-Q model, the relationship between the number of children and child quality can be ambiguous, depending on labor market outcomes for the mothers.

Aside from egalitarian policies in the developed world, one would expect the quantity-quality tradeoff to be more nuanced in poorer countries. Lower labor market prospects for women and higher chances of child labor in the developing world reduce the opportunity cost of childbearing and increase the returns to having more children, respectively (T. P. Schultz 1997). With more out-of-pocket expenditure on children's education, diminished opportunity costs of childrearing and increasing returns to child labor, the quantity-quality tradeoff would be more apparent in the developing world. Estimating the shadow price of child quantity and child quality is key in understanding these relationships.

To model the shadow prices of child quantity (π_n) and child quality (π_n) in equation (5), I estimate the effect of fertility on completed number of school years, using a TSLS estimator, with a pooled repeated cross-section. Building on Becker and Lewis (1973) and Mogstad and Wiswall (2016), equations (14) and (15) below summarizes the main specification used:

$$N_{iht} = \gamma_{hd} + \gamma_{ht} + \alpha_1 Z_{iht} + \alpha_2 W_{iht} + \alpha_3 X_{it} + \varepsilon_{ht} \tag{14}$$

$$Y_{it} = \gamma_{hd} + \gamma_{ht} + \beta_1 \widehat{N}_{iht} + \beta_2 W_{ht} + \beta_3 X_{it} + v_{ht} \tag{15}$$

Equation (14) is the first stage, where N_{iht} is the number of sons and daughters in household *h* where child *i* lives, at time *t*. Z_{iht} is a binary variable for whether household *h* where child *i* lives, has twins or not, at time *t*. W_{iht} is total wages earned within household *h*, where child *i* lives at time *t*. X_{it} is a vector of control variables including mother characteristics for child *i*, at time *t*. Equation (15) is the second stage, where Y_{it} is child *i*'s years of completed schooling. $\widehat{N}_{iht}$ is the predicted number of sons and daughters from the first stage in equation (14). γ_{hd} are time-invariant unobserved district characteristics where household *h* is located, and γ_{ht} is year fixed effects. ε_{ht} and v_{ht} are the residuals from equations (14) and (15), respectively.

As the instrument *Z* and treatment *N* vary at the household level, the estimated standard errors in both models are clustered at the household level to allow for correlation between unobservables within a household, producing asymptotically valid inference. Controlling for district fixed effects would help eliminate bias from unobserved district0-level characteristics such as school quality and infrastructure.

This TSLS model, estimates local average treatment effects (LATE) of fertility for children in families with 2 or more children, as the treatment is whether the family has twins or not. That is, this model estimates the siblings' weighted average response to the birth of one more child in the family, in terms of schooling years, only for those children whose parents were induced to have an additional child due to the instrument (J. D. Angrist and Evans 1998; J. Angrist, Lavy, and Schlosser 2010). In this model it is reasonable to expect that the number of children in household *h* at time *t* to be autocorrelated with the number of children in the same household at time *t+1*. Furthermore, the unobserved characteristics between households are not homoscedastic. Knowing that the instruments used may suffer from weak relevance, the standard Stock and Yogo (2005) test for weak instrument is not valid. I thus opt for the robust test for weak instruments in Olea and Pflueger (2013). This test for weak instruments is robust to heteroskedastic errors, errors that autocorrelated, and errors that are clustered.

The dependent variable Y_{it}, in the second stage (equation 15) can also be estimated twice for male and female children. Thus, I am able to test whether there exists significant gender differentials in human capital investments made by parents due to fertility. Also, to investigate whether the Q-Q tradeoff has long term effects, the model in equations (14) and (15) is re-estimated with daughters' employment status as the dependent variable in the second stage. This specification tests if whether an exogenous shock to family size would affect labor market outcomes for the daughters. To help understand the relationship between public sector jobs (the female's employer of choice in Egypt) and fertility, I also control for the share of workers employed by the public sector at the district level, as a proxy for public sector jobs' availability.

4 Results

In this section I present preliminary results for the first and second stage using the non-singleton child instrument for families with two or more children. Table 3 shows the results from estimating equations (14) and (15). The first column in each of the samples shows the estimated results from the first stage (equation 14). The coefficient on households with twins ("HH with twins") is the estimated $\hat{\alpha}_1$ in equation (14). The coefficient on the natural log of total wages earned within the household ("Log total HH wages") is the estimated $\hat{\alpha}_2$ in equation (14). The second column in table 3 shows the estimated results from the second stage (equation 15). The coefficient on the number of sons and daughters in a family ("N children") is $\hat{\beta}_1$.

The last two columns in table 3 show the estimated results using the pooled sample. Robust standard errors, clustered at the household level (as treatment and the instrument vary at the household level), are reported in parentheses. All the models include controls for the mother's education, employment status, age, age at first marriage, the birth rank of the child, and district fixed effects. The pooled sample also includes time fixed effects. Table 3 also includes the mean of the dependent variable in the second stage (son or daughter schooling years), the number of observations in the regressions, number of households and number of districts. The effective F-statistic for Montiel Pflueger robust weak instrument test is also reported at the bottom of the table, along with different asymptotic bias fractions (Tau).

4.1 The Q-Q tradeoff

In all rounds of the ELMPS in table 3 (and in other tables with different specifications), the first stage results show that the twins instrument is a strong predictor of the number of sons and daughters in a family (satisfying the relevance criterion), except for 1998. In fact, in all other specifications of equations (14) and (15) the twins instrument in the 1998 round is not significantly correlated with the number of sons and daughters in a family. This is possibly due to the data quality issues in the 1998 round, mainly because it did not include a fertility module. The Montiel Pflueger effective F-statistic for the instrument in 1998 corroborates this finding. In other rounds, however, the twins instrument is strongly relevant to family size and significantly predicts a 0.439, 0.512, and 0.440 increase in siblings in the rounds 2006, 2012, and 2018, respectively. The first stage results are consistent with other similar estimates of the first stage of family size on twins (J. D. Angrist and Evans 1998; J. Angrist, Lavy, and Schlosser 2010). The Montiel Pflueger effective F-statistic for the instrument in the rounds 2012 and 2018 rejects the null that the twins instrument is weak with potential asymptotic bias between 5-10%. The effective F-statistic is even stronger in the pooled sample rejecting the null of a weak instrument with less than 5% bias.

The second stage results of child schooling on the predicted number of siblings show a seemingly negative relationship. The estimated negative $\hat{\beta}_1$, however, is not significantly different from zero in any of the rounds, at the 95% confidence interval. The estimated $\hat{\beta}_1$ in the pooled sample, is significantly different from zero at the 95% confidence interval, predicting a reduction of nearly one year of child schooling due to a family size increase of one child. This result could be due to chance, as I am running several t-tests in table 3 and the following tables. Results from table 3 show that the Q-Q tradeoff in families with two or more children is not statistically significant in Egypt. The results obtained suggest that fertility has no effect on child schooling in Egypt between 1998 and 2018.

4.2 Gender differentials in human capital investment

Tables 4 and 5 show the estimated Q-Q tradeoff for sons and for daughters separately, respectively. The first stage results for both sons and for daughters support the relevance of the twins instrument. Similar to the findings in table 3, there seems to be no significant effect of fertility on the schooling years of sons or daughters. Notably, the model estimates from the pooled sample in table 4 predict a significantly different from zero reduction of the son's schooling years but not the daughter's schooling (the last column in table 4). Assuming this result may not necessarily be a randomly significant estimate of $\hat{\beta}_1$, this shows that there is weak evidence of the Q-Q tradeoff for sons but there is none for daughters.

It is important to interpret the heterogeneity results with caution. The effective F-statistic for sons in the bottom of table 4 for the rounds 1998 and 2006, does not reject the null that the twins instrument is a weak instrument, albeit it has a statistically significant coefficient at the 1% significance level in the 2006 round. In the 2012 round, it only rejects the weak instrument null with less than 20% potential bias. However, in the 2018 round the weak instrument test rejects the null at a potential bias level between 5 and 10%. The twins instrument performance further improves in the pooled sample, with an effective F-statistic rejecting the weak instrument null, with less than 5% potential bias. The twins instrument performs slightly better in the daughters' regressions (table 5), I am able to reject the null of a weak instrument in the 2012 and the 2018 rounds with less than 30% potential bias, and with less than 5% potential bias.

4.3 Fertility and labor force participation

Table 6 shows the estimated results of the effect of fertility on the probability of daughters (who are in the labor force) to be currently employed. The effective F-statistic in table 6 reflects similar instrument performance to the regressions in the tables 3-5. The estimated $\hat{\beta}_1$ in table 6, shows that there is not significant effects of family size on the probability of daughters being employed. This finding is consistent across all rounds of the ELMPS survey. Yet again, the results reported in table 6 must be interpreted with caution. The sample of daughters in families with two or more children who are currently in the labor force, includes only between 4 to 11% who are currently employed. Thus, this a sample of very unlikely to work females.

Another interesting finding from table 7, is that I observe a statistically significant association between the share of workers working in the public sector at the district level and fertility. The first stage results in table 7 show that a 1 percentage point increase in the share of workers in the public sector is associated with a reduction in fertility by 1.5, 2.3, 1.3, and 0.97 children in 1998, 2006, 2012, and 2018, respectively. I also test for whether this effect is jointly significant across the years by interacting the share of public sector workers with the survey round in the pooled sample regression (the second to last column in table 7). The results show that the effect of public sector jobs availability is also jointly significant and has been declining over the years. As for the estimated $\hat{\beta}_1$ in table 7, the results show that fertility has not significant effect on daughters' employment in any of the rounds.

Table 3: Repeated cross-section of twins on child education in families with 2+ children

	N children	Child schooling	N children	Child schooling	N children	Child schooling	N children	Child schooling	N children	Child schooling
	1998		2006		2012		2018		Pooled	
HH with twins	0.201		0.439***		0.512***		0.440***		0.453***	
	(0.175)		(0.117)		(0.101)		(0.077)		(0.054)	
N children		-1.853		-1.152		-1.162*		-0.721		-0.924**
		(2.952)		(0.926)		(0.692)		(0.587)		(0.396)
Log total HH wages	0.066	0.911***	0.092***	0.636***	0.142***	0.445***	0.011	0.207***	0.063***	0.469***
	(0.052)	(0.251)	(0.032)	(0.125)	(0.024)	(0.125)	(0.020)	(0.054)	(0.014)	(0.047)
Mean schooling		7.10		7.57		7.06		6.55		7.04
Observations		6,864		8,931		10,287		11,192		37,274
N households		2,219		3,004		3,932		4,526		13,681
N districts		31		31		35		34		36
R-squared		-0.116		0.155		0.272		0.418		0.275
Montiel Pflueger robust weak instrument test:										
Tau = 5%	37.42		37.42		37.42		37.42		37.42	
Tau = 10%	23.11		23.11		23.11		23.11		23.11	
Tau = 20%	15.06		15.06		15.06		15.06		15.06	
Tau = 30%	12.04		12.04		12.04		12.04		12.04	
Effective F statistic	1.32		14.11		25.47		32.58		70.88	

Notes: Robust standard errors clustered at the household level are reported in parentheses. All models include controls for the mother's education, employment status, age, age at first marriage, the rank of the child by birth date, and district fixed effects. The pooled sample includes time fixed effects. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 4: Repeated cross-section of twins on son education in families with 2+ children

	N children	Son schooling	N children	Son schooling	N children	Son schooling	N children	Son schooling	N children	Son schooling
	1998		2006		2012		2018		Pooled	
HH with twins	0.229		0.437^{***}		0.545^{***}		0.484^{***}		0.489^{***}	
	(0.257)		(0.160)		(0.133)		(0.097)		(0.073)	
N children		-3.542		-1.305		-1.570^{*}		-0.285		-1.045^{**}
		(5.049)		(1.251)		(0.928)		(0.634)		(0.502)
Log total HH wages	0.109^{*}	1.045^{*}	0.116^{***}	0.697^{***}	0.187^{***}	0.546^{***}	0.033	0.284^{***}	0.096^{***}	0.519^{***}
	(0.056)	(0.616)	(0.035)	(0.182)	(0.026)	(0.197)	(0.022)	(0.067)	(0.016)	(0.068)
Mean schooling		7.54		7.84		7.36		6.89		7.37
Observations		3,951		5,218		5,945		6,368		21,483
N households		1,936		2,626		3,254		3,737		11,554
N districts		31		31		35		33		36
R-squared		-1.149		0.108		0.157		0.465		0.238
Montiel Pflueger robust weak instrument test:										
Tau = 5%	37.42		37.42		37.42		37.42		37.42	
Tau = 10%	23.11		23.11		23.11		23.11		23.11	
Tau = 20%	15.06		15.06		15.06		15.06		15.06	
Tau = 30%	12.04		12.04		12.04		12.04		12.04	
Effective F statistic	0.79		7.40		16.69		24.74		45.14	

Notes: Robust standard errors clustered at the household level are reported in parentheses. All models include controls for the mother's education, employment status, age, age at first marriage, the rank of the child by birth date, and district fixed effects. The pooled sample includes time fixed effects. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 5: Repeated cross-section of twins on daughter education in families with 2+ children

	N children	Daughter schooling	N children	Daughter schooling	N children	Daughter schooling	N children	Daughter schooling	N children	Daughter schooling
	1998		2006		2012		2018		Pooled	
HH with twins	0.192		0.446***		0.451***		0.365***		0.404***	
	(0.218)		(0.130)		(0.126)		(0.099)		(0.065)	
N children		1.632		-0.873		-0.835		-1.638		-0.881
		(4.182)		(1.159)		(0.778)		(1.091)		(0.544)
Log total HH wages	-0.005	0.961***	0.061	0.590***	0.094***	0.460***	-0.009	0.110	0.025	0.453***
	(0.063)	(0.155)	(0.039)	(0.134)	(0.030)	(0.125)	(0.025)	(0.082)	(0.017)	(0.052)
Mean schooling		6.50		7.19		6.64		6.10		6.58
Observations		2,913		3,713		4,341		4,823		15,790
N households		1,681		2,244		2,791		3,162		9,878
N districts		31		31		34		34		35
R-squared		0.197		0.226		0.376		0.225		0.296
Montiel Pflueger robust weak instrument test:										
Tau = 5%	37.42		37.42		37.42		37.42		37.42	
Tau = 10%	23.11		23.11		23.11		23.11		23.11	
Tau = 20%	15.06		15.06		15.06		15.06		15.06	
Tau = 30%	12.04		12.04		12.04		12.04		12.04	
Effective F statistic	0.77		11.83		12.76		13.60		38.89	

Notes: Robust standard errors clustered at the household level are reported in parentheses. All models include controls for the mother's education, employment status, age, age at first marriage, the rank of the child by birth date, and district fixed effects. The pooled sample includes time fixed effects. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 6: Repeated cross-section of twins on daughter's labor force participation in families with 2+ children

	N children	Daughter working	N children	Daughter working	N children	Daughter working	N children	Daughter working	N children	Daughter working
	1998		2006		2012		2018		Pooled	
HH with twins	0.221		0.445^{***}		0.451^{***}		0.365^{***}		0.405^{***}	
	(0.214)		(0.130)		(0.126)		(0.099)		(0.065)	
N children		-0.282		-0.024		0.023		-0.022		-0.018
		(0.309)		(0.062)		(0.055)		(0.042)		(0.027)
Log total HH wages	0.006	0.031	0.061	0.014	0.094^{***}	0.014^{*}	-0.009	0.004	0.026	0.012^{***}
	(0.060)	(0.020)	(0.039)	(0.009)	(0.030)	(0.008)	(0.026)	(0.004)	(0.017)	(0.003)
% daughters working		0.08		0.11		0.06		0.04		0.07
Observations		2,920		3,719		4,342		4,819		15,800
N households		1,684		2,245		2,791		3,159		9,879
N districts		31		31		34		34		35
R-squared		-1.827		0.150		0.134		0.065		0.129
Montiel Pflueger robust weak instrument test:										
Tau = 5%	37.42		37.42		37.42		37.42		37.42	
Tau = 10%	23.11		23.11		23.11		23.11		23.11	
Tau = 20%	15.06		15.06		15.06		15.06		15.06	
Tau = 30%	12.04		12.04		12.04		12.04		12.04	
Effective F statistic	1.07		11.78		12.76		13.58		38.99	

Notes: Robust standard errors clustered at the household level are reported in parentheses. All models include controls for the mother's education, employment status, age, age at first marriage, the rank of the child by birth date, and district fixed effects. The pooled sample includes time fixed effects. * p < 0.05, ** p < 0.01, *** p < 0.001.

Table 7: Repeated cross-section of twins on daughter's labor force participation and public sector jobs in families with 2+ children

	N children	Daughter working	N children	Daughter working	N children	Daughter working	N children	Daughter working	N children	Daughter working
	1998		2006		2012		2018		Pooled	
HH with twins	0.232		0.459***		0.436***		0.368***		0.405***	
	(0.211)		(0.128)		(0.124)		(0.098)		(0.064)	
N children		-0.271		-0.026		0.028		-0.022		-0.018
		(0.281)		(0.061)		(0.057)		(0.041)		(0.027)
Public sector jobs (%, district)	-1.518***	-0.337	-2.265***	0.179	-1.260***	0.170*	-0.967***	0.011		
	(0.510)	(0.448)	(0.353)	(0.160)	(0.370)	(0.095)	(0.309)	(0.052)		
Public sector jobs, 1998									-1.829***	0.046
									(0.469)	(0.090)
Public sector jobs, 2006									-2.105***	0.137
									(0.310)	(0.089)
Public sector jobs, 2012									-1.129***	0.148**
									(0.324)	(0.059)
Public sector jobs, 2018									-1.015***	0.013
									(0.277)	(0.045)
Log total HH wages	0.029	0.036*	0.080**	0.013	0.095***	0.013*	-0.007	0.004	0.036**	0.012***
	(0.060)	(0.021)	(0.039)	(0.009)	(0.030)	(0.008)	(0.025)	(0.004)	(0.017)	(0.003)
% daughters working		0.08		0.11		0.06		0.04		0.07
Observations	2,920	2,920	3,719	3,719	4,342	4,342	4,819	4,819	15,800	15,800
N households	1,684		2,245		2,791		3,159		9,879	
N districts	31	31	31	31	34	34	34	34	35	35
R-squared		-1.672		0.149		0.133		0.065		0.131
Montiel Pflueger robust weak instrument test:										
Tau = 5%	37.42		37.42		37.42		37.42		37.42	
Tau = 10%	23.11		23.11		23.11		23.11		23.11	
Tau = 20%	15.06		15.06		15.06		15.06		15.06	
Tau = 30%	12.04		12.04		12.04		12.04		12.04	
Effective F statistic	1.21		12.80		12.28		14.14		40.12	

Notes: Robust standard errors clustered at the household level are reported in parentheses. All models include controls for the mother's education, employment status, age, age at first marriage, the rank of the child by birth date, and district fixed effects. The pooled sample includes time fixed effects. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

5 Conclusion

In expanding the understanding of the Q-Q tradeoff, this study uses evidence from Egypt to test for the existence of such tradeoff and aims to quantify the effect of fertility on education and labor market outcomes. The findings contribute to this discourse by elucidating the nuances of family planning, education, and labor outcomes in Egypt. In this study, I find no significant impact of fertility on child schooling and no significant gender differentials in human capital investment. Contrary to expectations, increasing family size does not significantly affect child schooling in Egypt between 1998 and 2018. In the sample of families with two children or more, sons and daughters had an already low average of 6.5-7.5 years of schooling. The Q-Q tradeoff in Egypt does not appear to explain the low education outcomes in Egypt, nor does it contribute to female labor force participation. Women from larger families did not show significantly different probabilities of being employed.

The absence of significant effects of family size on child schooling, gender differentials, and female employment in the context of a developing country is intriguing. This outcome resonates with findings from developed countries where ample welfare systems diminish the Q-Q tradeoff, which is not the case in Egypt. The findings in this paper suggest that policies focusing solely on family size might not be sufficient to drive significant changes in educational and labor outcomes. Family has already been steadily declining from Family size 6.46 children in 1998 to 5.15 in 2018, yet the average schooling years has been declining within the same period from 7.12 years in 1998 to 6.91 in 2018. This insight is vital for shaping future family planning and educational policies in Egypt. The Q-Q model is built on optimizing the household utility from child quantity and child quality, constrained by a household budget, assuming that sending children to school increases the household utility from child quality. The results in this paper, suggest that other binding constraints such as school quality and returns to education in the Egyptian labor market could be driving child education outcomes and female labor force participation.

The negative significant effect of prevailing public sector jobs on fertility is expected, as public sector employment is the employer of choice for women in Egypt. This increases the opportunity cost of child bearing for women and thus reduces fertility. In fact, the naïve OLS estimates in the first stage results in table 7 for the effect of public sector jobs on family size, albeit likely overestimating, predicts a larger negative effect on family size than the twins instrument. Despite rising female education levels, the stagnation in female labor force participation remains a paradox. This research opens new avenues to explore the role of educational investment in marriage markets and its impact on female labor force participation.

6 Next steps

In the coming months I will be working on cleaning and adding the new 2022 round of the ELMPS survey and analyzing the panel sample in addition to the pooled cross-section. In the panel analysis, I aim to trace adult females back to their childhood fertility decision made by their parents, and examining the effect of exposure to larger family sizes during childhood on marriage outcomes. I will also be performing sensitivity analysis to controlling for other socio-economic indicators of the household. The remainder of the analysis in the paper will be covering the other identification strategy I intend to use which is the gender composition of current children in the family. I plan to do this for several child profiles. I will analyze the effect of the gender composition of the first two children on the probability of having a third child, the first three children on the probability of a fourth, and the first four children on the probability of having a fifth child. I also plan to extend the analysis to include marginal treatment effects (MTE), if the gender composition instrument allows for enough common support. In support of the gender composition identification strategy, I also plan to investigate the existence of sex-selective abortions in the data. Ensuring there is no sex-selective abortion is imperative for the identification of an exogenous shock in fertility through the gender composition of current children. I also aim to estimate a Mincer equation to investigate the effect of fertility on the returns to education on wages for females and males.

7 References & Endnotes

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[i] The Arab Spring is a series of large-scale protests and uprisings in the Middle East and North Africa, in countries including: Tunisia, Egypt, Syria, Libya, and Yemen. The results of such events include the deposing of four regimes in Tunisia, Egypt, Libya, and Yemen.