Journal of Demographic Economics (2022), 1–37
doi:10.1017/dem.2022.17

CAMBRIDGE
UNIVERSITY PRESS

RESEARCH PAPER

Hong Kong wives say no to a big family—educational pairings and fertility in Hong Kong

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(Received 24 August 2021; revised 1 July 2022; accepted 1 July 2022)

Abstract

We used the 2016 Hong Kong Census data and the diagonal reference model to investigate the effects of partners' educational pairings on fertility in Hong Kong. Our findings suggest a negative relationship between couples' educational achievements and their fertility. Moreover, males' educational attainment is more consequential of whether having children or not and both males' and females' educational attainments are determinants of the number of children to raise. In addition, the more educated a wife is relative to her husband, the less likely the couple is to have children. Once these educationally hypogamous couples have at least one child, they tend to have fewer children than their homogamous counterparts. By contrast, couples with a relatively more educated male are more likely to have children and tend to rear more children than those in educationally homogamous marriages.

Key words: diagonal reference model; educational pairing; fertility; Hong Kong

JEL classification: J12; J13; N35; J16

1. Introduction

As with most settings in Asia, mid-20th-century Hong Kong was characterized by high fertility rates, with total fertility rates (TFRs) of above 4.0 births per woman and crude birth rates of around 35–39 per 1,000 until the late-1950s [Basten (2015)]. The dramatic decrease in fertility began in the 1960s and reached a low point of 0.9 children per woman in 2003. More recently, due to the increased migration from mainland China, the TFRs slightly rose to 1.1 in 2019 (The World Bank, 2021). However, such a number is still much lower than the world average of 2.4 children per woman and the TFRs of most developed countries (e.g., the United States recorded a 1.9 TFR in 2019). Therefore, a plethora of research has focused on the general trend of fertility development of Hong Kong [Yip *et al.* (2001)], certain influential factors that result in the lowest-low TFRs [Yi and Zhang (2010)], the public's attitudes toward childbearing [Chan *et al.* (2015)], and the potential measures to boost up the fertility [Leung (2011)]. However, one important area of fertility research is less explored in current studies focusing on Hong Kong, which is partners' educational pairings in influencing fertility decisions. Educational pairings include three types, which are educational homogamy, educational hypergamy, and educational hypogamy. Educational homogamy (or educationally assortative mating) refers to married couples with the same educational attainment. Educational hypergamy indicates a less-educated wife marrying a more educated husband; conversely, educational hypogamy denotes a more educated wife marrying a less-educated husband. Since having children is often a joint decision between the couples, it is interesting to explore how partners' relative bargaining powers would be consequential to the number of children in the family. Therefore, using the 2016 Hong Kong 5% By-census Sample Dataset and employing the diagonal reference model (DRM), this research tackles the question of how couples' educational pairings would affect their fertility decisions.

The connection between education and reproductive behaviors is much researched but remains controversial. In populations living before the demographic transition, a positive association between educational level and the number of children was often observed [Cronk (1991), Gurven and Von Rueden (2006), Skirbekk (2008), Von Rueden *et al.* (2011)], while in developed societies, the correlation tends to be mixed and possibly sex-dependent. Recently, scholars have generally reached the consensus that a strong inverse relation exists between education and completed fertility in postindustrial societies [Kravdal and Rindfuss (2008)]. However, intergender differences also emerged. Among women, the empirical results were often inconclusive, with some pointing to a negative relation [Hank *et al.* (2004), Koytcheva and Philipov (2008), Sobotka (2015)] and others revealing either a positive or U-shaped effect of education on reproductive behaviors [Winkler-Dworak and Toulemon (2007), Jalovaara and Miettinen (2013)]. Among men, the relation can be negative, slightly positive, or U-shaped [Fieder and Huber (2007), Kravdal and Rindfuss (2008), Barthold *et al.* (2012)]. One shortcoming of previous research is the inability to differentiate the effects of a couple's relative educational attainments from their absolute educational attainments on their reproductive behaviors. Previous analysis using either the square additive (SA) approach or the diamond additive (DA) model on this issue was often based on overly strong assumptions, which may bias the results. Employing the DRM, we offer a better option to tackle the challenge.

We organize this paper as follows. First, we briefly review several classical theories on educational pairings and fertility and combine them with the Hong Kong context, which prompts our theoretical hypotheses on couples' combined educational attainments on fertility and their relative bargaining power. Next, we present the data, method, and results. Finally, we discuss the findings.

2. Theories and hypotheses

Existing research has widely explored the association between social status and fertility or economic outcomes and fertility, in which a U-shape relation often exists in developed countries especially [Borg (1989), Boone and Kessler (1999), Skirbekk (2008)]. Tackling the fertility issue from its relationship with couples' educational backgrounds, we further complicate the story by adding more pre-endowed factors that are less susceptible to endogeneity problems, i.e., couple's educational

https://doi.org/10.1017/dem.2022.17 Published online by Cambridge University Press

attainments. We treat education as a non-reversible stock resource often acquired before the partners come together or at least before the birth of their children [Sassler and Goldscheider (2004), Nitsche *et al.* (2018)]. Education can be a more suitable predictor for fertility in two ways. First, educational attainment is already a good predictor for other measurements, such as future income and social status. Second, unlike income which can easily fluctuate and thus more endogenous to the childbearing process, educational attainment is less susceptible to fluctuation and endogeneity issues.

One theoretical contribution of our research is its simultaneous inclusion of both wives' and husbands' endowments into the analysis, which considers their absolute educational attainments compared to all other couples and their relative educational attainments compared to one another. Owing to the DRM, which Michael E. Sobel originally proposed to analyze the movement of social mobility [Sobel (1981, 1985)], our research, for the first time, dissects the relation between educational pairing and fertility in a traditional Chinese society, i.e., Hong Kong.

2.1 New home economics framework

We often see three major theoretical frameworks in research on educational pairing and fertility, which are the micro-economics model by Becker (2009), the "uncertainty reduction" argument by Friedman *et al.* (1994), and the "resource pooling" standpoint by Oppenheimer (1997). From a micro-economic perspective, Becker provided two assumptions to examine marriage as an economic behavior: first, individuals tend to maximize welfare as they conceive it; second, husbands and wives would specialize in some types of human capital differently [Becker (1993)]. While this theory can be gender-neutral, as Becker did not specifically point out the exact types of human capital husbands and wives would specialize in, Becker aligned it with the gender role expectations and unbalanced sex ratios prevailing in education from the mid to late 20th century [Nitsche *et al.* (2018)]. In other words, such a theory denotes that husbands would specialize in breadwinning and wives in caregiving and household management to maximize the gain of marriage. In addition to pricing the labor of couples, children are also assigned a cost as "the effective prices of children rise with the income" [Becker and Lewis (1973)]. Compared to parents with relatively low educational attainment, highly educated couples may find the opportunity cost of having one additional child costlier. The logic here is clear—highly educated parents may forgo more money-maximizing opportunities to raise their kids. At the same time, they tend to have larger anticipated investments in children than parents with fewer resources [Becker (1993)]. In addition, highly educated people might be more inclined to non-traditional family forms, such as embracing postmaterialist values through self-fulfillment and autonomy [Van de Kaa (1987), Lesthaeghe (1998)]. In this way, high educational attainment may result in lower levels of fertility intentions. For example, a cross-country comparison between Austria, Bulgaria, and France shows that homogamous low-educated have, on average, the highest fertility. In addition, the highly educated couples would normally postpone childbearing and have a small number of children in all countries except France—highly educated French partners' completed fertility did not differ much from that of others [Osiewalska (2017)].

As a typical capitalist society with a low level of social welfare, Hong Kong is a city with a particularly strong emphasis on persistent career ethos. Such a working ethos is clearly displayed in both its legal working ages and average working hours. For example,

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as a relatively developed region, Hong Kong still has not set a legal retirement age yet. Since Hong Kong does not have a contribution-based state pension, the city has seen a large group of elders relying on laborious low-skilled jobs to survive. At the same time, the minimum legal working age in Hong Kong is as low as 13 years old. In regard to working hours, based on Kisi's Global Work–Life Balance Index 2021, Hong Kong ranked first among the most overworked cities identified in the research, which is best exemplified by its longest working hours per week. Taken together, we can see that, in Hong Kong, the opportunity cost for not working is unusually high, which might partially explain the ultra-low fertility rate of the city [Basten (2015)]. Against this backdrop, highly educated couples here face a very high opportunity cost for childbearing. We, therefore, hypothesize that:

Hypothesis 1: Among educationally homogamous couples in Hong Kong, the more educated partners have lower fertility levels than those less-educated ones.

Here, we have differentiated between couples who were childless and those who had at least one child. Previous literature has shown the fundamentally different processes involved in deciding to have a first or a higher birth-order child [Ajzen and Klobas (2013), Morales (2020)]. For example, one mechanism for highly educated women to remain childless might be their declining fecundity with age, resulting in involuntary childlessness [Testa (2014)]. Therefore, though having no children in the end might be similar to some less-educated and financially challenging women, highly educated women went through a different channel to arrive at the same ending.

2.2 "Uncertainty reduction" framework

Another theory on educational pairing and fertility, the "uncertainty reduction" framework, yielded similar results to Becker's, but through a different mechanism. Focusing on the less-educated couples, Friedman *et al.* (1994) believe that having children may serve as a strategy to reduce biographical uncertainty for those facing unfavorable employment prospects, i.e., less-educated women are more likely to have children. This theory argues that uncertainty reduction is a universally immanent value that drives the choice of all rational actors, as coined by Friedman's words, "having a child changes life from uncertain to relatively certain" [Friedman *et al.* (1994, p. 383)]. Following Friedman's argument, women with lower education attainments would have fewer and relatively worse career options than their highly educated peers. Then, the former would respond to the unfavorable employment prospects by choosing the "alternative career" of being a mother. They thus perceive motherhood as a strategic choice to restructure an otherwise uncertain life course [Nitsche *et al.* (2018)]. To provide such a choice with an even deeper meaning, McDonald had argued that by having children, less-educated women are able to participate in family life, which at least provides some meaning in life [McDonald (2000)]. At this moment, only a few pieces of empirical evidence can back up the uncertainty reduction theory. For example, in the USA, the poorest women with non-permanent employment may choose to have a child before marriage because motherhood may increase their social status and thus better secure the future [Edin and Kefalas (2005)]. Research in Germany also showed that employment uncertainties might only postpone the childbearing of highly educated females. In contrast, the same situation would accelerate the childbearing process of those with low levels of education [Kreyenfeld (2010)]. When we extend this theory to couples' childbearing behaviors, we can expect couples with two less-educated partners to be the most likely to shift to uncertainty reduction by rearing children. In this way, the uncertainty reduction theory arrives at similar results as Becker's micro-economics model, as showed by hypothesis 1.

2.3 "Resource pooling" framework

As a competing framework for Becker's micro-economics model and Friedman's "uncertainty reduction" theory, the "resource pooling" model proposed by Oppenheimer (1997) arrived at the opposite results for educational pairing. With the increase in the desire to achieve a high standard of living, the specialization model suggested by Becker (1993) might not be the most efficient family model. Unlike Becker, who unintendedly designed females the role of homemaker, Oppenheimer (1988, 1994, 1997) recognized women's growing economic role in family finance and thus emphasized the increasing importance of dual-earner couples. From the gender equality perspective, highly educated women may also have more leverage in soliciting their partner's help or outsourcing domestic work [Kane (1995), Panayotova and Brayfield (1997)]. The reason is simple—a higher level of education is often associated with gender-egalitarian attitudes, especially relating to the men's behaviors within the domestic households [Kravdal and Rindfuss (2008), Esping-Andersen (2009)]. Moreover, an equal share of domestic responsibilities may even reduce the opportunity costs of childbearing between the couple [Torr and Short (2004), Goldscheider *et al.* (2013)]. In this way, getting married is more similar to economies of scale, which provides spillover benefits for both partners [Oppenheimer (1994)]. Therefore, highly educated couples may have higher fertility than couples with lower educational attainment.

Hong Kong has increasingly become a stratified society in which people strive to survive the high living cost, especially the property price. A single breadwinner is often not enough to support the daily expense of a family. While a dual-earner structure is a norm, those better-off ones might still be more likely to have children as they could afford Indonesian or Filipino domestic helpers to take care of household chores. In addition, Hong Kong has retained many traditional Chinese values, especially the cultural norms of the Canton area in mainland China. Traditional Chinese culture emphasizes the continuation of family lines, as shown by the Chinese maxim on childbearing that "having no heir is the gravest offense of filial piety" and "continuing the family line is a mandatory responsibility of couples" [Lee *et al.* (2000)]. Additionally, people believe that children will make a family complete [Adams (2016)]. Research focusing on Chinese couples experiencing sub-fertility in Hong Kong showed that sub-fertile couples often reported feelings of incompleteness, guilt, shame, and isolation from the "fertile" world. Compared to couples with low educational attainment, highly educated couples might be more eager to fulfill this traditional requirement of Chinese culture. Given the fact that highly educated couples are likely to be endowed with more financial resources anyway, we propose the following competing hypothesis to the previous hypothesis 1:

Hypothesis 2: Among educationally homogamous couples in Hong Kong, the more educated partners have higher fertility level than those less educated.

Now we have finished reviewing the theories on the association between partners' absolute educational attainment and fertility. However, even though couples may ultimately negotiate a joint decision on whether to have a child or not, it is possible that, at some point, each spouse calculates the costs and benefits involved in the process. Research that describes marital fertility in terms of solely wives' characteristics or solely husbands' would be consistent with the assumption that one party's preferences are weighted with greater consideration if spouses' private calculations lead to different conclusions about family size. In this way, it is important to consider the relative attribute of each partner to picture the decision of childbearing better.

2.4 Familism in childbearing—the relative importance of couples' educational attainments

Both husbands' and wives' educational attainments would matter for fertility decisions, but the relative importance of their educational attainments may be different [Sorenson (1989)]. As a previous British colony as well as an island imbued with Canton culture, Hong Kong is widely considered a traditional Chinese society under the influence of both modern values and strong patriarchal familism [Yeh *et al.* (2013)]. On the one hand, Hong Kong adopts more modern values, such as interpreting filial behaviors as more of an affection-based repayment toward parents than obedience to external norms and emphasizing more on their individualization over collectivism [Wong and Chau (2006), Ng *et al.* (2007)]. On the other, the Chinese essence is still pronounced in Hong Kong society, exemplified by its son preference for carrying on the family line [Wong (1986)]. Scholars have provided several characteristics to identify countries with strong patriarchal familism, including traditional gender roles, strong family ties, very low out of wedlock births, link to ideology (e.g., Confucianism), mothers as primary caregivers, women taking on household responsibilities, etc. [Anderson and Kohler (2013)]. In contrast, countries with weak familism are characterized by a high degree of individual autonomy, an equal share of housework, etc. Hong Kong has included most of the features of strong patriarchal familism with males playing the more dominant role. Coupled with the still-existing son preference in the society, we hypothesize that:

Hypothesis 3: In Hong Kong, males' educational attainments are more consequential in deciding the couple's overall fertility level.

2.5 Childbearing as a negotiation—educational discrepancy between couples

In addition to the male dominance mentioned above, previous research has also pointed out that in societies with stronger familism, education might result in larger intergender differences in fertility behaviors than in societies with weaker familism. For example, focusing on fertility rates in Europe, scholars have confirmed that relatively more educated females have shown different fertility patterns in Central and Eastern Europe (CEE) from their peers in Northern Western Europe. Compared to the latter, the former has lower fertility if their educational attainments are higher than their husbands' [Osiewalska (2018)]. One explanation is that CEE women, though they are given the same educational opportunity as males, are still under rather traditional family and social institutions. The lack of enough social support may negatively affect females' fertility behaviors. At the same time, we can understand education as a form of bargaining power and marriage as a negotiating process [Upadhyay *et al.* (2014)]. Then, those holding an equal or larger share of resources in the partnership,

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i.e., relatively more educated wives, may have more leverage in negotiating desired outcomes [Wolfe (1960)]. Females in hypogamous combinations have relatively more bargaining powers than their peers in either homogamous or hypergamous combinations. When females do not feel their rights are fully protected in rather traditional social environment, those with relatively more bargaining power, i.e., the more educated wives in hypogamous combinations, may refrain from having children or from having too many children.

In Hong Kong, the TFR has decreased continuously since the early 1980s. "Kong Girl," a concept that has gone viral since the mid-2000s, epitomized the materialism of Hong Kong society. It points to the negative qualities of a materialistic and demanding persona that has become a socially enregistered stereotype [Kang and Chen (2014)], as many females in Hong Kong today defy the traditional role of childrearing and homemaking but somehow still request males to be the major breadwinner of the family. On the one hand, Hong Kong is still a traditional oriental society that values continuing family lines. On the other, individualist females in this city perceive childbearing as threatening their autonomy and self-aspiration. In this way, it is possible that only females endowed with higher leverage could bargain with their partners on having fewer children to maintain a quality life. Therefore, we hypothesize that:

Hypothesis 4.1: In Hong Kong, females tend to have lower fertility levels in educationally hypogamous marriages than their counterparts in either homogamous or hypergamous ones.

Also following the bargaining framework, we would expect those wives with lower educational achievements than husbands to have fewer leverages in domestic chores. In a still traditionally oriental society, males endowed with higher resources are under pressure to continue the family line. Against this backdrop, we hypothesize that:

Hypothesis 4.2: In Hong Kong, males tend to have higher fertility levels in educationally hypergamous marriages than their counterparts in either homogamous or hypogamous ones.

Overall, fertility is a joint decision involving both partners' absolute educational attainments as well as their relative educational attainments. That is, both partners' educational attributes combine to produce an aggregate effect on fertility, and the party endowed with more earning abilities may have a better say in the negotiation. In the case of Hong Kong, having a child seemed to be less important to women than to men since Hong Kong males are under pressure to carry on the family lineage [Chan *et al.* (2015)]. In this sense, Hong Kong society provides a very interesting case in exploring the relative contribution of the partners, whose internal interests might be inherently contradictory.

3. Data and variables

We extracted the data from the 2016 Hong Kong Population By-census 5% Sample Dataset (hereafter the "By-census") provided by the Census and Statistics Department of Hong Kong (hereafter "the Department"). The Department collected full population censuses every 10 years since 1961 and By-censuses in the middle of the intercensal period. The By-census sampled approximately one-tenth of all

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housing quarters in Hong Kong in 2016, and all households therein were included in the inquiry. Thus, the By-census provides a fair representation of the overall demographic picture of Hong Kong.

The By-census did not provide information on the total number of children a woman had given birth to throughout her whole fertility cycle. However, the By-census does provide two types of information on the number of children living in the household: (1) the By-census directly included a variable named CHILD15, which is the "number of children aged under 15 in household," and (2) we could summate the total number of children still living under their parent's household. Though both are not the perfect measurement for the total number of children of a couple, the second measurement is a better choice for our research question. Children in Hong Kong tend to live with their parents until they graduate from college. Thus, the second measurement is much closer to the total number of children of a couple. Therefore, this study only measures children currently living in the household (CHH), not the number of children ever born (CEB) by the couple. Using CHH has two shorting comings. First, the wife might not have completed her whole fertility cycle during the census period, which resulted in an underestimation of her total fertility. Second, married children may no longer live in the same household as their parents and thus are not captured by the census data either. To tackle these two problems, we have only included couples whose wives were between 35 and 52 years old in our analytical sample. We chose the younger limit, i.e., 35, based on the distribution of age-specific fertility rates in Hong Kong in 2016. Table A.1 in Appendix A displays the age-specific fertility rates in Hong Kong in 2016. Thirty-five was the first year when the age-specific fertility rate decreased, implying that most women aged 35 or above had accomplished their reproduction. On the other hand, we chose the older limit, i.e., 52, based on the mean age of mothers at birth. The overall median childbearing age of women having their first births was 31.4 in 2016 [Census and Statistics Department (2017)]. Since most students in Hong Kong graduate with a college degree at the age of 21, we added another 21 years to 31.4 and rounded it to 52 years old. Therefore, our age range best captures a population that had just completed their fertility cycle and was still likely coresiding with their children. To ensure the selected age range is appropriate, we have also conducted a sensitivity analysis with subsamples of selected age ranges (refer to section 5.5).

3.1. Dependent variables

3.1.1 Fertility

Our dependent variable is a couple's fertility, measured as the number of children currently residing in the same household as their parents. We present a couple's fertility in two ways. First, we differentiate between couples with children (coded as 1) and childless couples (coded as 0). Second, we present a couple's fertility by a discrete variable taking on five possible values, which are 0 (zero child), 1 (one child), 2 (two children), 3 (three children), and 4 (four children or more).

3.2. Independent variables

3.2.1 Educational attainment

We have included both husband's and wife's educational attainments in our model. Both are discrete variables taking on six possible values: 1—primary school education or below (including illiterate), 2—1–4 years of secondary school, 3—5–7 years of

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secondary school or other sub-college degrees, 4—bachelor's degree, 5—master's degree; and 6—PhD degree. The original census data have a more detailed educational differentiation. However, to ensure that each educational category and all possible educational pairings would have enough observations, we combined certain categories to fit the model.

3.2.2 Educational discrepancy

Educational discrepancy captures the differences in the educational attainments of the couple. We present couple's educational differences in two ways. The first measurement takes on three possible values, with 1 representing hypogamy, 2 representing homogamy, and 3 representing hypergamy. Hypogamy refers to couples with a more educated wife and a less-educated husband. Hypergamy is the opposite. And homogamy refers to couples consisting of two equally educated partners.

The second measurement further breaks down the first and third categories: 1—the husband's educational attainment is lower than the wife's educational attainment by two levels or more, 2—the husband's is lower the than the wife's by only one level, 3—the husband has the same level of educational as the wife, 4—the husband's is higher than the wife's by only one level, and 5—the husband's is higher than the wife's by two levels or more.

3.3. Control variables

3.3.1 Income

We have included both household income, couples' individual income, and couples' relative income in the model. Household income is the logged monthly household income, which includes earnings in cash from all employment and other cash income for June 2016 of members of the household. Couple's individual income is the logged monthly personal income from all employment. Couples' relative income is an ordinal variable taking on six possible values, which are 1 for the husband having no income, 2 for the husband's income being lower than the wife's income, 3 for the husband's income being equal to or less than 1.5 times of the wife's income, 4 for the husband's income being 1.5 times to less than 2.5 times of the wife's income, 5 for the husband's income being 2.5 times of the wife's income or more, and 6 for wife having no income.

3.3.2 Place of birth

Since we are only interested in exploring the Chinese population in Hong Kong, we have only included Chinese ethnicity in our sample. However, we controlled for the place of birth of these Chinese people, as literature has pointed out that immigrants are more likely to have children than Hong Kong locals [Yip *et al.* (2001)]. Place of birth is a categorical variable taking on three values—1 for Hong Kong, 2 for mainland China, and 3 for others.

In addition, we also controlled for each partner's age, working industry, residential location, and 18 industry dummies.

4. Methodology

One major challenge in our analysis is to separate the effects of educational discrepancy on fertility decisions from partners' absolute educational attainments. The challenge stems from the fact that partners' educational discrepancy is inherently collinear with

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both partners' educational attainments, thus creating the difficulty to simultaneously include both absolute attainments and relative attainments into the model [Zhao and Sun (2021)]. A difficulty of the same nature confronts researchers of social mobility, as mobility is also by definition the differences between two statuses, i.e., one of the origin and one of the destination. In the 1960s and 1970s, scholars have proposed two major approaches to solve the problems, but both had encountered severe criticisms. The first is the SA approach, which assumes that we can attribute any variances unexplained by the baseline linear additive model of status dimensions to status differences. In this way, scholars identify the impacts of status differences as any nonlinearity, including all possible interaction terms, above and beyond the linear effects of only two status variables [Jackson (1962), Duncan (2018)]. However, scholars argue that the SA model could not obtain the pure effects status dimensions, and the interaction terms may conflate the effects of status differences [Sobel (1981)]. Different from the SA model, the DA model uses the sum of status dimensions to account for the main effects, which then makes it possible to identify the effects of status differences [Hope (1975)]. However, in this way, the DA model implicitly assumes that different status dimensions can be combined to form a single measurement of overall status and could not differentiate the effects of status differences and status dimensions [House (1978), Sobel (1981), Hendrickx *et al.* (1993)].

In contrast to the above conventional approaches, the DRM in this research is able to estimate the effects of the couple's educational discrepancy, husband's educational attainment, and wife's educational attainment altogether. It is proposed by Sobel (1981) in the 1980s and is mostly used in research on social mobility [Billingsley *et al.* (2018), Gugushvili *et al.* (2020)]. The DRM is also seen in studies focusing on assortative mating, especially educational assortative mating [Sorenson (1989), Tomás (2011)]. The DRM capturing the relative and absolute effects of partners' educational characteristics on completed fertility relies on a parsimonious and easily interpretable manner below [Sobel (1981), Sorenson (1989)]:

$$Fertility_{ijk} = p \times \mu_{ii} + q \times \mu_{jj} + \sum\nolimits_{1}^{\beta} x_{ijkl} + \sum\nolimits_{m}^{\gamma} z_{ijkm} + \varepsilon_{ijk} \tag{1}$$

where $Fertility_{ijk}$ is the value of the dependent variable, the fertility level of a couple, in cell ij of the DRM table, which has k observations. $p \times \mu_{ii} + q \times \mu_{jj}$ together specifies the influence of the position of husband's educational attainment (i) and wife's educational attainment (j). μ_{ii} is the estimated mean of *Fertility* in the diagonal cell in the row denoting the husband's educational attainment, whereas μ_{jj} represents the estimated mean for the diagonal cell in the column denoting the wife's educational attainment. $\sum\nolimits_{1}^{\beta} x_{ijkl}$ captures the educational discrepancy of the couple. $\sum\nolimits_{m}^{\gamma} z_{ijkm}$ includes all covariates in the analysis. ε_{ijk} represents the robust standard errors applied throughout the models.

To better illustrate the decomposition of $Fertility_{ijk}$ determination, we provide an illustration of DRM in Figure 1. The rows in the table represent the husband's education, and the columns represent the wife's education. The shaded cells in the diagonal line represent *Fertility* of the homogamous couples in the dataset. And those off-diagonal cells would represent *Fertility* of either hypergamous couples (top-right cells) or hypogamous couples (bottom-left cells). For instance, if we want to estimate *Fertility* for those couples composing of a husband with a PhD degree and a wife with primary school education, i.e., cell μ_{61} in Figure 1, we will rely on the information of both μ_{11} and μ_{66}, which together influence the *Fertility* of μ_{61}. μ_{11}

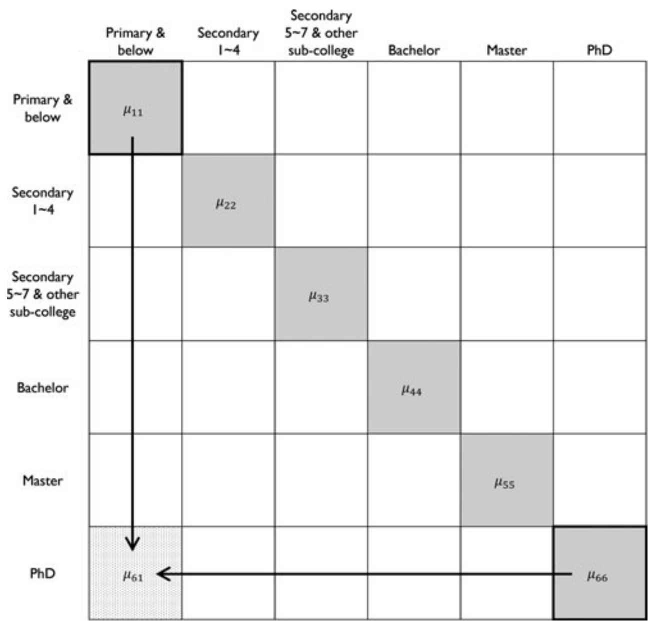

Figure 1. Illustration of DRM.

refers to couples with both primary school education and below, while μ_{66} represents couples composed of two PhD holders.

To accurately decompose $Fertility_{ijk}$ by two factors, we need to know the relative importance of the two homogamous cells involved. Here we introduce p, a weight parameter to estimate the strength of the husband's educational attainment in *Fertility* of a couple. p lies in the interval [0, 1]. q is also a weight parameter, which is to estimate the strength of the wife's educational attainment in *Fertility* of a couple. q also lies in the interval [0, 1]. In addition, p and q sum up to 1:

$$p + q = 1, \ p \in [0, \ 1] \tag{2}$$

The diagonal intercepts, combined with the two weight parameters, allow us to specify a cell-specific intercept for each off-diagonal cell in the DRM table [Sobel (1981), Van der Waal *et al.* (2017)]. For example, a p-parameter that equals to 1 would imply that the wife's educational attainment would have no effect on the fertility rate of the couple while the husband's educational attainment would singularly determine the family's fertility. In contrast, a p-parameter that equals 0.5 would create an intercept for each off-diagonal cell between the diagonal intercepts in the column and the role in which this off-diagonal cell is located. For example, if the p-parameter equals 0.6, then the intercept for the cell μ_{61} would equal $0.6 \times \mu_{11} + 0.4 \times \mu_{66}$. 0.4 is the q-parameter obtained by subtracting p from 1.

In addition to separating the effects between absolute and relative educational attainments, another challenge in our research is finding inter-group differences between the two weight parameters. One advantage of DRM is its ability to allow the p and q to vary for different groups [Sobel (1981), Sorenson (1989), Jin *et al.*

(2019)]. Incorporating couples with different conditions of educational pairing, we have the following formulas:

$$Fertility_{ijk} = (p + \sum_{l}^{p} x_{ijkl}) \times \mu_{ii} + (q + \sum_{l}^{q} x_{ijkl}) \times \mu_{jj} + \sum_{1}^{\beta} x_{ijkl} + \sum_{m}^{\gamma} z_{ijkm} + \varepsilon_{ijk} \quad (3)$$

$$p_l + q_l = 0, \; p_l \in [-1, 1] \quad (4)$$

$$(p + p_l) + (q + q_l) = 1 \quad (5)$$

where p_l and q_l indicate the differences in the relative salience of partners' educational attainments between the two groups of non-homogamy (hypergamy and hypogamy) and homogamy. That is, p and q are the weights for the husband's educational attainment and wife's educational attainment for homogamous couples; $p + p_l$ and $q + q_l$ are the weights for the husband's educational attainment and the wife's educational attainment for the other two educationally discrepant groups, i.e., the hypergamous couples and the hypogamous couples. We obtained the DRM estimates with the DRM module in Stata. Refer to Kaiser's (2018) manual for detailed operation.

It is also relevant to mention that the DRM is only suitable for situations in which education is in the same direction with fertility for both husbands and wives. The DRM only produces one set of coefficients to indicate the relationship between educational levels and fertility and two weights to indicate the relationship importance of husbands' and wives' characteristics. It does not work well if education has opposite relation to fertility between genders. Using the ordinary least squares (OLS) model,[1] we empirically tested that education negatively correlates with fertility for both genders, as shown in Table B.1 in Appendix B. One may question whether the relationship between couples' educational attainments and fertility is monotonic. Previous research in similar contexts has shown that the relationship might not be nonlinear and sometimes nonmonotonic. For example, De la Croix and Delavallade's article on the relationship between education and fertility in Southeast Asian countries shows that such a relation can be nonmonotonic [De la Croix and Delavallade (2018)]. Similar findings are also available in Myong *et al.*'s (2021) article on South Korea and Baudin *et al.*'s (2020) article on developing countries. Fortunately, DRM does not require this relation to be monotonic or linear. DRM treats couples' educational attainments as categorical variables. In addition, various previous studies have shown that the relationship between education and fertility does not need to be monotonic to apply the DRM [Sobel (1981), Sorenson (1989), Billingsley *et al.* (2018)]. Therefore, the DRM is suitable for our study.

5. Results

5.1. Fertility and selected sample characteristics

Table 1 reports descriptive statistics of the dependent, independent, and selected control variables of our analysis. The analytical sample contains 32,028 couples in total. In terms of couples' fertility, 79.79% of the married couples in our sample have at least one child living in the household. The mean number of children living in the household is 1.30. The mean logged household income is 10.46. And the mean

[1]As for the probability of whether having children or not, we also relied on OLS to obtain the linear probability.

Table 1 Descriptive statistics on selected variables ($N = 32{,}028$)

Variables	Mean (SD) or %
Dependent variables	
Whether have at least one child	79.79
Number of children in the family	1.30 (0.88)
Independent variables	
Educational attainment	
Husband's educational attainment	
Primary school/below	11.53
Secondary school 1–4	25.62
Secondary school 5–7/sub-college degree	37.41
Bachelor	17.13
Master	7.39
PhD	0.91
Wife's educational attainment	
Primary school/below	9.69
Secondary school 1–4	24.17
Secondary school 5–7/sub-college degree	44.23
Bachelor	16.34
Master	5.18
PhD	0.38
Educational discrepancy	
3 categories	
Husband < Wife	24.3
Husband = Wife	50.25
Husband > Wife	25.45
5 categories	
Husband < Wife by 2 levels or more	4.78
Husband < Wife by 1 level	19.52
Husband = Wife	50.25
Husband > Wife by 1 level	20.27
Husband > Wife by 2 levels or more	5.18
Income	
Logged household income	10.46 (0.99)
Logged husband's income	8.68 (3.48)
Logged wife's income	6.02 (4.78)

(*Continued*)

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Table 1 (*Continued.*)

Variables	Mean (SD) or %
Income discrepancy	
Husband no income	**7.96**
Husband:wife = (0, 1)	**21.38**
Husband:wife = [1, 1.5)	**13.45**
Husband:wife = [1.5, 2.5)	**10.95**
Husband:wife ≥ 2.5	**8.07**
Wife no income	**38.19**
Control variables	
Age	
Husband's age	**48.65 (7.84)**
Wife's age	**44.09 (5.16)**
Place of birth	
Husband's place of birth	
Hong Kong	**69.77**
Mainland China	**28.09**
Others	**2.14**
Wife's place of birth	
Hong Kong	**56.51**
Mainland China	**40.81**
Others	**2.68**
Residential location	
HK Island	**15.14**
Kowloon	**29.67**
New Territory or others	**55.19**

logged incomes for husband and wife are 8.68 and 6.02, respectively. The distribution for income discrepancy between couples is 7.96% for husbands with no income, 21.38% for husbands having less income than their wives, 13.45% for husband's income being equal to or 1.5 times of wife's income, 8.07% for husband's income being 2.5 times or higher than wife's income, and 38.19% for wives with no income. The husband's mean age is 48.65, and the wife's mean age is 44.09. The majority of the husbands in the sample were born between 1960 and 1969 (45.73%), while most wives were born between 1970 and 1979 (53.4%). In total, 69.77% of the husbands in the sample were born in Hong Kong, while that of the wives was only 56.51%.

Table 1 and Figure 2 display the distribution of husband's and wife's educational attainment. Though educational attainment is an ordinal variable, we nevertheless showed that the level of the husband's educational attainment is significantly higher

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than that of the wife's ($\Delta = 0.017$, $t = 3.23$, $p < 0.0005$). As shown in Figure 2, the two distributions are different mainly at the secondary 5–7/other sub-college degree level. More specifically, wives tend to concentrate in the secondary 5–7/other sub-college degree, while displaying a lower percentage in all other levels of educational distribution. The husbands in the couple, in contrast, are more spread out at both ends, i.e., a higher percentage in secondary 1–4 and below and higher percentage in above-secondary level as well. In our sample, the composition of hypogamy, homogamy, and hypergamy is 24.3%, 50.25%, and 25.45, respectively. A further breakdown of the educational discrepancy shows that 4.78% of the couples with husbands' educational attainment is lower than wives' by two levels or more, 19.52% is lower by one level, 20.20% of the couples with husbands' educational attainment is higher than wives' by one level, and 5.18% by two levels or more.

We then move to Figure 3, which shows the joint distribution of couples' educational attainment in our analytical sample. The diagonal shaded cells represent the homogamous couples. Comparing cells in the diagonal line to other off-diagonal cells, we can easily infer that homogamy is still the dominant mating pattern in Hong Kong. When the highest educational attainment of the couples is secondary-level or below, there are more hypogamous couples than hypergamous couples. However, when the highest educational attainment of the couples is above the secondary level, the comparison is shifted.

5.2. Couple's educational attainments and fertility

Model 2.1 in Table 2 reports the results from logistic DRM with whether having children living under the household as the dependent variable. Model 2.2 in Table 2 reports the results from linear DRM, whose dependent variable is the number of children in the household. The DRM produces weights to indicate the relative importance of the husband's and wife's educational attainments in influencing the couple's fertility decisions. These weights, labeled p for husband's educational attainment and q for wife's educational attainment, are presented in Table 2. In model 2.1, p ($\beta = 0.65$, $p = 0.004$) is statistically significant at 1% level, while q is not statistically significant. This indicates that the husband's educational attainment is consequential to a couple's decision of whether to have children and the wife's educational attainment is not too important in this case. Differently, in model 2.2, both p ($\beta = 0.44$, $p = 0.000$) and q ($\beta = 0.56$, $p = 0.000$) are statically significant at 1% level, indicating that both partners' educational attainments are consequential to the number of children at the household. The coefficients for p and q in model 2.2 are approximately the same size, and the weight difference ($\Delta w = p - q$) is not statistically significant. This shows that the levels of importance for both parents in determining the number of children in the family are similar.

Table 2 also shows the estimated mean fertility levels for homogamous couples in the sample when the control variables take on the value of zero. As shown in models 2.1 and 2.2, homogamous couples can generally observe a negative gradient between the couple's educational attainments and the likelihood of having children and between the couple's education attainments and CHH. In this way, we support hypothesis 1, which states that among homogamous couples in Hong Kong, the more educated couples are both less likely to have children and are likely to have fewer children than those less-educated ones. At the same time, we rejected hypothesis 2.

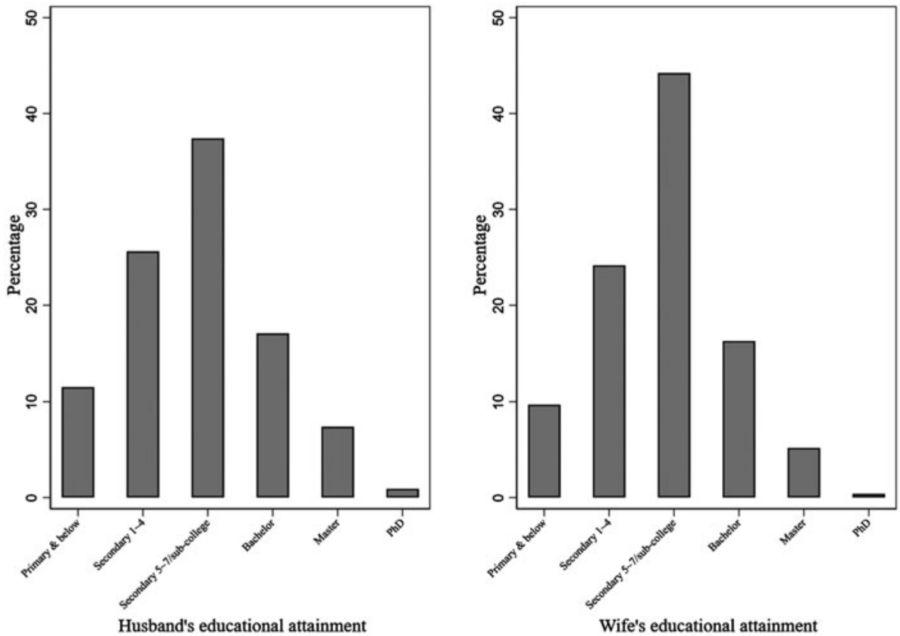

Figure 2. Distribution of husband's educational attainment and wife's educational attainment.

5.3. Relative importance of couples' educational attainments

While we have obtained the general weights for husband's and wife's educational attainments in influencing fertility, the partners under different types of educational pairings may display different intergroup weights. In other words, the level of familism may differ with couples' relative educational attainments. Table 3 displays the results for educational discrepancy and fertility with interactive weights. Models 3.1 and 3.2 display the respective weights p and q for different types of educational pairing on a couple's fertility. Model 3.1 shows that, for both hypogamous ($\beta = 1.00$, $p = 0.002$) and homogamous couples ($\beta = 1.00$, $p = 0.000$), husband's educational attainment is influential in determining whether the household would have children. For hypergamous couples, the importance of the husband's educational attainments in whether to have children is relatively weakened ($\beta = 0.59$, $p = 0.063$). The q in model 3.1 is not significant, implying that wives' educational attainments in any type of educational pairing are not so consequential to whether having children or not. Therefore, we can observe the strong influence of familism in Hong Kong society.

Unlike the results in whether to have children or not, once the couple decides to have children, both partners' educational attainments are influential in determining the number of children to have. Model 3.2 reports that p and q are statistically significant at 1% level for all three types of educational pairings. We also observed that, as shown in Figure 4 as well, along with the increase in the husband's relative educational attainment, his weight gets more influential in deciding the number of children to have ($0.51 < 0.54 < 0.58$). Along with the fact that hypergamous couples are likely to have more children than hypogamous couples, we may infer that the higher the relative educational attainment a husband has, the higher likelihood of

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		Wife's educational attainment						
		1	2	3	4	5	6	
		Primary & below	Secondary 1~4	Secondary 5~7 & other sub-college	Bachelor	Master	PhD	Total
1	Primary & below	1,343	1,446	840	52	11	0	3,692
2	Secondary 1~4	1,142	3,818	2,928	276	42	1	8,207
3	Secondary 5~7 & other sub-college	567	2,202	7,614	1,323	259	18	11,983
4	Bachelor	35	226	2,124	2,542	527	32	5,486
5	Master	17	50	601	937	733	29	2,367
6	PhD	1	0	58	103	88	43	293
	Total	3,105	7,742	14,165	5,233	1,660	123	**32,028**

Figure 3. Joint distribution of couple's educational attainment.

raising more children in the family. Similarly, the importance of the wife's educational attainment also increases along with the increase of her relative education (0.42 < 0.46 < 0.49). Since wives are likely to have fewer children when they have relatively higher educational attainments, we could infer that the higher the relative educational attainment a wife has, the higher the likelihood of raising fewer children. Figure 4 also shows an interesting trend of p and q, in which p and q would increase along with the increase of relative educational attainment of husband and wife respectively. However, at the same time, p is always larger than 0.5, and q is always smaller than 0.5. This implies that even if females would become more consequential in terms of fertility level along with their increase in relative educational level, their deciding role is still weaker than that of the males. This further corroborates that familism is still prevalent in Hong Kong society. However, it is important to note that both husbands and wives, the increase in importance in relation to their respective educational attainments, represented by ρ $(\rho = p_2 - p_1 = p_3 - p_2 = -(q_2 - q_1) = -(q_3 - q_2))$, is not statistically significant. This indicates that while we may observe a positive trend in educational attainment and bargaining power, the actual increase might be minimal.

In sum, the p-parameters in Tables 2 and 3 are all statistically significant. Especially in deciding whether a couple should have children or not, the husband's educational achievement is much more influential. Therefore, we support hypothesis 3.

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Table 2 Couple's educational attainments and fertility

	Whether have children		Number of children	
	Model 2.1		Model 2.2	
Variables	Coef.	S.E.	Coef.	S.E.
Weights for couple's educational attainment				
p (husband's educational attainment)	0.65***	(0.22)	0.44***	(0.05)
q (wife's educational attainment)	0.35	(0.22)	0.56***	(0.05)
Weight difference ($\Delta w = p - q$)	0.30	(0.45)	−0.11	(0.10)
Educational attainment				
1 Primary or below	0.25***	(0.07)	0.22***	(0.02)
2 Secondary 1–4	0.18***	(0.06)	0.03*	(0.02)
3 Secondary 5–7/other sub-college	−0.01	(0.06)	−0.06***	(0.01)
4 Bachelor	−0.17***	(0.05)	−0.04***	(0.02)
5 Master	−0.10	(0.09)	−0.06***	(0.02)
6 PhD[a]	−0.14	(0.17)	−0.08	(0.05)
Control variables				
Logged household income	0.20***	(0.02)	0.12***	(0.01)
Logged husband's income	0.07***	(0.02)	−0.02***	(0.01)
Logged wife's income	−0.03	(0.03)	0.002	(0.01)
Income discrepancy *(ref: Husband:wife = [1, 1.5))*				
Husband no income	0.12	(0.09)	−0.08***	(0.03)
Husband:wife = (0, 1)	−0.10**	(0.05)	0.01	(0.01)
Husband:wife = [1.5, 2.5)	0.02	(0.06)	0.03*	(0.02)
Husband:wife ≥ 2.5	0.13*	(0.07)	0.08***	(0.02)
Wife no income	0.27	(0.37)	0.12	(0.10)
Husband's age	−0.02***	(0.003)	−0.004***	(0.001)
Wife's age	−0.002	(0.004)	0.01***	(0.001)
Husband's place of birth *(ref: Hong Kong)*				
Mainland China	0.43***	(0.04)	0.17***	(0.01)
Others	0.02	(0.10)	−0.02	(0.03)
Wife's place of birth *(ref: Hong Kong)*				
Mainland China	0.56***	(0.04)	0.05***	(0.01)
Others	0.17*	(0.09)	0.06**	(0.03)
Residential location *(ref: Hong Kong Island)*				
Kowloon	−0.23***	(0.05)	−0.05***	(0.01)

(*Continued*)

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Table 2 (*Continued.*)

Variables	Whether have children		Number of children	
	Model 2.1		Model 2.2	
	Coef.	S.E.	Coef.	S.E.
New Territory and others	−0.20***	(0.04)	−0.02	(0.01)
Industry FE	Yes		Yes	
Observations	32,028		25,562	

Robust standard errors in parentheses
[a]As shown in Figure 3, the total number of PhDs in the dataset was very tiny. Thus, we need to be careful if we interpret the results of the PhDs as they might not be very robust.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table 3 Educational attainments and fertility with interactive weights

Variables	Whether have children		Number of children	
	Model 3.1		Model 3.2	
	Coef.	S.E.	Coef.	S.E.
Educational discrepancy (3 categories; ref: Husband = Wife)				
Husband < Wife	−0.15***	(0.05)	−0.04***	(0.01)
Husband > Wife	−0.0004	(0.05)	−0.01	(0.01)
Weights for couple's educational attainment				
Husband < Wife				
p_1 (husband)	1.00***	(0.52)	0.51***	(0.11)
q_1 (wife)	0.00	(0.52)	0.49***	(0.11)
$\Delta w_1 = p_1 - q_1$	1.00**	(1.04)	0.02	(0.21)
Husband = wife				
p_2 (husband)	1.00***	(0.26)	0.54***	(0.06)
q_2 (wife)	0.00	(0.26)	0.46***	(0.06)
$\Delta w_2 = p_2 - q_2$	1.00**	(0.52)	0.08	(0.12)
Husband > Wife				
p_3 (husband)	0.59*	(0.32)	0.58***	(0.12)
q_3 (wife)	0.41	(0.32)	0.42***	(0.12)
$\Delta w_3 = p_3 - q_3$	0.18	(0.64)	0.16	(0.24)
ρ			0.03	(0.09)
Observations	32,028		25,562	

Robust standard errors in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

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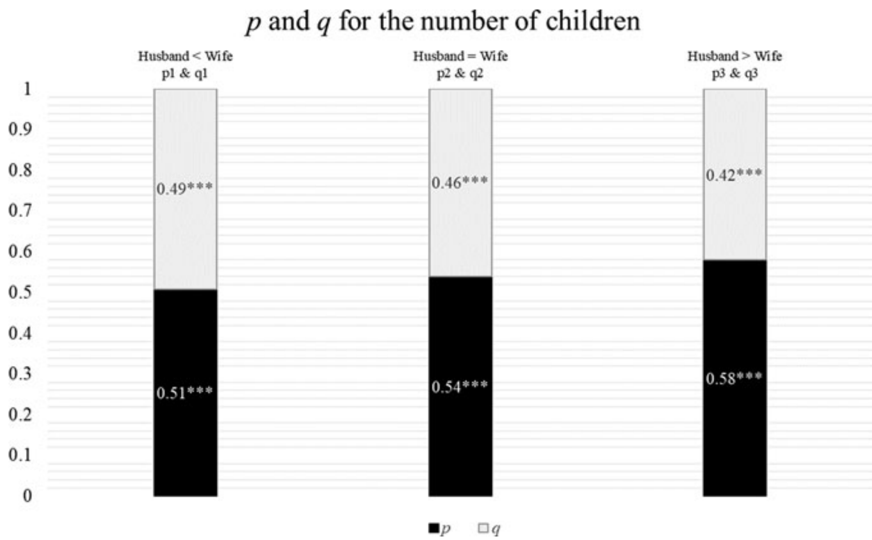

Figure 4. Weights of husband's educational attainment (p) and wife's educational attainment (q) for different conditions of educational discrepancy.

5.4. Couple's educational discrepancy and fertility

To assess the effects of an educational discrepancy, we added a categorical variable representing different levels of the educational discrepancy between couples to DRMs for fertility levels in Table 4. Model 4.1 shows a clear difference between the likelihoods of having children for specific educational pairings. The main effects of p and q in model 4.1 are similar to those in model 3.1, in which males play a dominant role in deciding whether to have children or not. Overall, hypergamous couples are more likely to have children than homogamous couples, who are more likely to have children than hypogamous couples. More specifically, among the five categories, couples with husbands being less educated than wives by two levels or more are the least likely to have children ($\beta = -0.57$, $p = 0.024$), followed by couples with husbands being less educated than wives by only one level ($\beta = -0.22$, $p = 0.074$). Couples with husbands being more educated than wives by two levels or more are the most likely to have children ($\beta = 0.42$, $p = 0.108$), followed by couples with husbands being more educated than wives by only one level ($\beta = 0.22$, $p = 0.064$).

We then move to model 4.2, which shows the number of children in a household. The main effects of p and q in model 4.2 are of similar magnitudes, which are in line with the results in model 3.2. As shown by the negative and statistically significant coefficients for the two groups of hypogamy ($\beta = -0.09$, $p = 0.000$; $\beta = -0.04$, $p = 0.003$), the more educated a wife is than her husband, the fewer children the couple is likely to have ($-0.09 < -0.04$). At the same time, homogamous couples are not too different from hypergamous couples in terms of the number of children in the household, as the corresponding coefficients are not statistically significant.

Taken together, we can observe that one's relative educational attainment is positively correlated with his/her bargaining power in the marriage. The more educated a female is in relation to her husband, the lower the fertility level of the couple in relation to the homogamous combination. In contrast, the more educated a

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Table 4 Educational discrepancy and fertility

	Whether have children		Number of children	
	Model 4.1		Model 4.2	
Variables	Coef.	S.E.	Coef.	S.E.
Educational discrepancy (5 categories; ref: Husband = Wife)				
Husband < Wife by 2 levels or more	−0.57**	(0.25)	−0.09***	(0.02)
Husband < Wife by 1 level	−0.22*	(0.12)	−0.04***	(0.01)
Husband > Wife by 1 level	0.22*	(0.12)	−0.002	(0.01)
Husband > Wife by 2 levels or more	0.42	(0.26)	−0.02	(0.02)
Weights for couple's educational attainment				
p (husband's educational attainment)	1.00**	(0.91)	0.58***	(0.06)
q (wife's educational attainment)	0.00	(0.91)	0.42***	(0.06)
Weight difference ($\Delta w = p - q$)	1.00*	(1.82)	0.16	(0.13)
Observations	32,028		25,562	

Robust standard errors in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

male is in relation to his wife, the higher the fertility level of the couple in relation to the homogamous combination. Therefore, we support both hypotheses 4.1 and 4.2.

5.5. Sensitivity analysis

As mentioned before, due to data limitations, we used CHH instead of CEB in the analysis. To ensure that results are not overly sensitive to the chosen age range, we conducted a robustness check by recalculating all the models on sub-samples with various age limits. We chose the following sub-samples: wives aged 35–45, 38–48, 40–50, and 42–52. Models C2.1.1–C4.2.4 in Appendix C present the findings corresponding to those in models 2.1–4.2 in the main analysis. The results in the sensitivity analysis are generally in line with those in the main analysis, in which higher educational attainments are negatively correlated with couples' fertility, males still play a more dominant role in deciding whether to have children or not, and a more educated wife would result in comparatively lower fertility for the couple.

6. Conclusion and discussion

This research identifies and quantifies how educational discrepancy among Chinese couples in Hong Kong would influence their fertility. The empirical results are in line with Becker's New Home Economics framework and the "uncertainty reduction" framework, which predict a reverse relation between couples' educational achievements and their fertility. In addition, we explored the relative importance of couples' educational attainments in influencing their fertility. In general, males' educational attainment is more consequential for whether to have children in the

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family or not, and both males' and females' educational attainments are influential factors for the number of children to raise. We can also observe that Hong Kong is a modern society with a certain influence of familism, as males' educational attainments are generally more consequential to the fertility level of the family. Within expectation, females in Hong Kong are less keen to have children than their male peers. The more educated a wife is relative to her husband, the less likely for the couple to have children. In case they do, they tend to have fewer children than their homogamous counterparts. Such a trend is reversed for males, as couples with a relatively more educated male are more likely to have children and are likely to have more children. Taken together, our results are similar to previous research focusing on traditionally western society, in which higher education indicates a rather low fertility level for couples. And for both genders, education displays a negative relation with fertility. A less mentioned point in previous research is males' still relatively dominant role in fertility levels. Our explanation is that Hong Kong is a still rather traditional society that emphasizes males' role in carrying on the family, which is the initial reason for raising our curiosity about this topic.

Our research has both academic and social importance. Although a few studies have also used the DRM to analyze couples' educational attainment and fertility [Sorenson (1989), Uchikoshi (2018)], previous studies had either focused on western countries or had only explored the fertility of homogamous couples. In this way, by using a regionally representative dataset, our research is the first one using a quantitative method to explore educational pairing and fertility in a non-western region. The negative gradient in the relationship between a couple's overall educational attainment and fertility shows that the "ultra-low fertility" trend in Hong Kong is still continuing [Basten (2015)]. The rise in females' social status in a traditional society with strong familism is stressful. Females only slightly increase their own importance when they are much more educated than their husbands. Otherwise, males still tend to dominate the fertility decision in a household. In this way, females still do not enjoy the same social position as their male peers in Hong Kong.

Our research is with limitations as well. First and foremost, as explained under section 3, we could not obtain the accurate number of children a couple gave birth to, which may lead to inaccurate estimation. Second, due to the uneven distribution of the couples in the DRM table (see Figure 3), we only obtained a few or even zero observations in certain cells. Too few observations in certain cells may result in the inability to estimate the model. Fortunately, we have a relatively large sample size which helps the convergence of the estimation. Future research may want to further expand this topic by incorporating more factors, e.g., time trend and inter-cohort differences, into the model to depict a more comprehensive picture of the relationship between partners' educational pairing and fertility.

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/dem.2022.17.

Acknowledgments. The authors gratefully acknowledge the funding support of the Beijing Office for Education Sciences Planning (Grant No. 3030-0001). The authors thank the anonymous reviewers and the journal editors for the constructive comments. The authors also acknowledge the Census and Statistics Department of Hong Kong for the census data. The codes used in the analysis can be found in the online Supplementary material.

Conflict of interest. The authors declare none.

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Appendix A: Age-specific fertility rates in Hong Kong, 2016

Table A.1 Age-specific fertility rates in Hong Kong, 2016

Age of mother	Fertility rate (number of live births per 1,000 women)
15	0.5
16	0.7
17	1.9
18	3.8
19	5.5
20	8.7
21	12.1
22	16.2
23	21.4
24	30.2
25	37.8
26	46.5
27	57.8
28	70.8
29	80.6
30	84.5
31	96.9
32	96.7
33	93.1
34	93.4
35	78.8
36	70.1
37	57.3
38	43.3
39	35.0
40	23.7
41	15.8
42	10.0
43	5.8
44	2.9
45	1.6
46	0.8

(*Continued*)

Table A.1 (*Continued.*)

Age of mother	Fertility rate (number of live births per 1,000 women)
47	**0.4**
48	**0.2**
49+	**0.2**
Total	**1,205**

Source: Demographic Statistics Section (1), Census and Statistics Department.

Appendix B: OLS regression

Table B.1 Linear probability model B1.1 and OLS regression B1.2

	Model B1.1		Model B1.2	
	Whether have children		Number of children	
Variables	Coef.	S.E.	Coef.	S.E.
Husband's educational attainment (ref: Primary or below)				
Secondary 1–4	−0.01	(0.01)	−0.09***	(0.02)
Secondary 5–7/other sub-college	−0.03***	(0.01)	−0.13***	(0.02)
Bachelor	−0.04***	(0.01)	−0.11***	(0.02)
Master	−0.02	(0.01)	−0.10***	(0.02)
PhD	−0.03	(0.03)	−0.10**	(0.05)
Wife's educational attainment (ref: Primary or below)				
Secondary 1–4	−0.001	(0.01)	−0.10***	(0.02)
Secondary 5–7/other sub-college	−0.005	(0.01)	−0.16***	(0.02)
Bachelor	−0.03***	(0.01)	−0.15***	(0.02)
Master	−0.05***	(0.02)	−0.18***	(0.03)
PhD	−0.04	(0.04)	−0.21***	(0.06)
Control variables				
Logged household income	0.04***	(0.004)	0.12***	(0.01)
Logged husband's income	0.01***	(0.003)	−0.02***	(0.01)
Logged wife's income	−0.01	(0.01)	0.003	(0.01)
Income discrepancy *(ref: Husband : Wife = [1, 1.5))*				
Husband no income	0.004	(0.01)	−0.08***	(0.03)
Husband : Wife = (0, 1)	−0.02*	(0.01)	0.01	(0.01)
Husband : Wife = [1.5, 2.5)	0.001	(0.01)	0.03*	(0.02)
Husband : Wife ≥ 2.5	0.02	(0.01)	0.07***	(0.02)

(*Continued*)

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Table B.1 (*Continued.*)

	Model B1.1		Model B1.2	
	Whether have children		Number of children	
Variables	Coef.	S.E.	Coef.	S.E.
Wife no income	0.01	(0.06)	0.13	(0.10)
Husband's age	−0.003***	(0.0004)	−0.004***	(0.0008)
Wife's age	−0.001	(0.0006)	0.01***	(0.001)
Husband's place of birth *(ref: Hong Kong)*				
Mainland China	0.06***	(0.01)	0.17***	(0.01)
Others	0.003	(0.02)	−0.02	(0.03)
Wife's place of birth *(ref: Hong Kong)*				
Mainland China	0.08***	(0.01)	0.05***	(0.01)
Others	0.03**	(0.01)	0.06**	(0.03)
Residential location *(ref: Hong Kong Island)*				
Kowloon	−0.04***	(0.01)	−0.05***	(0.01)
New Territory and others	−0.03***	(0.01)	−0.02	(0.01)
Industry FE	Yes		Yes	
Observations	32,028		25,562	

Robust standard errors in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

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Appendix C: Subsample analysis[2]

Table C.1 Couple's educational attainments and fertility by subsample

	Wife's age ∈ [35, 45]				Wife's age ∈ [38, 48]				Wife's age ∈ [40, 50]				Wife's age ∈ [42, 52]			
	Whether have children		Number of children		Whether have children		Number of children		Whether have children		Number of children		Whether have children		Number of children	
	Model C2.1.1		Model C2.2.1		Model C2.1.2		Model C2.2.2		Model C2.1.3		Model C2.2.3		Model C2.1.4		Model C2.2.4	
Variables	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Weights for couple's educational attainment																
p (husband's educational attainment)	0.66***	(0.19)	0.53***	(0.08)	0.84***	(0.26)	0.45***	(0.06)	0.84***	(0.17)	0.39***	(0.06)	0.81***	(0.29)	0.36***	(0.05)
q (wife's educational attainment)	0.34*	(0.19)	0.47***	(0.08)	0.16	(0.26)	0.55***	(0.06)	0.16	(0.17)	0.61***	(0.06)	0.19	(0.29)	0.64***	(0.05)
Weight difference ($\Delta w = p - q$)	0.32	(0.39)	0.06	(0.17)	0.69	(0.52)	−0.10	(0.13)	0.67*	(0.34)	−0.22**	(0.11)	0.61	(0.59)	−0.27***	(0.10)
Educational attainment																
1 Primary or below	0.29**	(0.13)	0.21***	(0.03)	0.21**	(0.09)	0.22***	(0.03)	0.34***	(0.08)	0.23***	(0.03)	0.28**	(0.11)	0.22***	(0.03)
2 Secondary 1–4	0.21***	(0.07)	0.02	(0.02)	0.15*	(0.08)	0.04*	(0.02)	0.16**	(0.06)	0.04*	(0.02)	0.12*	(0.06)	0.01	(0.02)
3 Secondary 5–7/other sub-college	−0.05	(0.06)	−0.05***	(0.02)	−0.10*	(0.05)	−0.07***	(0.02)	−0.07	(0.05)	−0.07***	(0.02)	−0.05	(0.06)	−0.07***	(0.02)
4 Bachelor	−0.15**	(0.07)	−0.03	(0.02)	−0.16**	(0.08)	−0.03	(0.02)	−0.19***	(0.07)	−0.03	(0.02)	−0.11	(0.07)	−0.06***	(0.02)

(*Continued*)

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Table C.1 (*Continued.*)

	Wife's age ∈ [35, 45]				Wife's age ∈ [38, 48]				Wife's age ∈ [40, 50]				Wife's age ∈ [42, 52]			
	Whether have children		Number of children		Whether have children		Number of children		Whether have children		Number of children		Whether have children		Number of children	
	Model C2.1.1		Model C2.2.1		Model C2.1.2		Model C2.2.2		Model C2.1.3		Model C2.2.3		Model C2.1.4		Model C2.2.4	
Variables	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
5 Master	−0.09	(0.10)	−0.01	(0.03)	−0.07	(0.10)	−0.06**	(0.03)	−0.10	(0.09)	−0.08***	(0.03)	−0.04	(0.10)	−0.11***	(0.03)
6 PhD	−0.21	(0.22)	−0.13**	(0.06)	−0.03	(0.20)	−0.11*	(0.07)	−0.15	(0.19)	−0.09	(0.07)	−0.20	(0.18)	0.02	(0.08)
Control variables																
Logged household income	0.20***	(0.03)	0.08***	(0.01)	0.18***	(0.03)	0.10***	(0.01)	0.19***	(0.03)	0.12***	(0.01)	0.22***	(0.03)	0.13***	(0.01)
Logged husband's income	0.07***	(0.03)	−0.003	(0.01)	0.10***	(0.03)	−0.005	(0.01)	0.09***	(0.03)	−0.01**	(0.01)	0.06***	(0.02)	−0.02***	(0.01)
Logged wife's income	0.05	(0.04)	0.02*	(0.01)	−0.02	(0.04)	0.01	(0.01)	−0.04	(0.04)	−0.003	(0.01)	−0.09**	(0.04)	−0.01	(0.01)
Income discrepancy *(ref: Husband:wife = [1, 1.5))*																
Husband no income	0.15	(0.15)	−0.08**	(0.04)	0.17	(0.13)	−0.10**	(0.04)	0.26**	(0.12)	−0.12***	(0.04)	0.14	(0.11)	−0.12***	(0.03)
Husband: wife = (0, 1)	−0.15**	(0.06)	0.03	(0.02)	−0.07	(0.06)	0.01	(0.02)	−0.06	(0.06)	−0.01	(0.02)	−0.02	(0.06)	−0.01	(0.02)
Husband: wife = [1.5, 2.5)	0.02	(0.07)	0.04**	(0.02)	0.08	(0.07)	0.03	(0.02)	0.07	(0.07)	0.02	(0.02)	0.10	(0.07)	0.003	(0.02)
Husband: wife ≥ 2.5	0.27***	(0.10)	0.11***	(0.02)	0.27***	(0.09)	0.06**	(0.02)	0.20**	(0.09)	0.03	(0.02)	0.06	(0.09)	0.04*	(0.02)

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Wife no income	0.96*	(0.50)	0.20	(0.13)	0.46	(0.48)	0.06	(0.13)	0.33	(0.44)	0.01	(0.12)	−0.25	(0.44)	0.09	(0.12)
Husband's age	−0.02***	(0.004)	−0.01***	(0.007)	−0.02***	(0.004)	−0.01***	(0.001)	−0.02***	(0.004)	−0.005***	(0.001)	−0.02***	(0.004)	−0.004***	(0.001)
Wife's age	0.01	(0.01)	0.01***	(0.001)	−0.01*	(0.01)	0.002	(0.002)	−0.01	(0.01)	0.004*	(0.001)	−0.01	(0.01)	0.002	(0.002)
Husband's place of birth *(ref: Hong Kong)*																
Mainland China	0.65***	(0.06)	0.16***	(0.01)	0.54***	(0.05)	0.18***	(0.01)	0.44***	(0.05)	0.19***	(0.01)	0.36***	(0.05)	0.17***	(0.01)
Others	0.08	(0.14)	−0.04	(0.04)	−0.03	(0.13)	−0.05	(0.04)	0.10	(0.13)	−0.04	(0.04)	0.05	(0.12)	−0.01	(0.04)
Wife's place of birth *(ref: Hong Kong)*																
Mainland China	0.70***	(0.06)	0.03*	(0.01)	0.63***	(0.05)	0.03**	(0.01)	0.60***	(0.05)	0.05***	(0.01)	0.49***	(0.05)	0.06***	(0.01)
Others	0.40***	(0.14)	0.12***	−0.04	0.29**	(0.12)	0.09***	(0.03)	0.18	(0.11)	0.05	(0.03)	0.12	(0.11)	0.04	(0.03)
Residential location *(ref: Hong Kong Island)*																
Kowloon	−0.33***	(0.06)	−0.07***	(0.02)	−0.20***	(0.06)	−0.04**	(0.02)	−0.08	(0.06)	−0.05***	(0.02)	−0.14**	(0.06)	−0.03**	(0.02)
New Territory and others	−0.26***	(0.06)	−0.03**	(0.02)	−0.27***	(0.06)	−0.01	(0.01)	−0.18***	(0.05)	−0.02	(0.02)	−0.17***	(0.05)	−0.01	(0.01)
Industry FE	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Observations	18,240		14,775		19,411		15,675		20,167		16,137		21,175		16,753	

Robust standard errors in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table C.2 Educational attainments and fertility with interactive weights by subsample

	Wife's age ∈ [35, 45]			
	Whether have children		Number of children	
	Model C3.1.1		Model C3.2.1	
Variables	Coef.	S.E.	Coef.	S.E.
Educational discrepancy (3 categories; ref: Husband = Wife)				
Husband < Wife	−0.08	(0.06)	−0.06***	(0.02)
Husband > Wife	−0.09*	(0.05)	−0.01	(0.01)
Weights for couple's educational attainment				
Husband < Wife				
p_1 (husband)	1.00***	(0.42)	0.80***	(0.18)
q_1 (wife)	0.00	(0.42)	0.20	(0.18)
$\Delta w_1 = p_1 - q_1$	1.00**	(0.84)	0.60	(0.37)
Husband = wife				
p_2 (husband)	0.67***	(0.24)	0.67***	(0.09)
q_2 (wife)	0.33	(0.24)	0.33***	(0.09)
$\Delta w_2 = p_2 - q_2$	0.34	(0.47)	0.34*	(0.19)
Husband > Wife				
p_3 (husband)	0.00	(0.30)	0.54***	(0.17)
q_3 (wife)	1.00***	(0.30)	0.46***	(0.17)
$\Delta w_3 = p_3 - q_3$	−1.00*	(0.59)	0.07	(0.35)
ρ			−0.13	(0.15)
Observations	18,240		14,775	
	Wife's age ∈ [38, 48]			
	Whether have children		Number of children	
	Model C3.1.2		Model C3.2.2	
Variables	Coef.	S.E.	Coef.	S.E.
Educational discrepancy (3 categories; ref: Husband = Wife)				
Husband < Wife	−0.05	(0.06)	−0.06***	(0.02)
Husband > Wife	0.001	(0.05)	−0.01	(0.01)
Weights for couple's educational attainment				
Husband < Wife				
p_1 (husband)	1.00**	(0.66)	0.79***	(0.15)

(*Continued*)

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Table C.2 (*Continued.*)

	Wife's age ∈ [38, 48]			
	Whether have children		Number of children	
	Model C3.1.2		Model C3.2.2	
Variables	Coef.	S.E.	Coef.	S.E.
q_1 (wife)	0.00	(0.66)	0.21	(0.15)
$\Delta w_1 = p_1 - q_1$	1.00	(1.32)	0.58*	(0.30)
Husband = wife				
p_2 (husband)	1.00***	(0.35)	0.58***	(0.08)
q_2 (wife)	0.00	(0.35)	0.42***	(0.08)
$\Delta w_2 = p_2 - q_2$	1.00	(0.70)	0.16	(0.16)
Husband > Wife				
p_3 (husband)	0.47	(0.38)	0.37**	(0.15)
q_3 (wife)	0.53	(0.38)	0.63***	(0.15)
$\Delta w_3 = p_3 - q_3$	−0.06	(0.76)	−0.27	(0.30)
ρ			−0.21*	(0.13)
Observations	19,411		15,675	
	Wife's age ∈ [40, 50]			
	Whether have children		**Number of children**	
	Model C3.1.3		**Model C3.2.3**	
Variables	**Coef.**	**S.E.**	**Coef.**	**S.E.**
Educational discrepancy (3 categories; ref: Husband = Wife)				
3 categories				
Husband < Wife	−0.06	(0.07)	−0.06***	(0.02)
Husband > Wife	−0.04	(0.05)	−0.01	(0.02)
Weights for couple's educational attainment				
Husband < Wife				
p_1 (husband)	1.00***	(0.50)	0.61***	(0.12)
q_1 (wife)	0.00	(0.50)	0.39***	(0.12)
$\Delta w_1 = p_1 - q_1$	1.00**	(1.00)	0.22	(0.25)
Husband = wife				
p_2 (husband)	0.97***	(0.27)	0.52***	(0.07)

(*Continued*)

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Table C.2 (*Continued.*)

	Wife's age ∈ [40, 50]			
	Whether have children		Number of children	
	Model C3.1.3		Model C3.2.3	
Variables	Coef.	S.E.	Coef.	S.E.
q_2 (wife)	0.03	(0.27)	0.48***	(0.07)
$\Delta w_2 = p_2 - q_2$	0.94*	(0.54)	0.03	(0.14)
Husband > Wife				
p_3 (husband)	0.21	(0.34)	0.43***	(0.13)
q_3 (wife)	0.79**	(0.34)	0.57***	(0.13)
$\Delta w_3 = p_3 - q_3$	−0.58	(0.68)	−0.15	(0.25)
P			−0.09	(0.10)
Observations	20,167		16,137	

	Wife's age ∈ [42, 52]			
	Whether have children		Number of children	
	Model C3.1.4		Model C3.2.4	
Variables	Coef.	S.E.	Coef.	S.E.
Educational discrepancy (3 categories; ref: Husband = Wife)				
Husband < Wife	−0.16**	(0.07)	−0.03	(0.02)
Husband > Wife	0.10	(0.18)	−0.00	(0.02)
Weights for couple's educational attainment				
Husband < Wife				
p_1 (husband)	1.00**	(0.76)	0.41***	(0.12)
q_1 (wife)	0.00	(0.76)	0.59***	(0.12)
$\Delta w_1 = p_1 - q_1$	1.00*	(1.53)	−0.19	(0.24)
Husband = wife				
p_2 (husband)	1.00***	(0.40)	0.45***	(0.07)
q_2 (wife)	0.00	(0.40)	0.55***	(0.07)
$\Delta w_2 = p_2 - q_2$	1.00**	(0.79)	0.10	(0.15)
Husband > Wife				
p_3 (husband)	1.00	(1.09)	0.49***	(0.14)
q_3 (wife)	0.00	(1.09)	0.51***	(0.14)
$\Delta w_3 = p_3 - q_3$	1.00	(2.19)	−0.02	(0.28)

(*Continued*)

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Table C.2 (*Continued.*)

	Wife's age ∈ [42, 52]			
	Whether have children		Number of children	
	Model C3.1.4		Model C3.2.4	
Variables	Coef.	S.E.	Coef.	S.E.
ρ			0.04	(0.11)
Observations	21,175		16,753	

Robust standard errors in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table C.3 Educational discrepancy and fertility by subsample

	Wife's age ∈ [35, 45]			
	Whether have children		Number of children	
	Model C4.1.1		Model C4.2.1	
Variables	Coef.	S.E.	Coef.	S.E.
Educational discrepancy (5 categories; ref: Husband = Wife)				
Husband < Wife by 2 levels or more	−0.37***	(0.13)	−0.11***	(0.03)
Husband < Wife by 1 level	−0.02	(0.07)	−0.05***	(0.01)
Husband > Wife by 1 level	0.001	(0.07)	−0.01	(0.01)
Husband > Wife by 2 levels or more	0.10	(0.15)	0.02	(0.03)
Weights for couple's educational attainment				
p (husband's educational attainment)	0.96***	(0.36)	0.70***	(0.09)
q (wife's educational attainment)	0.04	(0.36)	0.30***	(0.09)
Weight difference ($\Delta w = p - q$)	0.92	(0.71)	0.41**	(0.18)
Observations	18,240		14,775	
	Wife's age ∈ [38, 48]			
	Whether have children		Number of children	
	Model C4.1.2		Model C4.2.2	
Variables	Coef.	S.E.	Coef.	S.E.
Educational discrepancy (5 categories; ref: Husband = Wife)				
Husband < Wife by 2 levels or more	−0.35*	(0.21)	−0.09***	(0.03)
Husband < Wife by 1 level	−0.04	(0.10)	−0.04***	(0.02)
Husband > Wife by 1 level	0.12	(0.10)	0.004	(0.01)
Husband > Wife by 2 levels or more	0.30	(0.22)	−0.01	(0.03)

(*Continued*)

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Table C.3 (*Continued.*)

	Wife's age ∈ [38, 48]			
	Whether have children		Number of children	
	Model C4.1.2		Model C4.2.2	
Variables	Coef.	S.E.	Coef.	S.E.
Weights for couple's educational attainment				
p (husband's educational attainment)	1.00**	(0.72)	0.60***	(0.08)
q (wife's educational attainment)	0.00	(0.72)	0.40***	(0.08)
Weight difference ($\Delta w = p - q$)	1.00	(1.4)	0.20	(0.16)
Observations	19,411		15,675	
	Wife's age ∈ [40, 50]			
	Whether have children		Number of children	
	Model C4.1.3		Model C4.2.3	
Variables	Coef.	S.E.	Coef.	S.E.
Educational discrepancy (5 categories; ref: Husband = Wife)				
Husband < Wife by 2 levels or more	−0.35	(0.25)	−0.09***	(0.03)
Husband < Wife by 1 level	−0.06	(0.12)	−0.04***	(0.02)
Husband > Wife by 1 level	0.16	(0.12)	0.01	(0.01)
Husband > Wife by 2 levels or more	0.26	(0.27)	−0.03	(0.03)
Weights for couple's educational attainment				
p (husband's educational attainment)	1.00**	(0.72)	0.54***	(0.07)
q (wife's educational attainment)	0.00	(0.72)	0.46***	(0.07)
Weight difference ($\Delta w = p - q$)	1.00	(1.43)	0.08	(0.15)
Observations	20,167		16,137	
	Wife's age ∈ [42, 52]			
	Whether have children		Number of children	
	Model C4.1.4		Model C4.2.4	
Variables	Coef.	S.E.	Coef.	S.E.
Educational discrepancy (5 categories; ref: Husband = Wife)				
Husband < Wife by 2 levels or more	−0.48*	(0.25)	−0.08***	(0.03)
Husband < Wife by 1 level	−0.20*	(0.12)	−0.03*	(0.02)
Husband > Wife by 1 level	0.28**	(0.12)	0.01	(0.01)
Husband > Wife by 2 levels or more	0.37	(0.26)	−0.04	(0.03)
Weights for couple's educational attainment				

(*Continued*)

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Table C.3 (*Continued.*)

	Wife's age ∈ [42, 52]			
	Whether have children		Number of children	
	Model C4.1.4		Model C4.2.4	
Variables	Coef.	S.E.	Coef.	S.E.
p (husband's educational attainment)	1.00**	(0.87)	0.46***	(0.08)
q (wife's educational attainment)	0.00	(0.87)	0.54***	(0.08)
Weight difference ($\Delta w = p - q$)	1.00*	(1.74)	−0.07	(0.15)
Observations	21,175		16,753	

Robust standard errors in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Cite this article: Sun SB, Zhao X (2022). Hong Kong wives say no to a big family—educational pairings and fertility in Hong Kong. *Journal of Demographic Economics* 1–37. https://doi.org/10.1017/dem.2022.17