


RESEARCH PAPER

# Impact of foreign domestic workers on the fertility decision of households: evidence from Hong Kong

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(Received 15 March 2021; revised 18 August 2021; accepted 22 November 2021;  
first published online 21 December 2021)

## Abstract

A potential solution to low fertility is the employment of foreign domestic workers (FDWs), who substitute child-rearing and housework duties, thus reducing child-rearing costs. Recent studies argue that the flow of low-skilled foreign workers into the childcare sector influences fertility choice. However, these studies mainly use the availability of FDWs in the local area as the causal inference and focus on Western countries, making it difficult to identify individual direct effects or generalize the findings to other countries. To bridge this research gap and examine the impacts, this study uses household data from the Hong Kong census. Employing ordinary least squares, the inverse probability weighted regression adjustment, and the instrumental variable approach, we find that households that employ live-in FDWs give birth to more children. Moreover, the heterogeneous analysis reveals that women's greater proportional contribution to household income has a positive impact on households' fertility response after employing the FDWs.

**Key words:** Childcare; fertility; foreign domestic workers; Hong Kong

**JEL code:** J13; J16; J31; J61

## 1. Introduction

Total fertility rate in most developed countries, including the United States, Japan, Korea, and China, is lower than 2.10, called the replacement-level fertility [World Bank (2019)]. The causes of this low fertility in developed countries include female participation in the labor market, high costs of child-rearing, and conflicts of time allocation between couples [Balbo *et al.* (2013)]. In summary, childcare—in terms of both the time allocation and the monetary budget—is costly for rational couples in industrialized countries [Gauthier (2007)].

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To promote an increase in fertility, improvements in childcare availability and quality and a decrease in costs are thus required [Rindfuss and Brewster (1996)]. Many governments have attempted to reduce child-rearing costs by providing a children's allowance or expanding access to childcare facilities. However, these interventions have not yet solved the low fertility issue [Gauthier (2007); Balbo *et al.* (2013)]. Meanwhile, the marketization of child-rearing and housework has received attention from caregivers and experts as a way to reduce child-rearing costs and burden in developed countries. In particular, low-skilled immigrant workers employed at lower salaries—usually at minimum wage—play a key role in the childcare outsourcing industry because households can allocate their budgets and time to other goods and tasks, including labor supply. Thus, outsourcing child-rearing and housework to foreign domestic workers (FDWs) relieves the monetary and psychological burden of potential parents. Recent studies have shown that the flow of FDWs into the childcare outsourcing industry influences fertility behavior in households [Hazan and Zoabi (2015); Furtado (2016); Bar *et al.* (2018)]. Furthermore, these studies suggest that hiring FDWs serves as an incentive for highly educated or high-earning women to increase their number of births without sacrificing their careers by lowering child-rearing costs based on the “marketization hypothesis” [Freeman and Schettkat (2005)].

Although the relationship between fertility and the inflow of low-skilled workers has been largely explored based on the availability of low-skilled immigrants in the local area, most existing studies have not examined the direct effect of hiring domestic workers on fertility outcomes at the micro-level. Furthermore, research has mainly been conducted in developed Western countries, thus limiting generalization. Conversely, our study aims to detect the direct effects in households to explicate the impact of employing FDWs in Hong Kong. The government gave us access to a 5% random sample of household-level data from the 2016 bi-census, from which we constructed a dataset for the analysis. Hong Kong has a long history of outsourcing household chores to FDWs to relieve the monetary and opportunity costs of child-rearing. In 1973, the government introduced a policy to issue temporary visas for FDWs to increase their supply in the labor market. As a result, the number of FDWs has increased exponentially in the past two decades. Indeed, Hong Kong's long history of employing more live-in FDWs has resulted in their high labor market share in the region [9.3% of the total workforce in 2016; Legislative Council Secretariat (2017a)]; however, studies of the fertility response to the employment of FDWs are lacking. Thus, our analysis explicates the extent to which FDWs in Hong Kong influence fertility behavior using the number of infants (children under five years) in each household as the outcome.

We employ ordinary least squares (OLS) estimation and the inverse probability weighting regression adjustment (IPWRA) to examine the effect of employing FDWs on the fertility choice of households. Furthermore, we presume that the employment of live-in FDWs may be endogenous because of such unobservable traits as a preference for large families, which affect both the employment of FDWs and fertility choice. Therefore, we apply an instrumental variable (IV) approach, which is commonly used in the literature on health behavior, to address potential endogeneity. We use the status of winning the random ballot of the housing support scheme or receiving the housing support provided by public housing organizations as the IVs for FDW employment. Furthermore, given the availability of a large micro-level dataset, we examine the heterogeneity of the impact of outsourcing home

duties to low-skilled immigrants using subgroup analyses based on socioeconomic characteristics such as educational attainment and household income (including their female members).

Our specification with related control variables shows that FDW employment triggers an increase in the number of infants in the household in all the analyses by 0.34–0.60 children. Moreover, as our data allow us to track information on the address of the current residence and the residence five years ago for both samples and FDWs, we exploit this information for the causal inference. When we limit the sample to households that have not relocated to a new address as a subsample analysis, we also find that employing identical live-in FDWs for more than five years increases the number of infants in these households by 0.06–2.18 children, which is a robust causal relationship. Moreover, we find that the probability of having two or more children increases in households employing the FDWs. We test the validity of our IVs based on the novel methodology proposed by Conley *et al.* (2012) and find that even under the condition that our IVs violate the exclusion restriction, our results are still informative. Further, we demonstrate the subgroup analysis using the same estimation methods. We find that outsourcing households of highly educated and high-income-earning women tend to have more children, corroborating the extant literature. Moreover, this tendency is confirmed more robustly in households in which women's incomes contribute more significantly. Therefore, households in Hong Kong, especially those with women who earn more, give birth to more children after they employ live-in FDWs because of the financial relief regarding child-rearing. Our study reveals that outsourcing a share of home and child-rearing duties to FDWs improves fertility in Hong Kong as other studies that support the marketization hypothesis.

This research contributes to the existing literature in two ways. First, it provides insights into the impact of foreign immigrants on the local community in host countries. International labor mobility is an important phenomenon globally and immigrants affect the economy and society in host countries enormously [World Bank (2018)]. In response to this trend, many empirical studies have shown the outcomes of these immigrants. For instance, a large amount of research explicates whether immigrants affect the wages of natives in the local labor market [National Academies of Sciences, Engineering, and Medicine (2017)], influence the crime rate in cities [Ousey and Kubrin (2009)], stimulate the price of immigrant-intensive services in the local market [Cortés (2008)], and affect the academic performance of peers in schools [Ballatore *et al.* (2018)]. In particular, regarding the flow of FDWs into the outsourcing childcare industry, some studies explicate the impact on female participation in the local labor market. Cortés and Tessada (2011) suggest that the flow of immigrants into the housekeeping sector increases working hours among women at the top of the wage distribution in the United States. Using the Spanish case, Farré *et al.* (2011) show that the female immigration reduces the price of household services, and it increases the female labor participation among skilled women. Forlani *et al.* (2015) demonstrate that the share of immigrants working in housekeeping services affects the increase in native female labor supply, especially in countries with low support for family policy. Cortés and Pan (2013)<sup>1</sup> investigate the impacts of the employment of FDWs on the female labor participation in Hong

<sup>1</sup>Although Cortés and Pan (2013) use the micro-level census or bi-census data from the Hong Kong government in a similar way to us and employ the number of rooms as their IV for estimating female

Kong. They describe that the employment of live-in FDWs increases the female labor participation, especially among the mothers with young children. Also, they conclude that the mothers who have infants and complete the higher education especially benefit the welfare from the employment of the FDWs. Regarding the fertility response, Furtado and Hock (2010), Hazan and Zoabi (2015), and Furtado (2016) for the United States, Raz-Yurovich (2016) and Forlani *et al.* (2020) for Germany, and Romiti (2018) for the United Kingdom find that there is an incentive to have more children because of the outsourcing of housework. However, these works mainly use the availability of low-skilled immigrants in the local area from macro-level aggregate data to measure the effects of housekeepers on birth choice, except for Raz-Yurovich (2016); thus, it is impossible to identify the direct effect of outsourcing housework on fertility choice in households. Moreover, the focus of the abovementioned studies is on Western countries; thus, we aim to confirm the external validity of the relationship between fertility choice and outsourcing of child-rearing to low-skilled foreign workers.

Second, this research adds to the strand of the literature on the determinants of family planning in developed countries. In Balbo *et al.*'s (2013) review of fertility choice in developed countries, several aspects are shown to influence family planning at the micro-level, such as household income [Becker and Lewis (1973)] and sex preference [Mills and Begall (2010)], at the mid-micro-level [e.g., social capital; Philipov *et al.* (2006)], and at the macro-level, such as GDP [Sobotka *et al.* (2011)] and the availability of childcare assistance [Del Boca (2002)]. However, as research on the impact of outsourcing house duties on fertility choice remains limited, we add to the literature on the effect of the marketization of childcare. Moreover, our model includes the socioeconomic characteristics of households and women to ensure a robust estimation; thus, we prove whether characteristics other than the employment of FDWs affect the fertility outcomes in the household. Through our analysis, we aim to confirm whether accepting immigrants to support child-rearing activities can improve the social structure in countries facing low fertility.

The remainder of this paper is organized as follows. Section 2 describes the research context, including the conceptual framework and situation of FDWs in Hong Kong. Section 3 describes the data and section 4 discusses the estimation strategies employed. Section 5 presents the estimation results, and section 6 concludes.

## 2. Research context

As a theoretical consideration of fertility choice, the quality–quantity tradeoff proposed by Becker and Lewis (1973) explains that higher-income families stop having multiple children to guarantee the quality of their child. This concept has predominated the economic analysis on fertility for many decades, but some recent empirical literatures have suggested mixed relationships in the industrialized countries [Black *et al.* (2005); Angrist *et al.* (2010); Mogstad and Wiswall (2016); Bagger *et al.* (2021)]. As Doepke (2015) suggested, this is because public support for high-quality schooling or the restriction of child labor influences the household fertility decision. On the contrary, as some literatures empirically support, the U-shape relationship between fertility and women's education is observed in recent trends in the US. That is,

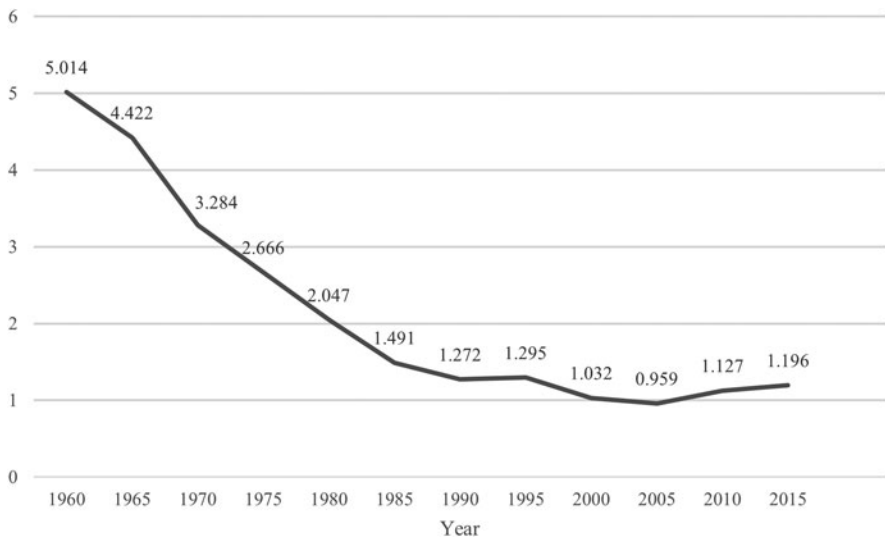
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labor force participation, they suggest that the number of rooms may affect having more children. Therefore, we use the status of the randomization-based housing scheme as our instrument in this research.

high-skilled or high-income families increase their fertility, dissenting from the traditional theoretical thoughts. Some works of literature [e.g., Hazan and Zoabi (2015); Bar et al. (2018)] suspect that this trend relies on the “marketization hypothesis” [Freeman and Schettkat (2005)]; that is, higher-income or higher-skilled mothers purchase the housekeeping or babysitting service, in which the lower-skilled immigrants often serve, to reduce their parental burden, and they enable to have more children.

However, the relationship between fertility and the outsourcing of housekeeping and childcare to lower-skilled immigrants is theoretically complex. As mentioned, the employment of FDWs is expected to relieve the monetary and psychological burden on couples rearing children, especially women. Some studies [e.g., Blau and Robins (1989); Balbo et al. (2013); Furtado (2016)] suggest that several mechanisms may be at work when we consider the effect of outsourcing housework on fertility decisions. First, a positive effect on fertility is expected because of relaxing the time budget constraint for couples. By hiring FDWs, couples in effect earn more hours that can be spent on child-rearing activities, and this may lead to an increase in the number of children. Second, a negative effect on fertility is also expected because with an FDW at home, women who used to perform housework full-time now have a higher opportunity cost of staying home and may decide to enter the labor market. That is, at the extensive margin, these women may engage in labor activities and increase labor hours, which is expected to have negative effects on fertility choice. Furthermore, a negative effect on fertility is also expected for women who had been working before the employment of an FDW. Because hiring an FDW allows them to work longer hours, they may have a higher chance of being promoted or more desire to pursue higher positions. This effect at the intensive margin is expected to negatively affect the number of children.

Although other studies have shown that lowering the costs of child-rearing by outsourcing is beneficial for female participation in local labor markets [Cortés and Tessada (2011); Cortés and Pan (2013)], the literature explains that the flow of low-skilled foreign workers into the childcare sector influences the fertility choice in local households, which is our main research interest. Hazan and Zoabi (2015) explain that highly educated women are likely to bear more children by substituting their time spent on housekeeping services and child-rearing. Furtado (2016) uses US census data to show that immigrant inflows are indeed associated with native women’s increased likelihood of having a baby, and positive responses come from married women and women with a graduate degree. Bar *et al.* (2018) suggest that the relationship between income and fertility flattened between 1980 and 2010 in the United States, a time of increasing inequality, as high-income families increased their fertility. According to the authors, this was because of the marketization of parental time costs, which is supplied by low-skilled foreign workers. Using survival analysis and data from the German Socioeconomic Panel, Raz-Yurovich (2016) demonstrates that outsourcing housework is positively associated with an early second birth among German women. Forlani *et al.* (2020) find that the local availability of household care service, which female immigrants mainly engage in, positively impacts fertility choice, especially in households with skilled women in Germany. Although it cannot evaluate the direct and significant effect on fertility, Romiti’s (2018) study suggests that immigrants in the childcare sector affect female labor supply without a fertility tradeoff using panel data from the United Kingdom. However, no studies examine the direct effects of outsourcing housework on the quantum of fertility choice (i.e., number of children) using the employment status of housekeepers based on

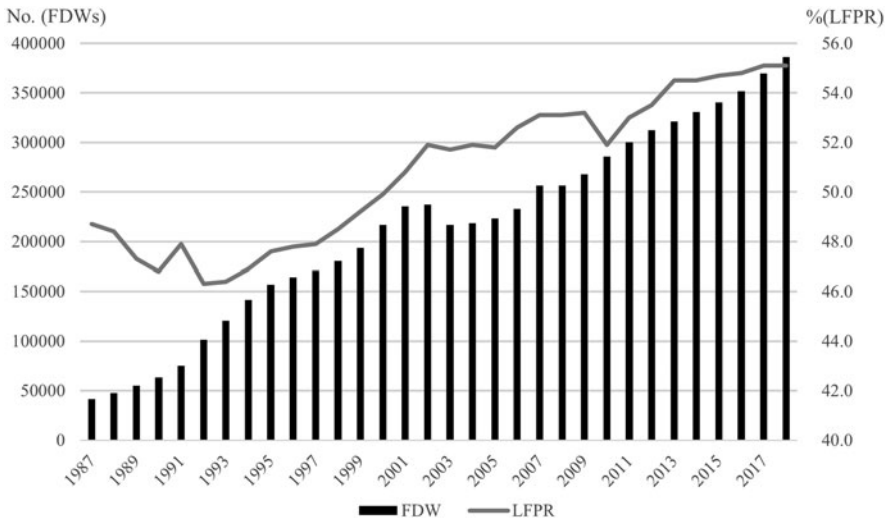


**Figure 1.** Trend of total fertility rate in Hong Kong. Edited by the author.  
 Source: World Development Indicators.

micro-level household data. Moreover, as most existing research is focused on the United States and Europe, we cannot verify its external validity in Asia.

Like the West, Hong Kong has also faced a low fertility rate for complex reasons. The fertility rate in the city was 5.01 in 1965. However, it has gradually decreased due to economic growth, stagnating at 1.03 in 2000, 1.13 in 2010, and 1.20 in 2015 (Figure 1). Although many women in Hong Kong intend to bear children in their life-cycle [Wong *et al.* (2011)], as Basten (2015) claims, they face a potential obstacle for low fertility, namely, a financial disincentive for childbearing and the inflexibility of time allocation to work and child-rearing. First, higher housing and child-rearing costs are crucial issues in the city because properties are so expensive that young families cannot afford to own a house. In addition, childcare costs are said to be higher because parents expect their children to succeed academically. Moreover, to gain a livelihood, couples need to work for longer hours (more than 49 h per week on average). These working environments create tremendous pressure, especially for women, to combine work and child-rearing. We observe these causes and tendencies not only in Hong Kong but worldwide.

Hong Kong has admitted FDWs into local families for approximately half a century. In 1973, the Hong Kong government introduced a temporary visa for live-in FDWs to release local women from housework and allow them to join the labor market. Since then, the number of FDWs has increased exponentially (Figure 2). For instance, it was 164,000 in 1996 and doubled to 352,000 in 2016. FDWs are typically from the Philippines (54%) and Indonesia (42%), and 98% are women. Of the households that employ live-in FDWs in 2016, 73.9% are married couples with children; thus, FDWs are recognized as crucial components for childcare [Legislative Council Secretariat (2017a)]. One of the reasons is that the female labor participation rate among the working-age population has increased in the past two decades from 47.8% in 1996 to



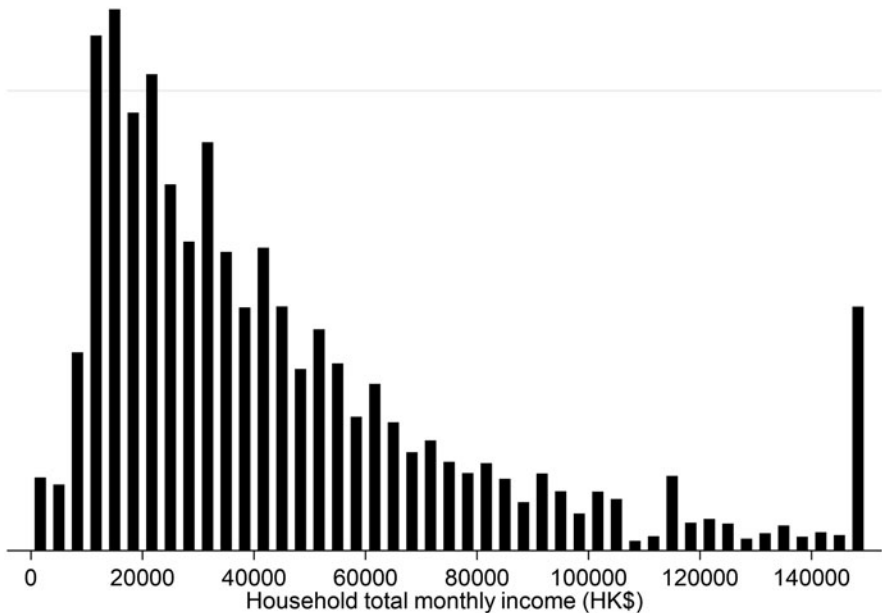
**Figure 2.** The number of FDWs and the trend of labor force participation rate among females. Edited by the author.

Source: Social Data Collected by the General Household Survey for FDWs from 1987 to 1991. Hong Kong Annual Digest Statistics for FDWs at 1992 hereafter. World Development Indicators for LFPR.

54.8% in 2016 [HKSAR (2019a); see Figure 2]. Further, in Hong Kong, it is a criminal offense to leave children under 16 years alone at home [HKSAR (2013)]; hence, FDWs are regarded as important guardians on behalf of working parents. The government sets the criteria for employing FDWs for local families, including a minimum household income (HK\$15,000) to guarantee the minimum hourly wage of Hong Kong (HK \$37.5) and the provision of one room for them to live in the house, although many live-in FDWs share a room with the children of their employers [Chan (2005)]. Moreover, the government permits a two-year contract for each employee and issues visas for FDWs based on each contract. Changing employers in Hong Kong within the two-year contract is prohibited, and the employed FDWs are once required to return to their place of origin at the end of the two-year contract even if they extend their contracts [HKSAR (2018)]. Finally, although some studies have demonstrated that FDWs in Hong Kong affect female labor participation [Cortés and Pan (2013)] and educational performance among children [e.g., Tang and Yung (2016)], the literature on the relationship between FDWs and fertility behavior in Hong Kong is scarce.

### 3. Data

We obtain governmental permission to use a 5% random sample of the 2016 bi-census provided by the Census and Statistics Department in Hong Kong. In the sample, 131,434 households and 366,619 individuals are recorded. To control the characteristics of the sample, we limit the population as follows and constructed the dataset accordingly. First, to trace the fertility history of each household precisely, we keep only households with one married woman aged 20–45 years and omit those without such a woman and those with two or more married women (e.g.,



**Figure 3.** Income distribution of the random 5% sample (the households with one married woman aged 20–45 years old).

households living together with a sister and a mother in the age cohort). Moreover, we consider an adequate income level in our survey. [Figure 3](#) depicts the income distribution of households with women in the targeted age cohort. In this dataset, the variance of the income distribution is significant: some households earn more than HK\$150,000 monthly, but the median monthly income in 2016 for the targeted age group is just HK\$19,000. As some research related to the FDWs in Hong Kong focuses on the low- and middle-income households too [e.g., [Tang and Yung \(2016\)](#)], this study also focuses on relatively low- and middle-income households, and we limit the monthly income of households to HK\$15,000 to HK\$58,000. There are two reasons for limiting these income thresholds. Firstly, the Hong Kong government limits the minimum threshold to employ one FDW in each household as HK\$15,000, as mentioned in section 2. Secondly, the maximum income for the government's housing ownership scheme (HOS), which we use the beneficiary status in our estimation strategy (details in section 4), is HK\$58,000. Considering the possibility of benefitting from employing the FDWs and applying the housing scheme, we assume that limiting this income range is reasonable for our estimation.

After refining the sample, we keep 20,391 households in our dataset. [Table 1](#) shows the descriptive statistics. We separate households that had employed FDWs at the time of the survey from those that had not. A *t*-test shows significant differences between the two groups for several of the variables. Households that employ FDWs are richer, have more family members and 5–10-year-old children, are likely to live in cities, and have more rooms in their houses. Women in households with FDWs have a higher education, earn a high income, contribute more to the household income, and are



Table 1. Descriptive statistics

Variable	No FDW households (17,871 households)		FDW households (2,520 households)		P-value
	Mean	Std. Dev.	Mean	Std. Dev.	
Number of infants (Below 5 years)	0.282	0.529	0.634	0.677	0.00***
Household monthly income	31308.230	11878.450	39668.450	11586.410	0.00***
Logged household income	10.279	0.385	10.538	0.334	0.00***
# of family member	3.472	1.155	4.797	0.989	0.00***
# of elderly people (65 yrs old more)	0.204	0.502	0.181	0.470	0.032*
# of children more than 5 yrs old	0.528	0.722	0.792	0.768	0.00***
Island living dummy	0.020	0.140	0.032	0.176	0.0001***
Age of wife/targeted lady	36.991	5.605	37.220	4.743	0.051
Education of wife/targeted lady	11.647	3.252	13.296	2.829	0.00***
Working hours of wife/targeted lady	25.569	22.663	29.742	21.151	0.00***
Log income of wife/targeted lady	6.304	4.540	7.274	4.275	0.00***
Divorce/separate/widow dummy	0.039	0.195	0.057	0.231	0.00***
First child is daughter	0.279	0.449	0.441	0.497	0.00***
# of room in the house	3.181	1.015	3.983	1.040	0.00***
Income ratio between the couple (female's income/couple's income)	0.399	0.366	0.447	0.347	0.00***
Log income of husband	7.927	3.906	8.062	3.893	0.105
Husband working hour	37.235	21.419	36.931	20.721	0.502
Marriage status of FDW			0.706	0.456	
Education of FDW			11.548	3.100	
Working hours of FDW			59.489	13.831	
Logged FDW's income			8.370	0.089	
Age of FDW			34.962	6.752	

Note: + $P < 0.10$ , \*  $P < 0.05$ , \*\*  $P < 0.01$ , \*\*\*  $P < 0.001$ .

likely to live without their husbands. Moreover, the first child in households with FDWs is likely to be a daughter. To estimate the pure effect of the employment of FDWs, we control for some socioeconomic characteristics in our estimation.

#### 4. Estimation strategy

We aim to investigate the impact of outsourcing housekeeping and childcare to FDWs on the household's fertility behavior. Based on the literature review, we hypothesize that *the employment of FDWs increases the number of childbirths in households in Hong*

*Kong*. As we use observational data instead of experimental data, we employ econometric methods for the analysis to identify a causal relationship and ensure internal validity. To test this hypothesis, we examine the following equation in the simplest form as follows:

$$y_i = \beta FDWemployment_i + \lambda X_i + \mu_i, \quad (1)$$

where  $y_i$  denotes the number of infants (under five years<sup>2</sup>) in the  $i$ th household, and  $FDWemployment_i$  equals 1 if the  $i$ th household employs an FDW and 0 otherwise.  $X_i$  is the vector of the characteristics including log of household income, the number of children aged over five years and of elderly people, an island residence dummy, the income ratio,<sup>3</sup> the age and educational experience of women, the first child's sex dummy (Female = 1), and the marriage status dummy (Divorce/Separate/Widow = 1).<sup>4</sup>  $\mu_i$  is the error term in the main model.

First, we conduct OLS estimations. However, we suspect that fertility outcomes may be influenced by factors that also affect the employment status of FDWs in households, which leads to an endogeneity problem. Our descriptive statistics show systematic differences between households that employ FDWs and those that do not. Thus, we employ two other methods. Firstly, to reduce potential self-selection bias based on the observable characteristics, we use the IPWRA estimator for the causal inference. This estimator is known as a “doubly robust” estimator because it is a consistent estimate if either the treatment model or the outcome model is correctly specified. Under this method, the inverse of the propensity score is used as weights to run regressions of the outcome variable [Wooldridge (2007)]. As we estimate the average treatment effects on the treated (ATT), we employ a weight equal to 1 for treated observations and  $ps(x)/(1-ps(x))$  for control observations, where  $ps$  refers to the propensity score, and estimate the treatment effects by comparing the averages of the two groups [Hirano *et al.* (2003)]. The IPWRA estimator can yield causal estimates of the ATT under the assumption that there is only selection on the observables.

Moreover, to reduce endogeneity due to unobserved factors that affect both the employment of FDW and birth choices, we apply the IV approach. A valid excluded IV,  $z$ , should be correlated with the endogenous variable [ $cov(x_{endog}, z) \neq 0$ ] and not be correlated with the error term in the main model [ $cov(z, \mu) = 0$ ]. We use the

<sup>2</sup>Although some literature that examines the role of outsourcing housekeeping work on fertility choice use other indicators of birth choice such as the birth experience in a particular year [e.g., Hazan & Zoabi (2015); Furtado (2016)] or the existence of child with a specific age [e.g., Forlani *et al.* (2020)], we select the number of children younger than five years (0–4 years) as the outcome of our estimation for two reasons. First, some studies use the number of children in this target cohort to clarify the recent trend of fertility behavior. For example, Furtado (2016) uses the outcome using this cohort as their robustness check. Second, in our later analyses, to eliminate the possible reverse causality between having a child and hiring an FDW, we restrict our sample in such a way that hiring an FDW occurs before the birth of a child. We do this by using a subsample of households that stayed at the same address for at least five years before the data collection year (i.e., our target cohort should be under five years). As a robustness check, we also analyze the impact on the number of children under three years old in Appendix C and those under one year old in Appendix D.

<sup>3</sup>We calculate the income ratio as the woman's income divided by household income. If women do not earn any income, the value is zero. On the contrary, if only women earn income or are single, the ratio is 1.

<sup>4</sup>The variables “log of household income” and “income ratio” may hold risks of endogeneity because female's labor supply and the birth choice may have interdependency. As a robustness check, we conduct regressions without these variables and also find consistent results (Appendix E).

following two IVs: (1) a dummy variable for winning the random ballot for the HOS organized by the Hong Kong Housing Authority and (2) a dummy variable for whether households receive housing subsidies from the government. Below, we explain how these instruments satisfy the necessary conditions for the IVs.

As mentioned above, households in Hong Kong face a chronic scarcity of housing because of high market prices, which have increased since 2004 following the Asian financial crisis and the SARS epidemic. The price index of domestic properties was 150.9 in 2010 and 296.8 in 2015 compared with the 1999 index of 100 [HKSAR (2020)]. Moreover, housing prices in Hong Kong surpass those in other large cities such as Singapore, Shanghai, Los Angeles, and New York [CBRE (2019)]. Thus, families, especially young families, struggle to afford a house. To support local families, the government offers a housing scheme for inhabitants to rent or own their houses at a lower price.

We examine two major schemes: public rental housing (PRH) and the HOS. The Hong Kong Housing Authority provides PRH for low-income families based on eligibility criteria. Demand for PRH exceeds supply; for example, in 2016, there were more than 153,000 applicants for approximately 12,000 flats [Legislative Council Secretariat (2017b)]. Applicants receive an offer of rental housing by random computer batching based on characteristics such as family size and choice of district [Hong Kong Housing Authority (2020)]. On average, applicants have to wait four years for the first offer of houses [Legislative Council Secretariat (2017b)]. Although computer batching is conducted in groups classified by characteristics, the variation in waiting time is similar regardless; thus, some households can move into the offered flat within three years, whereas others wait for six years or more [Hong Kong Housing Authority (2019)]. In 2019, the average waiting period was 5.4 years [Hong Kong Housing Authority (2019)].

Meanwhile, the HOS has been offered since 1978, although there was a moratorium period from 2003 to 2012 [Legislative Council (2011); Li (2016)]. It provides homeownership opportunities to families unable to buy houses in the private sector. If applicants satisfying the conditions win the annual lottery, they can purchase the houses provided by the government at a discounted price (usually 30–40% of the market price). The Hong Kong Housing Authority has many applications every year. For example, 135,000 households applied at the sale in December 2014, the first HOS sale after the moratorium, and this number of applications is 62.5 times larger than the number of sales flats [Forrest and Yip (2015)]. Although the number of applications and flats fluctuates, competition is high [HKSAR (2019b)]. There are other schemes through which the Hong Kong Housing Authority and Hong Kong Housing Society lease or sell subsidized flats, such as the Tenants Purchase Scheme, Private Sector Participation Scheme, and Flats for Sale Scheme, which mainly follow the ballot method (see the eligibility criteria of the HOS and PRH in Appendix A).<sup>5</sup>

We use these two variables for homeownership through the HOS and receiving a housing subsidy as our IVs. For our first condition for valid IVs, FDW employment is likely to be strongly correlated with the housing support variables because the number of rooms is an important FDW employment condition. For the second condition, there are two major concerns. The first is whether self-selection bias exists

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<sup>5</sup>The proportion of households that own their house using the HOS is 10.1% in the full sample and 13.1% in the not-moving sample. The proportion of households receiving the housing subsidy is 43.3% in the full sample and 52.7% in the not-moving sample.

in the application of these support schemes because households that apply for these schemes and those that do not may be systematically different. However, as demand for these schemes is exceptionally high in Hong Kong, this suggests that most sample households will apply. Although the proportion of young and married applicants for subsidized housing schemes is unknown, demand is extremely high. Li (2016) discusses the housing market and policy instruments in Hong Kong and finds that the cohort born after 1980, the target sample in this research, has faced the most difficulties obtaining housing. Furthermore, according to a survey by the Chinese University of Hong Kong [CUHK (2019)], the housing affordability ratio among Hong Kong citizens has fallen as low as  $-6.13$  in 2015,  $-5.06$  in 2016, and  $-6.62$  in 2017 compared with  $4.35$  in 2002. This result indicates strong demand for housing support in Hong Kong. Moreover, households that receive support are selected by random ballots. Thus, there is no opportunity for the Hong Kong Housing Authority to assess households based on their characteristics or preferences. Considering these suggestions, we do not expect selection bias in applications, while selection into the housing subsidy schemes is also random in our context.<sup>6</sup>

The second concern may be the violation of the exclusion restriction assumption, that is, receiving a housing subsidy from these schemes may affect birth choice directly aside from the effect through hiring FDWs (e.g., via increased wealth due to subsidies).<sup>7</sup> While this is difficult to test, we address this concern by conducting the sensitivity test proposed by Conley *et al.* (2012) to examine whether the IV estimates provide important information even when the exclusion restriction is violated. We report the results of the bound estimation under the assumption that the instruments have non-zero effects on the outcome.

Based on the above discussion, we model the structural equations for the two-stage least squares (2SLS) using cross-sectional data. The first-stage model is as follows:

$$FDWemployment_i = \gamma_1 Z_1 + \gamma_2 Z_2 + \varphi X_i + \varepsilon_i, \quad (2)$$

where each IV  $Z_i$  is the dummy variable for whether the  $i$ th household owns a house by winning ballots or is subsidized for housing by the government in addition to the vector  $X_i$  used in equation (1). Equation (1) is applied to the second stage of 2SLS estimation.

Further, to eliminate the potential reverse causality between the employment of FDWs and outcomes, we also conduct estimations based on a subsample that only includes households that have not moved for five years and redefine  $FDWemployment_i$  as hiring an FDW who has the same address five years before the data collection ( $5yearsFDWemployment_i$ ). In the bi-census in 2016, respondents were asked where household members, including FDWs, lived five years ago. We take advantage of this question to ensure that FDWs were working in the house before the children were born. This approach can eliminate the possibility of reverse causality in the model using the same instruments.<sup>8</sup> Also, we employ the probit and IV-probit models with a dummy variable of whether the households have more than

<sup>6</sup>Some news articles introduced the difficulty to find the public housing among young people [South China Morning Post (2018, 2019)].

<sup>7</sup>Some existing literature explicates the potential relationship between housing style (i.e., Rent or Ownership) or housing price and fertility decision [Lovenheim and Mumford (2013); Detting & Kearney (2014); Lin *et al.* (2016)].

<sup>8</sup>We apply the  $5yearsFDWemployment$  model in the OLS and IPWRA estimations, too.

two infants or not (= 1 if they have two or more infants in the household) as the outcome variable to check the probability of having multiple children.

In addition to the 2SLS, we employ the IV-Tobit model, particularly when the dependent variable, the number of infants in each household, which is not infinite, is observed only over some interval of its support [Cameron and Trivedi (2010)]. According to our descriptive statistics, the highest number of infants in each household is four. If we use 2SLS under this condition, the results, especially the coefficients, may be upward-biased; hence, we adopt the IV-Tobit model.<sup>9</sup> We use robust standard errors and report 95% confidence intervals because the sample size is large [Wasserstein and Lazar (2016)].

The first-stage estimation for each instrument in the models shows that the excluded variables are significant at the 0.1% level and strongly correlated with the endogenous variable in the benchmark model (*FDWemployment<sub>it</sub>* in Appendix B). There is a difference in the signs of the coefficients between two excluded variables: positive for winning the HOS and negative for receiving housing support. This is attributed to the number of rooms provided in the scheme; that is, the average number of rooms is different between the HOS (3.73 rooms) and the housing scheme (3.06 rooms), while the average number of rooms in the full sample is 3.27 rooms. Cortés and Pan (2013) suggest that the number of rooms affects the decision to employ FDWs because of the governmental regulation in Hong Kong. Therefore, as the housing scheme affects the number of rooms, it also affects the decision to employ FDWs. Although the dummy variable for winning for HOS is not significant in the first stage of the limited-sample model (*5yearsFDWemployment<sub>it</sub>* in Appendix B), we find that the *F*-test for the excluded variables is statistically significant. Moreover, the *p*-values of the Anderson–Rubin Wald *F*-test of both models are under 0.01. Thus, these instruments are appropriate for our estimation with the endogenous variable (see the first-stage estimation in Appendix B).

Using the large micro-level household dataset from the census, we can also examine the individual impacts of FDWs on fertility choice. Thus, in addition to the estimation using all the samples in the dataset, we conduct subgroup analyses based on the socioeconomic characteristics of the samples to examine the heterogeneous treatment effects. We examine the effects of women's educational level and income, the income ratio, and household income, which are likely to affect FDW outcomes [Hazan and Zoabi (2015); Furtado (2016)]. Tables 2–5 present the summary statistics of each subgroup based on these characteristics. Regarding the educational attainment of women (Table 2), we divide the sample into five levels: primary school, lower secondary school, higher secondary school, associate degree, and bachelor/graduate level. The mean educational attainment in the full sample is 11.851 years, which represents a higher secondary school level. Furthermore, we investigate the heterogeneity in household income in two strata: low and high, and in five groups: 0–20%, 21–40%, 41–60%, 61–80%, and 81–100% of the mean (Table 3). The mean monthly income of the sample is HK\$32,341 and the median monthly income is HK\$30,500; thus, the income distribution is upward-biased. Similar to the household income subgroup analysis, women's income is divided into two strata and five groups based on income rank (Table 4). About 32.9% of women in our sample have no

<sup>9</sup>Some studies exploring the effects on the number of biological children employ the Tobit or IV-Tobit regression model [Fort et al. (2016); Marcén et al. (2018)]. Around 72% of the women in our sample have no children under five years, 23.6% have one, and 4.4% have two or more.

**Table 2.** Descriptive analysis for educational attainment sub-group (unit: year)

Education level	Obs	Mean	Std. Dev.	Min	Max
Primary	1,191	5.095	1.482	0	6
Lower second	4,094	8.684	0.631	7	9
Higher second	7,839	11.175	0.699	10	13
Associate	3,268	14.301	0.459	14	15
Bachelor	3,999	16.429	1.000	16	21

**Table 3.** Descriptive analysis for household income level sub-group (unit: HK\$)

HH income	Obs	Mean	Std. Dev.	Min	Max
Lower	10,214	22034.19	4672.569	15000	30500
Higher	10,177	42686.12	7785.243	30510	58000
0–20%	4,307	17488.49	1674.578	15000	20000
21–40%	3,956	23549.98	2031.797	20020	27000
41–60%	4,217	31081.84	2283.771	27050	35000
61–80%	3,833	39784.32	2660.142	35040	44670
81–100%	4,078	50863.61	3913.506	44690	58000

**Table 4.** Descriptive analysis for ladies' income level sub-group (unit: HK\$)

Wife income	Obs	Mean	Std. Dev.	Min	Max
Lower	10,196	2618.291	3926.468	0	10410
Higher	10,195	19596.13	7976.353	10500	58000
0–20%	6,699	0	0	0	0
21–40%	1,667	5478.794	2153.854	300	8000
41–60%	3,920	10833.47	1358.184	8060	13000
61–80%	4,860	16837.44	2124.014	13050	20000
81–100%	3,245	28674.37	7806.84	20050	58000

income (i.e., they do not perform market activities outside the home). On the contrary, 54.8% earn more than HK\$10,000 per month. Finally, we investigate the heterogeneous treatment effects of the income ratio (Table 5). An income ratio of zero suggests that women do not earn outside the home; on the contrary, an income ratio of one implies that only the women, mainly single parents, contribute to household income. In our sample, 7,579 women (37.2%) contribute more than half of household income.

**Table 5.** Descriptive analysis for income ratio between a couple level sub-group (unit: HK\$)

Income ratio	Obs	Mean	Std. Dev.	Min	Max
lower	10,223	0.103	0.151	0	0.4
Higher	10,168	0.709	0.243	0.4003	1
0–20%	6,699	0.000	0.000	0	0
21–40%	1,458	0.212	0.075	0.005964	0.302198
41–60%	4,081	0.399	0.047	0.302326	0.472727
61–80%	4,075	0.556	0.070	0.472789	0.772727
81–100%	4,078	0.995	0.030	0.774194	1

## 5. Results

### 5.1 Main analysis

Table 6 presents the main results estimated using the OLS, IPWRA, 2SLS, and IV-Tobit models. The OLS estimation suggests that the employment of FDWs is positively associated with the number of infants (0.360 children in column 1) in the household at the 0.1% significance level, although this cannot be interpreted causally. If we take into account the confounder on the treatment and outcome and apply the IPWRA estimation, the result is consistent (0.341 children in column 2). Moreover, we also observe the same tendency, namely, positive and significant results, if we employ the 2SLS and IV-Tobit models (0.601 children in columns 3 and 4). This finding corresponds with the theoretical consideration proposed by d’Albis *et al.* (2017) that easier access to market-based childcare services and the expectation of a lower price allow parents to purchase such services, and this encourages childbearing. Columns 5 and 6 show the results of the impacts of employing the FDWs on having the multiple children, and we find that the probability of having more than two children increases in the FDWs-employed households. In our context, feasible access to FDWs may relax the burden of child-rearing. We also replace the outcome variable with the number of children less than one or three years old and find consistent results (Appendix C and D).

Regarding the other covariates, household income negatively affects fertility outcomes in each model (−0.048 to −0.089 children). In terms of the sex of the first child in the household, son preference has a long history in Chinese culture because the husband is dominant in the family [Bo (2018)]. However, since Hong Kong was colonized by the United Kingdom until 1997, integrating it into international culture, such son preference has diminished and is now regarded as a feudal tradition. Our results show that if the first child is a daughter, these families are more likely to bear a second child (0.344–0.359 children). One of the reasons is that the number of migrants from Mainland China has increased and they have a stronger preference for sons than Hong Kong-born residents [Basten and Verropoulou (2013)]. Moreover, as expected, women’s age also negatively affects the number of births. In addition, if the household has children aged five years or older, there is a disincentive to bear a child.

However, as a reverse causality may exist in the above analysis, we undertake another regression by restricting our sample to households that had not relocated in the five years before the survey year (12,404 households) using the address information. Of this sample, 367 households have employed the same live-in FDW for more than

**Table 6.** Results (full sample ( $N = 20,391$ ))

	Y = Number of infants				Y = Have more than two infants	
	OLS (1)	IPWRA (2)	2SLS (3)	IV-Tobit (4)	Probit (5)	IV-Probit (6)
FDW in the household	0.360*** (0.013) [0.336–0.385]	0.341*** (0.013) [0.316–0.366]	0.601*** (0.091) [0.423–0.778]	0.601*** (0.091) [0.423–0.778]	0.677*** (0.047) [0.585–0.768]	0.714 (0.480) [–0.228 to 1.656]
Log-monthly household income	–0.048*** (0.010) [–0.067 to –0.029]		–0.089*** (0.019) [–0.125 to –0.052]	–0.089*** (0.019) [–0.125 to –0.052]	–0.251*** (0.050) [–0.348 to –0.153]	–0.257** (0.093) [–0.440 to –0.074]
# of elderly persons	–0.005 (0.007) [–0.018 to 0.007]		–0.003 (0.007) [–0.016 to 0.010]	–0.003 (0.007) [–0.016 to 0.010]	–0.067+ (0.040) [–0.146 to 0.013]	–0.066 (0.041) [–0.146 to 0.013]
# of pupils	–0.198*** (0.005) [–0.208 to –0.189]		–0.213*** (0.007) [–0.228 to –0.198]	–0.213*** (0.007) [–0.228 to –0.198]	–0.714*** (0.047) [–0.805 to –0.622]	–0.716*** (0.054) [–0.821 to –0.611]
Live in islands	0.034 (0.026) [–0.017 to 0.085]		0.02 (0.027) [–0.032 to 0.072]	0.02 (0.027) [–0.032 to 0.072]	0.041 (0.110) [–0.175 to 0.257]	0.038 (0.114) [–0.185 to 0.262]
Age of wife	–0.026*** (0.001) [–0.027 to –0.025]		–0.026*** (0.001) [–0.027 to –0.025]	–0.026*** (0.001) [–0.027 to –0.025]	–0.044*** (0.003) [–0.050 to –0.039]	–0.044*** (0.003) [–0.050 to –0.038]



Education years of wife	0.008***	0.005***	0.005***	0.014*	0.014
	(0.001)	(0.002)	(0.002)	(0.006)	(0.008)
	[0.006–0.010]	[0.002–0.008]	[0.002–0.008]	[0.002–0.026]	[–0.003 to 0.030]
Single female	0.141***	0.127***	0.127***	0.159	0.157
	(0.016)	(0.018)	(0.018)	(0.113)	(0.118)
	[0.108–0.173]	[0.092–0.162]	[0.092–0.162]	[–0.063 to 0.382]	[–0.074 to 0.388]
First child is a daughter	0.359***	0.344***	0.344***	0.632***	0.630***
	(0.009)	(0.010)	(0.010)	(0.041)	(0.051)
	[0.342–0.376]	[0.324–0.364]	[0.324–0.364]	[0.553–0.712]	[0.529–0.730]
Income ratio	–0.276***	–0.286***	–0.286***	–0.508***	–0.509***
	(0.011)	(0.012)	(0.012)	(0.060)	(0.061)
	[–0.298 to –0.255]	[–0.308 to –0.263]	[–0.308 to –0.263]	[–0.625 to –0.391]	[–0.629 to –0.390]
Constant	1.739***	–0.089***	–0.089***	2.359***	2.428*
	(0.102)	(0.019)	(0.019)	(0.514)	(1.021)
	[1.539–1.939]	[–0.125 to –0.052]	[–0.125 to –0.052]	[1.351–3.367]	[0.428–4.429]

+ $P < 0.10$ , \* $P < 0.05$ , \*\* $P < 0.01$ , \*\*\* $P < 0.001$ . Robust-standard error in parenthesis. 95% CI in bracket.

About (1), the OLS estimation is represented. About (2), we show the average treatment effect on the treated using the IPWRA estimator. This estimator compares the outcome between treatment group (FDW employing households) and control group (Not-employment group) based on each treatment and control regression estimation. The control variables of outcome model in (2) are the same as (1); on the contrary, the treatment model includes the dummy variables of HOS and housing subsidy with the control variables of the outcome model. For brevity, we only represent the ATT results here. For (3), we employ the 2SLS model. For (4), we employ the IV-Tobit model. About (5) and (6), we replace the outcome with the dummy variable whether they have more than two infants in the family. The coefficients represent the marginal effects.

**Table 7.** Results [samples not moving for five years ( $N = 12,404$ )]

	Y = Number of infants				Y = Have more than two infants	
	OLS	IPWRA	2SLS	IV-Tobit	Probit	IV-Probit
	(1)	(2)	(3)	(4)	(5)	(6)
FDW works more than five years	0.061*	0.047+	2.050***	2.183***	0.359*	4.054***
	(0.026)	(0.025)	(0.363)	(0.397)	(0.147)	(0.897)
	[0.009–0.112]	[–0.002 to 0.097]	[1.338–2.762]	[1.404–2.961]	[0.070–0.647]	[2.295–5.813]
Log-monthly household income	0.034**		–0.036+	–0.041+	0.053	–0.086
	(0.012)		(0.020)	(0.021)	(0.071)	(0.069)
	[0.011–0.057]		[–0.075 to 0.003]	[–0.082 to 0.000]	[–0.086 to 0.191]	[–0.222 to 0.049]
# of elderly persons	–0.006		0.006	0.007	–0.051	–0.013
	(0.007)		(0.009)	(0.009)	(0.053)	(0.043)
	[–0.021 to 0.008]		[–0.012 to 0.024]	[–0.011 to 0.025]	[–0.155 to 0.054]	[–0.097 to 0.072]
# of pupils	–0.153***		–0.214***	–0.218***	–0.695***	–0.651***
	(0.006)		(0.014)	(0.015)	(0.064)	(0.076)
	[–0.165 to –0.141]		[–0.241 to –0.187]	[–0.247 to –0.190]	[–0.820 to –0.570]	[–0.801 to –0.501]
Live in islands	0.009		0.014	0.014	0.093	0.081
	(0.031)		(0.035)	(0.035)	(0.172)	(0.139)
	[–0.052 to 0.069]		[–0.055 to 0.082]	[–0.055 to 0.083]	[–0.245 to 0.431]	[–0.191 to 0.352]
Age of wife	–0.030***		–0.033***	–0.033***	–0.072***	–0.062***
	(0.001)		(0.001)	(0.001)	(0.004)	(0.008)
	[–0.031 to –0.028]		[–0.035 to –0.031]	[–0.036 to –0.031]	[–0.080 to –0.064]	[–0.079 to –0.046]

Education years of wife	0.016***	0.008***	0.008**	0.037***	0.012
	(0.001)	(0.002)	(0.002)	(0.009)	(0.011)
	[0.014–0.019]	[0.004–0.012]	[0.003–0.012]	[0.020–0.054]	[–0.009 to 0.034]
Single female	0.145***	0.150***	0.150***	0.610***	0.484**
	(0.019)	(0.027)	(0.028)	(0.160)	(0.152)
	[0.107–0.182]	[0.097–0.203]	[0.096–0.205]	[0.296–0.924]	[0.186–0.782]
First child is a daughter	0.295***	0.296***	0.297***	0.664***	0.515***
	(0.011)	(0.014)	(0.014)	(0.061)	(0.098)
	[0.274–0.317]	[0.269–0.324]	[0.268–0.325]	[0.544–0.784]	[0.324–0.706]
Income ratio	–0.282***	–0.311***	–0.313***	–0.783***	–0.655***
	(0.013)	(0.017)	(0.018)	(0.085)	(0.113)
	[–0.308 to –0.256]	[–0.344 to –0.277]	[–0.347 to –0.278]	[–0.951 to –0.616]	[–0.876 to –0.434]
Constant	0.034**	–0.036+	–0.041+	0.13	1.827*
	(0.012)	(0.020)	(0.021)	(0.719)	(0.711)
	[0.011–0.057]	[–0.075 to 0.003]	[–0.082 to 0.000]	[–1.280 to 1.540]	[0.435–3.220]

+ $P < 0.10$ , \* $P < 0.05$ , \*\* $P < 0.01$ , \*\*\* $P < 0.001$ . Robust-standard error in parenthesis. 95% CI in bracket.

About (1), the OLS estimation is represented. About (2), we show the average treatment effect on the treated using the IPWRA estimator. This estimator compares the outcome between treatment group (FDW employing households) and control group (Not-employment group) based on each treatment and control regression estimation. The control variables of outcome model in (2) are the same as (1); on the contrary, the treatment model includes the dummy variables of HOS and housing subsidy with the control variables of the outcome model. For brevity, we only represent the ATT results here. For (3), we employ the 2SLS model. For (4), we employ the IV-Tobit model. About (5) and (6), we replace the outcome with the dummy variable whether they have more than two infants in the family. The coefficients represent the marginal effects.

five years. Table 7 presents the regression results. The OLS and IPWRA estimations confirm the increase in children at more than the 10% significance level (0.047–0.061 children in columns 1 and 2). The 2SLS estimation and IV-Tobit model show that if FDWs have been employed for more than five years, households had more children (2.050–2.183 children in columns 3 and 4) at under the 1% significance level, which is robust as it is free of possible reverse causality. When we demonstrate the probability of having two or more infants in the household using the probit model approach, the results are significantly positive (0.359–4.054 as the marginal effects in columns 5 and 6); thus, the FDWs prompt the fertility choice in the households. Our IV models show relatively larger coefficients of the treatment of employing FDWs compared to OLS models because these estimators are the local average treatment effects (LATE), which is the average treatment effects (ATE) of compliers in the population [Imbens and Angrist (1994)]. Under this assumption, the IV estimators often exceed the estimates by OLS, and the LATEs do not necessarily inform the exact effect sizes of the ATE in the total samples [Angrist and Evans (1998); Oreopoulos (2006)].<sup>10</sup> Further, this effect of FDWs on fertility choice in our model is a conservative estimate of the true impact, as we code FDW employment equal to one when the household employs the same FDW for more than five years and zero otherwise. This indicates that those households that have employed the same live-in FDW for under five years or different live-in FDWs over time are coded as zero. Regarding the other covariates, the results are similar to those in Table 6. Hence, the results of this analysis show that FDW employment has a positive impact on increasing the number of children in the household.

## 5.2 Heterogeneity analysis

From our large sample, we explore the heterogeneous effects using subgroup analysis. The models in the subgroup analyses employ the 2SLS models and the same control variables presented in OLS and IV models in Tables 6 and 7, which are less likely to be endogenous. Table 8 shows the treatment effect (*FDWemployment* or *5yearsFDWemployment*) on the number of infants born within five years for each subgroup. Regarding educational attainment (columns 1–5), we find that FDW employment has a robust impact, especially in the higher education groups. In particular, we observe that it has a significant impact on the number of births among women who completed above higher secondary school level (e.g., 0.664–3.887 children in bachelor-level group), concurring with the findings of Hazan and Zoabi (2015) and Furtado (2016). For higher-skilled women, as shown by previous studies, FDW employment may relieve the constraints of fertility choice because the budget constraint is altered based on the marketization hypothesis.

Next, we focus on women's income in the household. Columns 6–12 suggest that women who earn more and employ FDWs are more likely to have more babies. Bar *et al.* (2018) also suggest similar implications using US data. We thus confirm that the marketization of childcare is effective for the fertility choice among high-income

<sup>10</sup>We also examined whether the households that employed the same FDWs and stayed at the same address for more than five years statistically differ from those who did not hire the FDWs and stayed for the same period. We find that there is no significant difference in the number of infants (Appendix F). Furthermore, the *F*-test for checking the multicollinearity of covariances also shows insignificant results on the null hypothesis. Those results are available upon request.

**Table 8.** Results for sub-group analysis (only interest variables shown)

	Primary	Lower second	Higher second	Associate	Bachelor		
Wife Education	(1)	(2)	(3)	(4)	(5)		
FDW in the household	0.392	0.808*	0.408**	0.583*	0.664***		
	(0.679)	(0.375)	(0.125)	(0.239)	(0.186)		
	[-0.938 to 1.723]	[0.073–1.543]	[0.163–0.652]	[0.115–1.051]	[0.299–1.030]		
<i>N</i>	1,191	4,094	7,839	3,268	3,999		
FDWs work more than five years	-1.107	0.438	1.574**	2.273**	3.877*		
	(1.529)	(1.003)	(0.481)	(0.818)	(1.546)		
	[-4.104 to 1.890]	[-1.529, to 2.404]	[0.631–2.517]	[0.669–3.877]	[0.846–6.907]		
<i>N</i>	823	2,741	5,153	1,795	1,892		
Wife income	Lower	Higher	0–20%	21–40%	41–60%	61–80%	81–100%
	(6)	(7)	(8)	(9)	(10)	(11)	(12)
FDW in the household	0.209	0.831***	0.094	0.39	0.426**	0.917***	0.811***
	(0.161)	(0.111)	(0.216)	(0.313)	(0.147)	(0.172)	(0.200)
	[-0.106 to 0.524]	[0.613–1.049]	[-0.330 to 0.518]	[-0.224 to 1.004]	[0.138–0.714]	[0.580–1.254]	[0.420–1.203]
<i>N</i>	10196	10195	6,699	1,667	3,920	4,860	3,245
FDWs work more than five years	0.887*	2.869***	0.764	1.949*	0.644	2.990**	3.575*
	(0.413)	(0.690)	(0.582)	(0.819)	(0.541)	(1.043)	(1.674)
	[0.078–1.697]	[1.517–4.220]	[-0.376 to 1.905]	[0.344–3.553]	[-0.416 to 1.703]	[0.946–5.034]	[0.293–6.857]
<i>N</i>	6,158	6,246	3,860	1,067	2,599	3,000	1,878

(Continued)

Table 8. (Continued.)

	Lower	Higher	0–20%	21–40%	41–60%	61–80%	81–100%
Income ratio (wife/couple)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
FDW in the household	0.054	0.851***	0.094	0.279	0.039	0.507**	0.941***
	(0.173)	(0.107)	(0.216)	(0.648)	(0.248)	(0.174)	(0.129)
	[−0.284 to 0.392]	[0.642–1.060]	[−0.330 to 0.518]	[−0.992 to 1.550]	[−0.447 to 0.526]	[0.167–0.848]	[0.688–1.194]
<i>N</i>	10223	10168	6,699	1,458	4,081	4,075	4,078
FDWs work more than five years	0.53	2.801***	0.764	1.428	−0.218	1.892*	1.929**
	(0.488)	(0.578)	(0.582)	(2.594)	(0.752)	(0.928)	(0.597)
	[−0.426 to 1.486]	[1.668–3.935]	[−0.376 to 1.905]	[−3.655 to 6.511]	[−1.692 to 1.256]	[0.073–3.711]	[0.760–3.099]
<i>N</i>	6,053	6,351	3,860	935	2,417	2,414	2,778
Household income	Lower	Higher	0–20%	21–40%	41–60%	61–80%	81–100%
	(20)	(21)	(22)	(23)	(24)	(25)	(26)
FDW in the household	0.793***	0.403***	0.775**	0.687***	0.732***	0.376*	0.403*
	(0.151)	(0.117)	(0.292)	(0.191)	(0.212)	(0.172)	(0.173)
	[0.497–1.088]	[0.174–0.632]	[0.202–1.348]	[0.312–1.061]	[0.316–1.148]	[0.039–0.713]	[0.064–0.742]
<i>N</i>	10214	10177	4,307	3,956	4,217	3,833	4,078
FDWs work more than five years	2.220***	1.808**	2.414**	1.516**	2.444*	3.092*	1.105
	(0.475)	(0.616)	(0.844)	(0.570)	(0.962)	(1.510)	(0.702)
	[1.289–3.152]	[0.601–3.016]	[0.761–4.068]	[0.400–2.632]	[0.560–4.329]	[0.132–6.051]	[−0.271 to 2.481]
<i>N</i>	6,302	6,102	2,495	2,553	2,734	2,358	2,264

(Continued)

**Table 8.** (Continued.)

HH income× income ratio	Low & lower (27)	Low & higher (28)	High & lower (29)	High & higher (30)
FDW in the household	0.344 (0.302) [-0.248 to 0.936]	0.878*** (0.154) [0.577–1.180]	–0.238 (0.220) [–0.670 to 0.194]	0.734*** (0.156) [0.427–1.040]
<i>N</i>	5,519	4,695	4,704	5,473
FDWs work more than five years	1.793* (0.843) [0.140–3.445]	1.749*** (0.495) [0.778–2.720]	–0.671 (0.687) [–2.017 to 0.676]	3.974** (1.539) [0.958–6.990]
<i>N</i>	3,293	3,009	2,760	3,342

Note: +*P*<0.10, \**P*<0.05, \*\**P*<0.01, \*\*\**P*<0.001. Robust-standard error in parenthesis. 95% CI in bracket.

The outcome is the number of infants (less than five years old). We employ 2SLS model in the estimation controlling log-monthly household income, number of elderly persons, number of pupils in the household, HHs that live in islands, age of females, education years of females, divorce/widow/separate dummy, First order’s gender dummy and ratio of couple’s income. About the treatment effects of FDWs working for more than five years, we limit the sample who has not moved for five years.

women. Furthermore, to check the robustness of the results, we investigate the income ratio (columns 13–19). We confirm that higher-income women and those making the top 40% contribution to household income have more children after exploiting the services provided by FDWs. Notably, the result for the top 20% income earners is more robust (0.941–1.929 children; column 19). This implies that a woman's income and her contribution to household income are crucial determinants of the fertility decision when households employ FDWs.

We also find that both low- and high-income households employing FDWs have a positive impact on fertility behavior at the 5% significance level (columns 20–26). In addition, we observe a positive impact in all five income groups. This tendency is the same for the model using FDW employment over five years. In summary, the employment of FDWs is effective at raising the rate of having children in households regardless of household income, especially if we control for the related variables. Hence, all things being equal, FDW-employing households, even lower-income ones, may increase their number of children.

To clarify the mechanism through which income and FDW employment affect the fertility decision, we create a  $2 \times 2$  analysis between low and high household income and low and high income ratio (columns 27–30). Our higher contribution group, in which women earn an income of more than 40% of the household total (the minimum ratio of the higher income ratio group is 40.03%), is responsive to the fertility choice against access to FDWs regardless of the absolute value of household income. We observe the same tendency in the five-year estimation. These results imply that the income contribution by women rather than absolute household income is a crucial component for the fertility response to outsourcing housekeeping and child-rearing to immigrants.

### 5.3 Sensitivity analysis

To confirm the validity of our IV results, we conduct the sensitivity test developed by Conley *et al.* (2012) known as the plausibly exogenous test. This test assesses whether our IVs continue to provide informative results when relaxing the strong assumption of the exclusion restriction. We rewrite the 2SLS equations in equations (1) and (2), including the additional terms of the IVs in the second stage, as follows:

$$FDWemployment_i = \gamma_1 Z_{1i} + \gamma_2 Z_{2i} + \varphi X_i + \varepsilon_i, \quad (3)$$

$$y_i = \beta FDWemployment_i + \lambda X_i + \theta_1 Z_{1i} + \theta_2 Z_{2i} + \mu_i, \quad (4)$$

In the previous analysis, we assumed that  $\theta_j = 0$  in equation (4), and this resulted in point estimates for the coefficients of  $FDWemployment_i$  and  $5yearsFDWemployment_i$ . According to Conley *et al.* (2012), researchers can remove the assumption that  $\theta_j = 0$  and select possible values for  $\theta$  in a range of flexible ways, allowing the instruments to have small direct effects on the outcome, which violates the assumption of the exclusion restriction. Under this weak condition, we estimate the bounds of the effect of the endogenous variable, namely,  $FDWemployment_i$  and  $5yearsFDWemployment_i$ . We employ the union of confidence intervals approach in the plausibly exogenous test and specify the possible restrictions for  $\theta_j \in [-\kappa, +\kappa] \forall j$ , where  $\kappa > 0$  is arbitrarily small. The size of  $\kappa$  is the direct effect of the instruments on the number of infants and the degree of the violation of the exclusion restriction.



**Table 9.** Bounds for the effect of FDW employment on the number of infants

Support for possible values of $\theta = \theta_1 = \theta_2$	FDW in the household		FDW works more than 5 years	
	(1)		(2)	
	Lower	Upper	Lower	Upper
$\theta \in [-0.0001; +0.0001]$	0.422	0.779	1.335	2.767
$\theta \in [-0.0005; +0.0005]$	0.417	0.784	1.319	2.786
$\theta \in [-0.001; +0.001]$	0.411	0.791	1.300	2.811
$\theta \in [-0.005; +0.005]$	0.362	0.841	1.145	3.008
$\theta \in [-0.01; +0.01]$	0.301	0.903	0.949	3.257
<i>N</i>	20,391		12,404	

*Notes:* The outcome is the number of infants (less than five years old). We employ 2SLS model in the estimation controlling log-monthly household income, number of elderly persons, number of pupils in the household, HHs that live in islands, age of females, education years of females, divorce/widow/separate dummy, first order's gender dummy and ratio of couple's income. We employ robust standard error. About the treatment effects of FDWs working for more than five years, we limit the sample who has not moved for five years. Bounds are estimated using the STATA package "plausexog".

Table 9 shows the results of the plausibly exogenous test in which we estimate the bounds for the estimator of interest  $\beta$  using 95% confidence intervals with the alternative values of  $\kappa = 0.0001, 0.0005, 0.001, 0.005, \text{ and } 0.01$ . The results are from the 2SLS estimator controlled by the same vector as in column 3 of Tables 6 and 7. We find that the estimated bounds do not fluctuate with  $\kappa$  as much and that no bounds of our estimation include zero or negative coefficients. Moreover, the 95% confidence interval is [0.423, 0.778] for the effect of employing FDWs (column 3 in Table 3) and [1.338, 2.762] for the effect of employing FDWs for more than five years (column 3 in Table 4) when we assume that the IVs do not violate the exclusion restriction. Given that the union of confidence intervals approach proposed by Conley *et al.* (2012) is considered to be conservative, this indicates that the results presented earlier are robust even if we relax the strong exclusion restriction necessary for the estimation employing the IVs. Thus, we can conclude that our central inference is informative and valid.

### 6. Conclusion

We explore the impact of employing FDWs in Hong Kong on fertility outcomes using the micro data from the census. Using OLS, the IPWRA, and the IV approach with variables related to the housing schemes, we find that households that employ FDWs have more children. To validate the robustness of this finding, we exploit past and current address information and explicate the causal relationship between the long-term employment of FDWs and fertility response. We find that households that had employed the same FDW for five years before the survey year robustly increased the number of children. Furthermore, the subgroup analysis reveals that highly educated women have a positive impact on the fertility response in households. Regarding income characteristics, we find that the employment of FDWs in

households is prevalent when women have a higher income and contribute more to household income. In summary, FDWs in Hong Kong have a positive impact on households' fertility response, especially in "career women's households". Moreover, we confirm that relaxing the exclusion restriction does not nullify our inference that employing FDWs positively affects birth choice using a sensitivity analysis.

As mentioned in the research context, there are two potential fertility-related outcomes when employing FDWs in households: an increase in births due to easing budget constraints or a decrease in births due to female participation in the labor market. Our results show that FDWs in Hong Kong have recently served to reduce the costs of child-rearing in households rather than increasing its opportunity cost. In particular, for households in which women have a higher education or contribute more income to the household, the fertility response is more responsive to FDW employment. This implication supports the concept of the marketization hypothesis [Freeman and Schettkat (2005); Hazan and Zoabi (2015); Bar *et al.* (2018)], meaning that women purchase and outsource their housework to migrant workers so that they are able to give births without sacrificing their careers. The first-stage estimation of our IV approach suggests that households with higher female income ratios are more likely to employ FDWs. That is, they have a strong preference for outsourcing home duties and have children after hiring FDWs. We consider these outcomes for two main reasons: to mitigate conflicts with career advancement and to exert higher bargaining power in the household. First, high-skilled women face difficulties handling both home duties and labor supply because of time constraints. FDWs relieve their pressure by combining these tasks, and this can motivate women to have a child to maintain work/life balance. Second, if the woman's income share in the household is high, her intra-household bargaining power may rise because her income provides direct bargaining power and because such women tend to acquire the knowledge or skills to handle the work environment, which may raise their intra-household bargaining power further [Hoddinott and Haddad (1995); Doss (2013)]. Some recent studies find that households decide their intra-household resource allocation based on not only the unitary model but also the collective model, which allows for different preferences and bargaining power among household members [e.g., Browning and Chiappori (1998); Attanasio *et al.* (2012)]. In particular, women prefer to consume health- and education-related resources more than men, and households with female high bargaining power consume more such items [Hoddinott and Haddad (1995); Quisumbing and Maluccio (2003)]. These explanations apply to the preferences and perceived costs of outsourcing housekeeping and child-rearing; that is, households with women who contribute to household income more and have higher decision-making power are likely to outsource household duties. Although fertility decisions are jointly made with partners, women can have a much stronger influence on the fertility choice in the household than men [Rasul (2008); Stein *et al.* (2014); Doepke and Kindermann (2019)]. The employment of FDWs who relieve the burden of child-rearing thus promotes the willingness of households that have women with higher bargaining power to have more children. Both mechanisms may drive fertility decisions in households with higher-skilled and higher-income women.

In comparison with the above description, we discuss the tradeoff between quality and quantity of children. The conventional economic intuition suggests that the parents will spend less on the quality of children if they invest in the quantity more. Although our data do not allow us to investigate the quality or skills of the infants, the existing literature implies that there is a positive relationship between the

employment of FDWs and the quality or skill enhancement among children in Hong Kong. Tse *et al.* (2009) tested the English reading ability among the fourth-grade students in Hong Kong and find that the children in the FDW-employing households get higher scores. This tendency is robust among the children that the parent's socioeconomic status is relatively high. Tang and Yung (2016) explore the impact of employing the FDWs on the educational performance of children using the household data from the census and the unique survey. They reveal that the probability of late schooling decreases at 3–4% among elementary students whose mothers work and employ Filipino live-in FDWs. Tang (2019) discovers that the probability that children can speak English increases by 12–25% of their mothers works outside and the FDWs speak English in their home. Moreover, Leung (2012) and Dulay *et al.* (2017) also present that the FDWs are likely to improve the communication skills or the language ability of the children. Through these works, we understand that the FDWs play a crucial role in the skill enhancement of the children, and this structure is robust among the households with working mothers or high-income parents. In other words, our findings and the previous literature suggest that the higher-income households purchase and outsource the housekeeping services, and guarantee both the quality and quantity of children, relying on the marketization hypothesis. On the contrary, it is relatively difficult to ensure both the quantity and the quality of children from the households with lower income because such a concept may not apply to these groups from the findings. As De la Croix and Doepke (2003) imply the linkage of inequality and the differentials of the fertility between rich and poor based on quality–quantity tradeoff, we need to explicate the differential of the quality and the quantity under the marketization hypothesis in the future.

Our analysis has important implications for countries that have faced or will face low fertility. First, as Furtado (2016) suggests, immigrants increase labor supply in host countries, especially in low-skilled industries, and immigration increases the fertility rate, which can maintain the strength of the future workforce. While the literature finds such possibilities in the United States and Europe, this study explicates that they are also applicable in Asia. Asian countries such as Japan, Thailand, Singapore, China, and Korea have faced an extremely low fertility rate for decades. Other emerging countries also face the risk of a declining fertility rate [United Nations (2019)]. Some countries have started to issue temporary visas for low-skilled immigrants to strengthen the labor force in industries including the housekeeping sector, and these immigration policies could also be effective for demographic issues. Moreover, the findings of our subgroup analysis imply that considering both the direct and the indirect costs of child-rearing is important for implementing family policies. As mentioned in the Introduction, the outcomes of existing policies to solve demographic issues such as children's allowance and parental leave are mixed. Although these policies can compensate for some of the costs for mothers, they may be unable to mitigate conflicts between career success and maternity in their daily lives. According to Doepke and Kindermann (2019), subsidizing market-based childcare services is more efficient at increasing the fertility rate than other policies such as parental leave and tax credits. In other words, FDWs help parents not only by performing home duties at lower cost but also by easing the pressure on them, especially high-earning women, thereby allowing them to balance their jobs and household responsibilities. Therefore, alleviating both the monetary (direct) and the opportunity (indirect) costs of child-rearing is important for “having it all.”

However, this study has its limitations. To understand the mechanism by which FDWs influence the fertility decision of each household, it uses cross-sectional data, which cannot fully control for unobserved characteristics in the estimation. Another limitation is that we do not have a complete history of the FDW employment of households. While we eliminate potential reverse causality by using subsample analyses and IV strategies, future studies should seek to collect specific information on this variable, as this is not available in census data.

**Supplementary material.** The supplementary material for this article can be found at <https://doi.org/10.1017/dem.2021.33>

**Acknowledgement.** This research was supported by Grant-in-Aid for JSPS Fellows (21J10147), Zengin Foundation for Studies on Economics and Finance, K. Matsushita Foundation, and Hodogaya foundation. We are grateful to two anonymous reviewers, the editor of the journal, participants at the 23rd Labor Economics conference in Japan, 2020 Autumn meeting at the Japanese Economic Association, 2nd conference at the Japanese Association for Development Economics, and PAA 2021 meeting for their valuable comments. We are responsible for the remaining errors.

**Conflict of interest.** None.

**Data availability.** The data that support the findings of this study are available from *the Census and Statistics Department in Hong Kong government* upon request.

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**Cite this article:** Nakamura N, Suzuki A (2023). Impact of foreign domestic workers on the fertility decision of households: evidence from Hong Kong. *Journal of Demographic Economics* 89, 105–135. <https://doi.org/10.1017/dem.2021.33>