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The Effect of Fertility on Female Labour Supply in Vietnam

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Abstract

The paper analyses empirically the impact of fertility on female labour force participation in the less researched context of developing countries. Particularly, it focuses on the effect of having an additional child on a female's probability of labour force participation. This study is based on a sample of women aged 18-35 with at least two children from the Vietnam Population and Housing Census Survey 2009.

This study uses an instrumental variable methodology based on the widely observed phenomenon of parental son preference in Vietnamese society to address the endogeneity problem of fertility. Results suggest that the presence of an additional child among families with two or more children is likely to reduce the labour force participation probability of mothers and the effect of these children on female labour supply varies with the mother's and father's educational attainments.

1 Introduction

The relationship between fertility and female labour supply is of longstanding interest to many scholars in both theoretical and empirical literature. However the way an increase in the number of children affects the labour supply behaviour of women is difficult to predict. On one hand, the presence of an additional child will increase household work and opportunity costs of participating in the labour market, so this may reduce the net benefit from female labour supply. On the other hand, an increase in the number of children may increase financial difficulties for households because of increased need of consumption, and this can motivate the labour force participation of women. The magnitude of the effect of fertility on female labour supply is different across different countries. An analysis and understanding of the effect of fertility on labour force participation rates may help explain the post-war increasing trends in the FLFP rate in most countries in the last century. It may also help to explain different trends in labour supply in different countries.

The majority of empirical studies of this subject find a negative impact of fertility on FLFP. However, as shown in the survey of previous literature, Willis (1987) notes that the interpretation

of this relationship is still not clear, it is complicated and ambiguous due to the endogeneity of fertility[1]. The author states "… it has proven difficult to find enough well-measured exogenous variables to permit cause and effect relationships to be extracted from correlations among factors such as the delay of marriage, decline of childbearing, growth of divorce, and increased female labour force participation with aggregate or even micro level data" (p.74). In theory, it is believed that fertility and labour supply are jointly determined[2] because fertility is a choice variable that may be influenced by FLFP decisions. In addition, female labour supply is likely due to be affected by omitted factors such as heterogeneous preferences among different groups of women that may also influence fertility (Jacobsen et al. 1999). Thus, observed negative relationships between fertility and FLFP may be spurious and the negative correlations found may be misleading and cannot be interpreted as evidence of causal impacts (Jacobsen et al. 1999; Cristia 2008).

Many studies have attempted to disentangle the causal mechanisms linking fertility and FLFP. They have exploited exogenous variations in family size to identify the causal relationship between the number of children and the labour supply. For example, several studies use twins at first birth (Rosenzweig and Wolpin 1980b; Bronars and Grogger 1994; Gangadharan et al. 1996; Jacobsen et al. 1999). These studies find that twins at first birth have a negative effect on labour force participation of women. Although twins at first birth is a good IV for fertility, occurrences of twins are rarely observed and studies are often based only on very small samples.

Angrist and Evans (1998) first propose a source of exogenous variations based on the sex composition of the first two children. They exploit a widely observed phenomenon of parental preference for a mixed sex composition of children in Western society and, in particular, in the United States. Parents whose the first two children being of same sex are more likely to have a third child than those of mixed sex siblings. The authors also use twins at second birth as an instrument and compare this with the case of a mixed sex composition to estimate the consequences of moving from the second to the third child on female labour supply and both show that children have negative effects on female labour supply.

This chapter will exploit the identification strategy of Angrist and Evans (1998) that uses the sex composition of the first two children to study the effect of fertility on FLFP in Vietnam but it is different to Angrist and Evans (1998) is that this study uses another instrument which is suitable with Vietnamese parents' preference of sex composition. The study will analyse the causal impact

[1]Browning (1992) also writes when analysing household economic behaviour: "we have a number of robust correlations but there are very few credible inferences that can be drawn from them".
[2] Also see Schultz (1978) and Goldin (1994).

of having more than two children on women's labour force participation among families with two or more children in Vietnam, a developing country where the socioeconomic environment is very different from Western countries. The choice of mixed sex siblings as an IV in Angrist and Evans (1998) study is motivated by the fact that in the US, parents prefer a balanced sex composition, so an unbalanced sex composition of children is a good instrument for having more than two children. However, Vietnam is an Asian society where a son preference exists and parents prefer a male dominated sex composition of children to a mixed sex composition (Haughton and Haughton 1995). Thus, the present study hypothesizes that the first two children being girls should be a good instrument to predict the probability of having a third child, or the total number of children, better than a balanced sex composition. If parents have two girls consecutively, they are more likely to have a third child than those with two boys or those with one girl and one boy. The study also uses twins at second birth as an instrument for having a third child. Moreover, this chapter also investigates heterogeneity in the impact of children on women's labour force participation, depending on different educational levels of mothers and fathers, living areas and access to childcare support from grandparents.

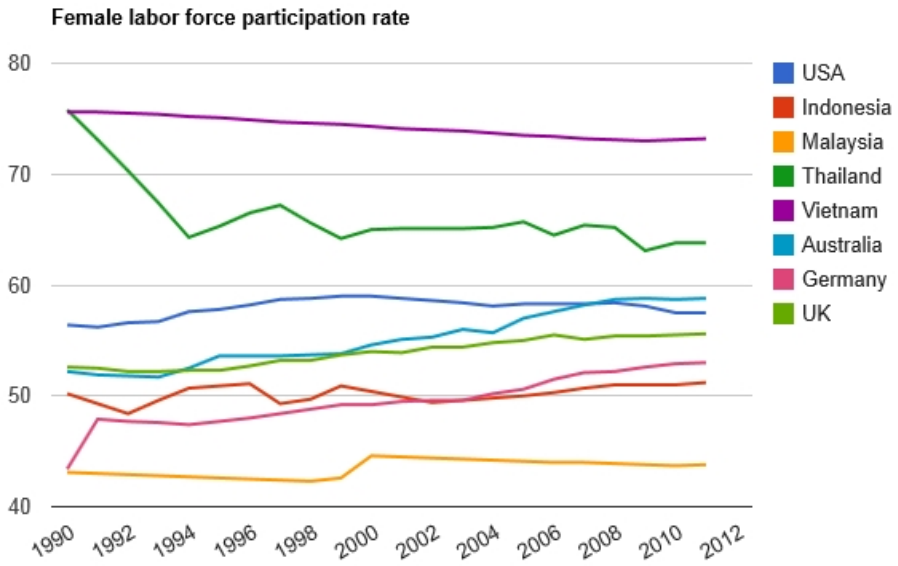
The rest of this chapter is organised as follows: section 2 describes the data, sample construction and descriptive statistics; section 3 presents construction of key variables; section 4 analyses the effect of sex composition of children on fertility and validity of instrumental variables; section 5 describes the econometric methodology; section 6 presents empirical results and discussion; section 7 analyses heterogeneity in the impact of children on female labour supply; and section 8 provides concluding remarks.

2 Data

2.1 Vietnam population, female labour force, and fertility rate

Along with the increase in education level and the worldwide decline in fertility, female labour force participation (FLFP) rates have increased dramatically, especially in the last few decades. Although there has been a continuous decline trend in fertility and a remarkable increase in education levels in developing countries, female labour force participation has been constant or declined in some African and most Asian countries over the last three decades (Priebe, 2011). The trend is also seen in Vietnam (see Figure 1).

Figure 1: Female labour force participation of selected countries (%)



Source: TheGlobalEconomy.com, The World Bank

Vietnam is a developing country in Southeast Asia with a population of 86 million in 2009 and 89 million in 2011 (OECD 2013). At the point of the 2009 census, the country had 49.2 million people aged 15 and older who belonged to the labour force, accounting for 57.3% of the entire population, in which women shared a smaller proportion than men (48% female and 52% male). By 2009, 29.6 percent of the population was living in urban areas compared to 23.7 percent in 1999. Labour force participation rate is defined as the proportion of the population accounted for by labour force to the population aged 15 and over. In 2009, 76.5% of total of 64.3 million people aged 15 and over participated in the labour force, in which 81.8% men compared to 71.4% women. Labour force participation rate varies between urban and rural areas as well as across regions with a higher participation rate for the population in rural areas. The labour force participation rate in 2009 in rural areas was 14 percentage points higher than for urban areas (80.6% compared to 67.1%), in which the differential is larger among women than men (see Table 1). While 60.4 percent of urban women participated in the labour force, this figure for women in rural areas was 76.3 percent.

Table 1 - Labour force participation rates by sex, urban/rural areas, 2009 (%)

Residence region	Total	Male	Female
Entire country	76.5	81.8	71.4
Urban	67.1	74.4	60.4
Rural	80.6	85.0	76.3

Source: VPHC, 2009

Women's participation in the labour force has improved and one of the key national targets is to reduce gender gaps in labour market, and employment. The females' participation rate in the labour market has accounted for nearly a half of the labour force and contributed considerably to economic growth and development in Vietnam. However, as with many other Asian countries, female labour force participation rate has been decreasing during the last two decades 1990-2010 (see Figure 1). In addition, the gender pay gap has been widening in the Vietnamese labour market.

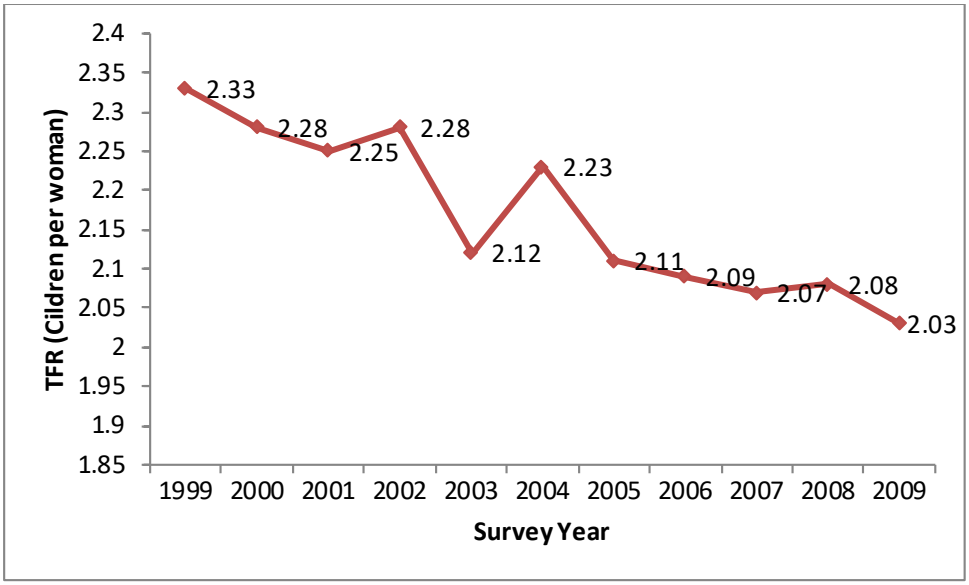
Over past years, many programmes creating job opportunities for women have been implemented such as the project named "Providing vocational training, creating jobs for women during the period 2010-2015" has achieved certain results in improving women's competitiveness in the labour market, helped them find better paid jobs. However, gender inequality still persists in the labour market with the labour force participation of men is higher than women because men often have better access to decent employment opportunities. According to the millennium development goals report 2013 of Ministry of Planning and Investment (MPI), in 2011, women's labour participation rate was at 72.6 percent, which is 9.1 percent lower than men. Women account for a high proportion in the informal sector with limited access to skill development and training. During the period 2009-2011, women's participation in the wage employment labour force is 20 percent lower than men's participation (MPI 2013).

Unlike the case of developed countries, tradition-based expectations, nonexistence of enforced antidiscrimination laws, and the continuing importance of extended family ties still significantly affect women's behaviour of labour force participation, especially in Asian countries such as China, Thailand, Korea. These characteristics are also present in Vietnam where tradition-based expectations such as son preference (Haughton and Haughton, 1995; Bélanger, 2002) and extended family as a source of social and emotional support (Hirschman and Vu, 1996) still plays a role.

Vietnam has experienced a continuous decrease in fertility rates, especially in the period of 1999-2009 and female education has achieved remarkable progress in both quantity and quality. Total fertility rate (TFR) decreased rapidly from 2.33 children per women in 1999 to 2.03 children per women in 2009 (see Figure 2). In general, TFR in urban areas was lower than in rural areas. In 2009, TFR in urban areas was 1.81 children per women, while the figure for rural areas was 2.14 children per women. This differential may be due to urban areas have easier access to information, medical facilities that help prevent unwanted pregnancies. It may also be due to urban areas have better living conditions compared to rural areas. The rapid fall in TFR had important contributions to reducing population growth.

A decline in fertility also accompanied an increase in income. While fertility rate dramatically dropped, GDP per capita increased from 1161.5 to 1770.3 USD per capita during the period from 2007 to 2016 (Worldbank 2017). This pattern is consistent with microeconomic predictions: higher income leads to a reduction in fertility and the inverse relationship of fertility and labour force participation (Becker and Lewis 1973; Willis 1973).

Figure 2: Total fertility rate in Vietnam, 1999-2009



Sources:
- 1999: Central Census Steering Committee, "The 1999 Vietnam Population and Housing Census: Sample results", The Gioi Publishing House, 2000.
-2000–2008: General Statistics Office, "Population Change and Family Planning Surveys: Major Findings", Statistics Publishing House.

Taken together all factors affecting women's participation in the labour force, some factors have positive effects, while other factors have negative impacts on their participation. One question is that while fertility rate in Vietnam dropped rapidly and female education also has achieved remarkable progress during past years, why women's participation in the labour force has not changed much, even slightly decreased. Whether the decrease in fertility rate had no impacts on the participation or these impacts have been offset by other factors such as gender inequality in the labour market, gender-biased perception. Thus, assessing the determinants of women's labour force behaviour in the specific context of a country is necessary for policy design aimed at equal opportunities in the labour market. In the chapter, the author focuses on empirical analysis the impacts of fertility on women's participation behaviour in the labour market. The thesis uses micro data from Vietnamese Census of Population and Housing 2009.

2.2 Vietnam Population and Housing Census (VPHC)

The paper uses Vietnam Population and Housing Census 2009 that comes from IPUMS International. The Population and Housing Censuses were conducted by the Vietnamese GSO with financial and technical support by the United Nations Population Fund (UNFPA) and other United Nations organizations. Among the United Nations agencies, the United Nations Population Fund (UNFPA) played a lead role in supporting the censuses. UNFPA provided assistance in planning the censuses, design of the questionnaires and piloting, training and monitoring processes. When the census was finished, UNFPA assisted in data analysis and dissemination.

The Population and Housing Censuses in Vietnam are conducted every 10 years for all households, with the objective of collecting basic data on population and housing for research and analysis of socioeconomic development plans. Up to now, Vietnam has implemented four Population and Housing Censuses in total since reunification in 1975.

The 2009 Vietnamese Population and Housing Census is the fourth and most recent population census and was conducted on April 1st, 2009. Compared with previous censuses, the 2009 Census had a much larger scope. Beside contents similar to previous censuses on sex, age, ethnicity, education, marital status and demographic features, etc., this census surveyed additional indicators on disabilities, cause of death, materal mortality and basic amenities in the household. The size of the 2009 census sample survey was increased to 15% of the population to allow expansion of the survey contents, while the 1989 and 1999 Census sample survey sizes were only 5% and 3% respectively.

Data from the fifteen per cent Census sample survey of the national population with a national probability sample of 3,692,042 households consisting of 14,177,590 individuals was included to expand the census coverage. The size of the 2009 census sample provides data representing the district level, while the sample sizes of the 1989 and 1999 censuses provide data representing the provincial level only. In addition, Intelligent Character Recognition (ICR) technology was used for data capture instead of traditional keyboard data entry (Nakamura et al. 1979). This study will use the 2009 VPHC to utilise a large sample.

The sample is randomly selected to ensure representation of the whole population. The census is implemented taking the household as a survey unit. The household head is the main respondent and face-to-face interviews are utilised. The VPHC includes detailed information on the characteristics of individuals and households, such as demographics of household members, ethnicity, area of residence, educational background, employment status and birth history of

women (having given birth, number of children ever born, alive, died, etc.) as well as information on mortality and housing (owners, source of water, main facility and appliances, etc.).

2.3 Descriptive statistics

Definitions of variables, instruments, means and standard deviations of these variables are provided in Table 4.

Table 2 - Sample descriptive statistics - Independent variables (families with two or more children)

Variables	Mean (standard deviation)		
	All women sample	Married women sample	
	All women	Wives	Husband
Children ever born	2.287	2.293	2.293
	(0.618)	(0.624)	(0.624)
More than two children (=1 if woman had more than two children)	0.221	0.225	0.225
	(0.415)	(0.418)	(0.418)
Girl 1st (=1 if first child was a girl)	0.502	0.502	0.502
	(0.499)	(0.499)	(0.499)
Girl 2nd (=1 if second child was a girl)	0.485	0.485	0.485
	(0.499)	(0.499)	(0.499)
Two girls (=1 if the first two children were girls)	0.243	0.243	0.243
	(0.429)	(0.429)	(0.429)
Two boys (=1 if the first two children were boys)	0.255	0.255	0.255
	(0.436)	(0.436)	(0.436)
Same sex (=1 if the first two children were the same sex)	0.499	0.498	0.498
	(0.499)	(0.499)	(0.499)
Twin2 (=1 if second birth was twins)	0.005	0.005	0.005
	(0.070)	(0.070)	(0.070)
Age	29.912	29.875	33.052
	(3.740)	(3.746)	(4.806)
Age at first birth (mother and father's age in years when first child was born)	21.113	21.076	24.253
	(2.838)	(2.814)	(3.993)
Ethnicity (=1 if the woman is Kinh, =0 if other ethnic group (minority))	72.1%	71.7%	71.7%
	(0.448)	(0.450)	(0.450)
Urban	0.192	0.184	0.184
	(0.394)	(0.388)	(0.388)
Co-residence with parents/in-laws	0.095	0.096	0.096
	(0.293)	(0.295)	(0.295)
Regions			
Red	0.149	0.149	0.149
	(0.357)	(0.356)	(0.356)
North East	0.209	0.211	0.211
	(0.407)	(0.408)	(0.408)
North West	0.068	0.068	0.068
	(0.253)	(0.253)	(0.253)
North Central	0.123	0.121	0.121
	(0.328)	(0.327)	(0.327)

Central Coast	0.085	0.084	0.084
	(0.278)	(0.278)	(0.278)
Central High	0.078	0.078	0.078
	(0.268)	(0.269)	(0.269)
South East	0.123	0.121	0.121
	(0.328)	(0.326)	(0.326)
Mekong	0.163	0.164	0.164
	(0.369)	(0.370)	(0.370)
Parent's Education			
Less than primary	0.270	0.273	0.233
	(0.444)	(0.445)	(0.423)
Primary	0.623	0.627	0.644
	(0.484)	(0.483)	(0.478)
Secondary	0.066	0.064	0.086
	(0.248)	(0.244)	(0.280)
University	0.041	0.036	0.036
	(0.198)	(0.186)	(0.187)
Number of observations	706,602	669,155	669,155

Notes: The all women samples include women aged 18-35 with at least two children. Married women samples include women who were married at the time of the Census.

The dependent variable *FLFP* is a binary variable that indicates whether women participate in the labour market. Among families with two or more children, the number of children ever born on average to a woman in 2009 is 2.28. *Moretwo* is an endogenous variable of interest in the labour supply equation. As can be seen from the table, 22% of women with two children had an additional child. IVs for having more than two children are *Twogirl* and *Twin2*. *Twogirl* is constructed based on the sex components of the first two children in the population of women with at least two children. About 24% of these families had children of the same sex.

Multiple second births are also used to generate instruments for measuring the movement from two children to three children. A multiple second birth *Twin2* is defined as children having the same mother, the same age and the same month of birth. The mean of multiple second births in the full sample is 0.0049 for the 2009 census.

The table also describes demographic and geographic location variables, including indicators of mothers' age, age at first birth, ethnic background, an urban indicator, geographic region and educational attainment. The average age of mothers in both the all women and married women samples is approximately 30 and the age at first birth mean is 21. There is little difference on the age mean between the all women and married women samples. This could be due to married women accounting for a high proportion of the full sample. The sample includes more than 50 ethnic groups. The majority ethnic group is Kinh, accounting for 72% in the 2009 sample. The

majority of women in the sample live in rural areas, only nineteen per cent of women live in urban areas.

With respect to geographic location, the sample includes eight regional variables corresponding to eight areas: the Red River Delta, North East, North West, North Central, Central Coast, Central Highlands, South East and the Mekong River Delta. The majority of women live in the North East, the Red River Delta and the Mekong River Delta, with the largest proportion of women in the North East area.

The majority of women in the sample have a low educational attainment (primary education or lower). Over half of all women aged 18-35 with at least 2 children completed primary education. Women with secondary education level or above account for a very low proportion. Only 10.7% of women completed secondary and university levels, in which 6.6% of whom completed secondary education and only 4.1% of whom achieved university level. The proportion of women with secondary and university education is slightly lower among the married women sample.

3 The effect of children's sex on fertility and validity of instrumental variables

3.1 The effect of children's sex on fertility

There have been studies in the literature on parents' preference on the sex composition of their children (Angrist and Evans 1998; Carrasco 2001; Iacovou 2001; Chun and Oh 2002; Cruces and Galiani 2007). This preference may affect parents' childbearing decisions and the number of children they wish to have and therefore their labour supply decisions. This parental preference may vary between cultures, nations or over time. According to previous studies, a preference for mixed sex siblings is mainly found in developed countries. Families who have a mixed sex composition of children are less likely to have more children. The effect of a mixed sex composition on childbearing decisions of couples has been examined in a number of studies. Angrist and Evans (1998) examine the 1980 US census data and found that 43.2% of women with two girls or two boys had a third child, while only 37.2% of women with one boy and one girl had a third child. They also showed that the probability of having a third birth among households where the first two children have the same sex (two girls or two boys) is 5-7% higher than households with different sexes in their children. Also, Iacovou (2001) finds families where the first two children have the same sex have an 8-11% higher probability of having a third child than families with a mixed sex component in Britain. Both studies showed that there is no significant difference in the probability of having a third child between couples with two daughters and couples with two sons. This implies that a balanced sex combination is preferred in the US and Britain.

However, the story is different in Asian countries in general and Vietnam in particular. The main finding here is for a male dominated preference. Table 5 reports the impact of children's sex composition on the probability of having an additional child. In the first part of the table, the study describes the fraction of women who have a second birth based on the sex of the first child among families with one or more children. The first two rows show whether a woman's first child is a girl or boy. The third row shows the difference in the fraction of women having a second child with the first child as a girl and the first child as a boy. The table shows that the proportion of having a second child among the couples with the firstborn child as a girl is higher than among the couples with the first child as a boy by 5%. In Angrist and Evans' (1998) study, the likelihood of having a second child is not different between families with a daughter and families with a son as the first child.

The second part of the table describes the proportion of women who have a third birth, conditional on the sex of the first two children in families with two or more children. The first three rows describe the combination of the sexes of the first two children: one boy, one girl; two girls; or two boys. The next line shows the differences in the fraction of women having a third child between the women with two girls and with two boys. The fifth line describes differences between women with two girls and women with one girl, one boy. Data suggests that women with two girls are much more likely to have a third child in comparison to women with two boys as well as to those whose first two children are of mixed sex (one girl, one boy). The impact of two girls on the probability of mothers having more than two children is considerably large in the 2009 census. For example, about 37.7% of women with two girls have a third child, while only 15.5% of women with two boys and 16.7% of women with one girl, one boy have a third child. Women with two girls have a higher probability of having a third birth than women with two boys or women with one boy and one girl, by about 22 and 21 percentage points respectively. The results of the t test show that these differences are statistically significant at the 1percent level.

Table 3 - Proportion of families with another child by the sex of existing children

		All women	**Married women**
Families with one or more children	**Sex of first child**	**Fraction of families that had another child**	
	One girl (1)	0.624	0.645
		(.0000239)	(.0000246)
	One boy (2)	0.573	0.594
		(.0000219)	(.0000232)
	Difference (1) - (2)	0.051	0.051
		(.0000057)	(.0000060)

Number of observations		1,213,230	1,105,653
		All women	**Married women**
Families with two or more children	**Sex of first two children**	**Fraction of families that had another child**	
	One girl, one boy (1)	0.167	0.170
		(.0000347)	(.0000359)
	Two girls (2)	0.377	0.386
		(.0000489)	(.0000498)
	Two boys (3)	0.155	0.158
		(.0000409)	(.0000430)
	Difference (2) - (3)	0.223	0.228
		(.0000357)	(.0000368)
	Difference (2) - (1)	0.210	0.216
		(.0000288)	(.0000296)
	Difference (3) - (1)	-0.120	-0.125
		(.0000115)	(.0000124)
Number of observations		706,721	669,155

Note: The samples are the same as in Table 4. Standard errors are reported in parentheses. The statistical significance of differences in the table is based on t-test results.

Like China, India, Korea and some other East and South Asian countries where son preference has been so persistent (Gu and Li 1994; Park and Cho 1995; Poston Jr et al. 1997; Das Gupta et al. 2003), Vietnamese families have a strong preference for sons rather than a balanced sex composition of children for economic, social, symbolic and cultural reasons, and this is different to the environments of the US in the research by Angrist and Evans (1998) and in Britain by Iacovou (2001). The relationship between the number of girls and the probability of having an additional child is also confirmed in the works of Haughton and Haughton (1995) and Bélanger (2002) in regards to Vietnam. Vietnamese families are much more likely to have a second child if the first child is a daughter. Moreover, if the first two children are daughters, households will try to have at least one son (Haughton and Haughton 1995; Bélanger 2002). However, they may not have the motivation to have additional children if their first two children are sons. Haughton and Haughton (1995) stated that the probability of having more children is very high among families with no sons yet, regardless of the given number of children, while the probability is lower among families with no daughters.

Hence, the probability of having more children increases along with the rise in the number of daughters. For families with one or more children, a first girl may be a good predictor for having a second child. For families with two or more children, the first two girls is a good instrument for whether families will have more than two children. However, the study will use two girls *Twogirl*

as an instrument for an identification strategy of having a third child in the sense that parents with the first two children being girls are more likely to have another child than those who had two sons or those who had one son and one daughter.

The study also uses variables related to unplanned fertility (twins at second birth) as an IV. Since twins are fertility shocks, these events occur randomly and so they can be used as good IVs to generate exogenous variations in fertility. It needs to be noted that the challenge of using these IVs is that it is difficult to obtain a large sample size due to occurrences rarely being observed in the survey sample. As a result, a small sample may produce estimated results that may not be very accurate. However, this study uses a large sample size from the VPHC, so limitations due to small sample size should not be an issue.

3.2 Validity of instrumental variable

A natural concern is that why I focus on the third child, but not on the second child or in other words why does this study not exploit the outcome of moving from the first child to the second child and use only the first child's sex as an instrument. Although there is a difference in the likelihood of having a second child between families with a daughter and families with a son as the first child, this difference is not too large. However, there is a big difference in the probability of having a third child between families with two girls and families with two boys or families with one boy and one girl. Thus, the thesis focuses on the movement from two children to three children. If the sex composition of the first two children is randomly assigned, it will be a good predictor for having a third child.

If the sex of existing children was randomly determined by nature, the sex ratio (the number of boys born per one hundred girls) should stay around the normal level (about 106). If the sex of existing children is not randomly assigned, we cannot use the sex components of the first two children as instruments for fertility because these instruments will be correlated with error terms in the labour supply equation. This leads to violation of the exogeneity condition of a valid instrument. In order to become good instruments for having more children, the assumptions are that instruments created from the sex composition of children must be correlated with having more children and have no impact on the labour force participation of mothers. This can be attained if the sex of children is randomly assigned, irrespective of the preference of parents.

In some developing countries, there are concerns that the presence of son preference may cause the sex composition to no longer be randomly assigned. For example, in Korea or China, the sex ratio by birth order provides evidence of sex selection against female embryos by parental actions

(Chun and Oh 2002). It may be claimed that *Twogirl* may be not randomly determined because, with current modern ultrasonic technologies, it is easy for parents to learn the sex of a fetus. If parents use the sex identification of a fetus to have sex selective abortions, the sex composition of children is no longer randomly assigned. Prenatal sex identification may cause a sex ratio imbalance at birth, as has occurred in recent years in some developing countries. However, the documents of law aspects promulgated as well as the sample data in the study rule out this concern.

First, there may be claims that son preference in Vietnam may lead parents to seek prenatal sex selection. However, a law prohibiting prenatal sex selection was introduced in 2003 by the National Assembly Standing Committee and strengthened by Government Decree No.114 issued in 2006, so sex selective abortions are illegal behaviour under Vietnamese law. Therefore, if this is a case, families who carry out such illegal activities only account for a very small proportion of the entire population.

Second, one can claim that the virtual random assignment of *Twogirl* may lead to regression estimates of fertility and labour supply on these instruments that have a causal interpretation[3]. The random assignment of *Twogirl* can be checked by comparing the demographic characteristics of women who have girls as the first two children with those have two boys or those have one girl and one boy. Table 6 describes the difference in mothers' age, age at first birth, ethnicity, urban indicator and years of schooling by *Twogirl* for the 2009 sample. In general, the differences of magnitude in means (standard errors) for mothers' age at first birth, ethnicity, living areas and years of schooling in the 2009 sample by *Twogirl* are too small and insignificant. There is also no contrast of *Twogirl* for mothers' demographic characteristics. None of these differences are significant at the 5% level, despite the large sample size of the 2009 census. This means that there is no difference in means or standard errors for demographic characteristics between the groups of women who have two girls and those who do not have two girls as their first children.

Table 4 - Differences in means (standard errors) of maternal demographic characteristics by *Twogirl* and *Twin2*

Variables	Difference in means (standard errors)	
	By *Twogirl*	By *Twin2*
Age	-0.0100	0.2820
	(0.0103)	(0.063)
Age at first birth	-0.0096	0.248
	(0.0078)	(0.048)

[3] For example, older women are more likely to have twins (Waterhouse, 1950).

Kinh	-0.00074	0.062
	(0.0012)	(0.0075)
Urban	-0.0011	0.0238
	(0.001)	(0.0066)
Years of schooling	0.082	-2.993
	(0.083)	(0.507)

Notes: The samples are the same as in Table 4. Standard errors are reported in brackets. Kinh is the main ethnic group in Vietnam.

However, there are traditional differences among mothers with twins. The average age as well as age at first birth of mothers with twins is higher than those with no twins by about one quarter of a year. These results are also consistent with a previous well-known study by Waterhouse (1950) which reveals that twins are more likely for older women.

Third, the study also checks the sex ratio of children in the used data sample. Table 7 reports the sex ratio of children by birth order for the data used in this study. The sex ratio (the number of boys divided by the number of girls times 100) of the first child and second child are around 104 and 105 in the 1989 and 1999 censuses, respectively. This ratio is 106 for the 2009 census. In general, the sex ratio of children from data used in the sample is close to the natural sex ratio, and therefore there are no signs of sex selection or parental control that may affect the sex ratio.

Table 5 - Sex ratio by birth order

	Sex ratio (the number of boys born per one hundred girls)		
Birth order	**1989**	**1999**	**2009**
First birth	104.49	105.14	106.56
Second birth	104.35	105.16	105.92
	Sex ratio of children under 5		
First birth	106.25	107.12	106.96
Second birth	103.68	106.03	106.13

Sources: Vietnam Population and Housing Censuses 1989, 1999, 2009

Last, the primary school enrolment rates in Vietnam are approximately the same for boys and girls. According to Vietnam Women's Union of Ho Chi Minh City, the primary school enrolment rate for girls is 91.5% and that for boys is 92.3% (Union 2014). This shows that there is no discrimination by parents against girls, and the son preference mainly reflects the cultural preference in Vietnam. Son preference does not lead parents to use abortion methods to control the sex of their children. Son preference does not cause sex selective abortion as is seen in Korea. In general, there is no sign of sex selective abortions despite of the existence of a son preference.

In summary, all the evidence shows that son preference mainly reflects cultural preferences among Vietnamese people. It does not affect the sex selection, or the sex ratio, of children. At least the first and second order births in this study are randomly determined, and therefore this study assumes that *Twogirl* is randomly assigned. Furthermore, as mentioned above, the first two girls "*Twogirl"* is correlated with having more than children because of the existence of the parental son preference in Vietnam and therefore this instrument meets the relevance condition of a valid instrument. However, whether the instrument is unrelated to dependent variable "labour force participation of mothers". Theoretically, they do not and are therefore a valid instrument. Moreover, this instrument *Twogirl* affects dependent variable "female labour supply" only through independent variable "having more than two children" so it meets the exogeneity condition of a valid instrument.

4 Empirical methodology and estimation

This section describes econometric models and the estimation method. This study can only observe whether the female was involved in work outside the home. In this case, the empirical analyses only focus on the choice of working or not working in the labour market which is a categorical variable taking the value 1 or 0.

4.1 OLS models

To investigate the direct impact of fertility on FLFP, this study will start with the simplest model by treating fertility as an exogenous variable. This can be obtained by estimating the OLS model in the following equation:

$$Y_i = \alpha + \beta X_i + \gamma W_i + u_i \qquad (1)$$

where Y_i is the dependent variable for *FLFP* for individual i (i = 1, 2,…,n); it takes the value of 1 if the woman participates in the labour market and 0 if not;

X_i is the independent variable that indicates whether mother i has more than two children; it is equal to 1 if the woman has more than two children;

u_i is a random error term representing measurement error or unobserved factors on Y_i;

Parameter β captures the effect of having a third child on FLFP. A significantly negative or positive β shows whether the presence of a third child reduces or increases the mother's probability of working in the labour market; and

W is a vector of control variables, namely, age, age at first birth, ethnicity, the urban indicator, regional dummy variables, co-residence with parents or parents-in-law and education of mothers.

4.2 Two stage least squares

The OLS models consider the fertility variable as an exogenous determinant of female labour supply behaviour. However, fertility (the number of children) is an endogenous variable. An important challenge in the estimation is the possible endogeneity of fertility. First, labour supply decisions of women and the number of children as well as the time of childbearing are jointly determined in the household's utility maximisation problem. The number of children may be influenced by FLFP decisions or by other variables in the labour supply equation such as mothers' education, mothers' income or her husband's income. Second, there may be some omitted variables such as different groups of women with heterogenous tastes (that are unable to measured) that affect both fertility and labour force participation decisions. Consequently, estimates of the effect of fertility and other exogenous variables on labour supply behaviour could bias estimation results if we fail to account for the endogeneity of fertility. The OLS results may be biased and unreliable and not reflective of true relations between fertility and labour supply. Thus, in exploring the relationship between fertility and women's labour supply, the endogeneity problem needs to be taken into account. To address the endogeneity problem, this study estimates the model using 2SLS methods.

In the first stage, the endogenous variable "*fertility*" X_i is decomposed into two parts: one part is uncorrelated with error term ε_i and will be used in the second stage; the other part is correlated with the error term (Stock and Watson 2012). The part of X that is uncorrelated with error term is isolated by regressing X_i on instruments Z_i and exogenous variables W_i to obtain the predicted values $\hat{X}_i$

$$X_i = \lambda + \delta Z_i + \pi W_i + \varepsilon_i \qquad (2)$$

where Z is a vector of IVs that are correlated with X_i but uncorrelated with error term ε_i; and the parameter δ is unknown coefficients that represent the correlation between instruments and fertility.

In the second stage, we regress Y_i on the predicted value of the endogenous variable X_i obtained from the first stage and exogenous variables W_i as in equation (3). The coefficient of $\hat{X}_i$ obtained

from the second stage regression is the 2SLS estimator $\hat{\beta}^{TSLS}$ and $\hat{\beta}^{TSLS}$ is a consistent estimator of β.

$$Y_i = \alpha + \beta X_i + \gamma W_i + u_i \quad (3)$$

As explained in section 4, the sex of the first two children is randomly determined and the instruments used in this study *Twogirls* and *Twin2* are strongly correlated with having a third child because of the son preference mentioned above and as checked in the next section.

This thesis uses the 2SLS method to estimate the effect of having more than two children on the labour force participation decisions of mothers. The IVs used are *Twogirl* and *Twin2*. In the first stage, the endogenous variable X_i "*Moretwo*" is regressed on IVs Z_i *Twogirl* and *Twin2* separately and include exogenous variables W_i as in equation (4.2). In the second stage, the dependent variable *FLFP* is estimated on the fitted value of the *Moretwo* variable $\hat{X}_i$ that is obtained from the first stage and other exogenous variables as in equation (4.3). The coefficient obtained on $\hat{X}_i$ shows the effect of the existence of a third child on FLFP.

5 Empirical results

This study mainly focuses on the empirical analysis of the 2009 census sample. The sample is restricted to mothers aged 18-35. After applying all the restrictions, a final sample of 706,602 women aged 18-35 with two or more children was obtained.

5.1 OLS and 2SLS results

This chapter reports the empirical results. Only the coefficients of the variable of interest are presented. Completed estimates can be found in Appendix B. Firstly the results of the first stage of 2SLS estimation are presented, and then the results of OLS and the second stage of 2SLS estimation are reported.

Table 8 reports the results of the first stage of 2SLS estimation for the all women and married women samples. The first two columns report the results for the all women sample; the last two columns report the results for married women. The choice of controlling variables follows the literature and, in particular, Angrist and Evans (1998). I begin by estimating model (A) with inclusion of the sex of the first two children, age, age at first birth, and ethnicity. Model (B) additionally controls for the indicator of whether the family lives in an urban area. This is the preferred specification. Model (C) further controls for the regional variables. In model (D), the indicator of whether the woman resides with her parents or parents-in-law is included, and finally

model (E) controls for the educational variables of mothers. The models use two different instruments (the first two children being girls *Twogirl* and twins at second birth *Twin2*) separately.

Table 6 - First stage regression - Impact of two girls and twin birth on probability of having more than two children (women aged 18-35 with two or more children)

Models	All women		Married women	
	Twogirl (1)	Twin2 (2)	Twogirl (3)	Twin2 (4)
(A)	0.1771***	0.7887***	0.1818***	0.7842***
	(.0013)	(.0064)	(.0013)	(.0066)
(B)*	0.1771***	0.7892***	0.1818***	0.7846***
	(.0012)	(.0064)	(.0013)	(.0066)
(C)	0.1768***	0.7876***	0.1815***	0.7832***
	(.0013)	(.0064)	(.0013)	(.0066)
(D)	0.1873***	0.7782***	0.1907***	0.7742***
	(.0014)	(.0069)	(.0014)	(.0072)
(E)	0.1867***	0.7793***	0.1903***	0.7753***
	(.0014)	(.0068)	(.0014)	(.0071)
F-test for significance of IVs (for model C)	F =19360.50***	F =15257.24***	F = 19073.46***	F =14101.24***
No of obs	706,602	706,602	669,062	669,062

Notes: All models control for firstgirl, secondgirl, age, age at first birth and ethnicity. Model (B) controls for the urban dummy variable. Model (C) additionally controls for regional variables. Model (D) = Model (C) + Coresidence variable. Model (E) = Model (D) + Education variables. Standard errors are reported in brackets. * denotes statistical significance at 10 percent; ** denotes significance at 5 percent; *** denotes significance at 1 percent. Regional variables include the Red River Delta, North East, North West, North Central, Central Coast, Central Highlands, South East and the Mekong River Delta. Co-residence indicates whether the woman resides with her parents or parents-in-law.

As can be seen from the first column, women with two girls consecutively have 18 percentage points higher probability of having a third child than women with two boys or one boy and one girl. The results are very stable and consistent across the different specifications of the models from (A) to (E). Similar figures are also reported for the married women sample (column 3) because married women account for 93% of the all women sample.

Noticeably, the coefficients of *Twogirl* for the 2009 data in all models (A-E) are very high and much higher than those of *Samesex* (the coefficients of *Samesex* are reported in Appendix B). All estimates are statistically significant at the 1% level. Moreover, we can use the first stage F-statistic to test whether given instruments are weak. The results of the first stage F-statistic for the joint

significance of IVs, as can be seen in Table 8, is very high (F-statistic>10 is in the safety zone). If first stage F-statistic is less than 10, the given instruments are weak. These F-statistic results demonstrate the statistical significance of this instrument. *Twogirl* is correlated with *Moretwo*, so it meets the relevance condition of a valid instrument. Moreover, as shown in the previous section, this instrument also meets the exogeneity condition of a valid instrument. Thus, it will be used as a good instrument for having more than two children.

I also check instruments such as *Samesex, Twogirl and Twoboy* that Angrist and Evans (1998) used. The effect of *Samesex* on having more than two children is also significant but its coefficient is smaller than the coefficient of *Twogirl*. Furthermore, using *Twogirl* as an instrument for having a third child is appropriate with the son preference of parents in Vietnam, and therefore I choose *Twogirl* as a preferred instrument. for this study and *Samesex* is only used for comparison purposes against the study of Angrist and Evans (1998).

In addition, *Twogirl* and *Twoboy* are instruments which are decomposed from the *Samesex* instrument by Angrist and Evans (1998). I also examine the correlation of two instruments with endogenous variable '*Moretwo*'. Only *Twogirl* has a significant effect on *Moretwo* and the estimate is statistically significant at the 1 percent level, while the coefficient of *Twoboy* is very small, approaching zero and statistically insignificant. This implies that there are almost no incentives for parents of two boys to have a third child and they are also more likely to stop additional childbearing if they have two boys. Therefore, this study does not use *Twoboy* as an IV.

I also run several regressions using the instruments *Samesex, Twogirl and Twoboy* as in Angrist and Evans (1998) for the purpose of comparison, and results are reported in Appendix B. The results show that the effect of *Samesex* on having more than two children in this study is similar to the results in Angrist and Evans (1998) study. The results of the 2SLS estimates show that coefficients of *Moretwo* in the 2SLS estimates using *Twogirl* and *Twoboy* as IVs and the estimates using *Twogirl* are nearly the same. This is due to the effect of *Twoboy* being insignificant and approaching zero in the first stage of the 2SLS estimates and *Twogirl* being the main factor affecting the *Moretwo* variable (having more than two children). These effects of *Twogirl* and *Twoboy* are very different to those in Angrist and Evans (1998). In their study, both *Twogirl* and *Twoboy* have significant effects on having more than two children when *Samesex* is decomposed into *Twogirl* and *Twoboy*. However, in this study, since *Twoboy* has no significant effect on having more than two children, the effect of *Samesex* is mainly due to *Twogirl,* and therefore *Twogirl* is the main factor for having a third child among Vietnamese parents.

Like *Twogirl,* twins at second birth *Twin2* is also used to measure the consequences of moving from the second child to the third child. This study also uses twins at second birth as an instrument for having a third child. Apparently, twins are events that occur naturally and unplanned, so twins at second birth is also a good instrument for having a third child. Results from columns (2) and (4) of Table 8 show that *Twin2* has significant effects on having more than two children and results are unchanged across all the different specifications of the models.

In this part, the results of the OLS estimates and the second stage of 2SLS estimations are presented. *Twogirl* and *Twin2* are used as IVs to estimate the effect of having more than two children on women's labour force participation in 2SLS regressions. A set of control variables are included: the sex of the first two children; female's age; age at first birth; educational attainment; ethnicity; whether the family lives in an urban area; residential region variables; and whether the female resides with her parents or parents-in-law, (for other coefficients not reported here, see Appendix B).

Table 9 summarises the results of OLS regression and the second stage regression of 2SLS estimates for the women aged from 18 to 35 with two or more children sample. The first three columns summarise the results for the all women sample, the last three columns summarise the results for the married women sample. The OLS results for the all women and married women samples are represented in the first columns respectively. The OLS estimates show that having a third child decreases a woman's probability of labour force participation by about 3 percentage points. These impacts are not changed much when additional controls for other covariates are added. Similar results are also shown for the married women sample. All results of the OLS estimates are statistically significant. These negative effects are similar to the results reported in the analysis of the US data by Angrist and Evans (1998), Iacovou (2001) for Britain and Cruces and Galiani (2007) for two developing countries (Mexico and Argentina).

The 2SLS results for the all women sample using *Twogirl* and *Twin2* as instruments are presented in the second and third columns of Table 9. Column (2) of Table 9 reports the results using *Twogirl* in the 2SLS estimates of mothers' labour supply responses. Using *Twogirl* as an instrument is totally appropriate with the existence of the son preference in Vietnam. The estimate results indicate the negative and significant effects of having a third child on FLFP from models (A) to (E) for both samples. For example, in the model (B), the results suggest that the presence of a third child reduces the probability of participating in the labour force by about 2.8 percentage points for the all women sample (or by 2.5%) and 2.9 percentage points for married women (or by 2.58%). The mother's labour supply response is slightly smaller when controlling for regional variables,

co-residence and education variables as in models (C), (D) and (E) for both samples. Particularly, in model (C), the effect of a third child on mothers' participation probability in the labour market reduces by 2.5 percentage points for the full sample and by 2.7 for the married women sample when controlling for regional dummy variables. All coefficients of *Moretwo* are statistically significant at the 1 percent level.

Thus, the 2SLS estimates using *Twogirl* as an instrument demonstrate the significantly negative effects of the *Moretwo* variable on women's labour force participation. Noticeably, the results of the 2SLS estimates using *Twogirl* as an instrument are smaller than the corresponding OLS results for both the all and married women samples. It appears that OLS estimates overstate the causal effects of fertility on labour supply. This finding is similar to the findings of Angrist and Evans (1998).

Multiple births are considered to be one of the most important exogenous variations in the economic literature. Most studies focus on twins at first birth such as Bronars and Grogger (1994), Jacobsen et al. (1999) and Rosenzweig and Wolpin (1980b). Some studies use twins at second birth such as Angrist and Evans (1998) and Iacovou (2001). Like *Samesex* or *Twogirl*, twins at second birth *Twin2* is used to measure the consequences of moving from two to three children. Although a twin is randomly assigned and a good instrument for the additional childbearing variable, using twins also has some difficulties because the number of observations is often limited and it can be difficult to attain a sufficiently large sample size.

In order to address the problem of data limitations, this study uses the population census survey with a much larger sample size than previous studies including Angrist and Evans (1998) study. The results of 2SLS estimates using *Twin2* are reported in the third and sixth columns of Table 9. The results of 2SLS estimates using *Twin2* as an instrument show statistical significance at the 1% level. Having an additional child decreases a woman's probability of labour force participation by about 4.9 percentage points with including other covariates such as sex of the first two children, mother's age, age at first birth, ethnicity and the indicator for whether families are living in an urban area as in model (B). The estimate results also show that this impact slightly reduces if regional variables, co-residence or education variables are added in the regression. The results are similar for the married women sample.

Table 7 - Effect of having more than two children on female labour force participation (women aged 18-35 with two or more children)

Estimation method	All women	Married women

	OLS	2SLS		OLS	2SLS	
IVs	_	**Twogirl**	**Twin2**	_	**Twogirl**	**Twin2**
Model (A)	-0.0277***	-0.0270***	-0.0500***	-0.0278***	-0.0280***	-0.0495***
	(0.0009)	(0.0058)	(0.0065)	(0.0009)	(0.0058)	(0.0068)
Model (B)	-0.0340***	-0.0275***	-0.0490***	-0.0338***	-0.0287***	-0.0484***
	(0.0009)	(0.0057)	(0.0065)	(0.0009)	(0.0057)	(0.0067)
Model (C)	-0.0320***	-0.0246***	-0.0440***	-0.0322***	-0.0267***	-0.0430***
	(0.0009)	(0.0055)	(0.0063)	(0.0009)	(0.0055)	(0.0065)
Model (D)	-0.0310***	-0.0247***	-0.0417***	-0.0308***	-0.0254***	-0.0422***
	(0.0009)	(0.0055)	(0.0066)	(0.0009)	(0.0055)	(0.0068)
Model (E)	-0.0280***	-0.0241***	-0.0413***	-0.0285***	-0.0249***	-0.0418***
	(0.0009)	(0.0055)	(0.0066)	(0.0009)	(0.0055)	(0.0068)
Obs	706,602	706,602	706,602	669,062	669,062	669,062

Notes: All models control for firstgirl, secondgirl, age, age at first birth and ethnicity. Model (B) additionally controls for the urban dummy variable. Model (C) additionally controls for regional variables. Model (D) = Model (C) + Coresidence variable. Model (E) = Model (D) + Education variables. Standard errors are reported in brackets. * denotes statistical significance at 10 percent; ** denotes significance at 5 percent; *** denotes significance at 1percent.

5.2 Discussion

Overall, both OLS and 2SLS estimates in this study show that the presence of the third child has significantly negative effects on female labour supply. Noticeably, results of the 2SLS estimates constructed using twins at second birth *Twin2* are greater than the estimates using *Twogirl*. As noted in Angrist and Pischke (2008), different instruments do not necessarily generate the same estimate results even in the case of all valid instruments. This point can be explained by Local Average Treatment Effects (LATEs).

LATEs only provide an estimate of the average treatment effect on a population of compliers (subgroups). It does not provide the treatment effect for everyone. According to Angrist and Imbens (1995), the LATEs is equivalent to the estimator of the IV estimate (β_{IV}) if instruments are binary variables. LATEs is calculated by dividing the difference in the means of the outcome variable (y) by the difference in the means of treatment (d) at the two different instruments (z):

$$\beta_{IV} = (\bar{y}_1 - \bar{y}_0) / (\bar{d}_1 - \bar{d}_0)$$

where $\bar{y}_1$ is the mean of outcomes of women's labour supply for those observations with instruments (such as *Twogirl* and *Twin2) = 1*;

$\bar{y}_0$ is the mean of outcome of women's labour supply for those observations with the value of instruments = 0;

$\bar{d}_1$ is the mean of women having more than two children when the instruments *Twogirl* or *Twin2* are equal to 1; and

$\bar{d}_0$ is the mean of women having more than two children if these instruments are 0.

Since an instrument may have stronger impacts on one or several subgroups of the population (the compliers), different instruments may lead to different LATEs. This is the reason why the causal effects of the presence of a third child on the labour supply of women (coefficients of *Moretwo* are different) are different when using different instruments such as *Twogirl* or *Twin2*. In this case, the effect of the third child on labour supply using twins as an IV is bigger than the third child due to two girls. One explaination for the bigger twins effects is that a third child who was born due to twins has no space with the second child and is an unplanned birth, so two young children at the same time may require more attention than an older child and younger child. Moreover, mothers with twins may spend more economic sources as well as time in comparison with mothers with the older child and younger child.

In general, both OLS and 2SLS estimates in this study show negative effects of the existence of a third child on female labour supply. This is similar to the findings in the study in the US by Angrist and Evans (1998) or in Britain by Iacovou (2001) or in Mexico by Cruces and Galiani (2007). However, the magnitude of these impacts on female labour supply is smaller than the findings by Angrist and Evans (1998) and Iacovou (2001), but similar to the findings by Cruces and Galiani (2007). These smaller effects may be due to supportive policies from governments such as childcare services, maternity leave, part time job availability and so on that vary between the different countries. For example, childcare services in developing countries in general and Vietnam in particular are more available and cheaper than in developed countries like the US or Britain. According to a report from the University of Pennsylvania in America, the US does not have a national policy on child care and the cost for child care is very high (UniversityofPennsylvania 2014). Also, a study by Child Care Aware America in 2013 reports that the day care cost per year for an infant ($15,000) exceeds the average tuition costs at public colleges in 31 of the states of America[4].

[4] University of Pennsylvania, http://knowledge.wharton.upenn.edu/article/economic-impact-of-child-care/.

Maternity leave policy is also very different between countries. According to ILO (2014), the US provides new mothers with 12 weeks of maternity leave and women in France are entitled to 16 weeks of paid leave. Meanwhile women in Vietnam received 18 weeks of paid maternity leave with the policy up to 2014, and with the current policy, now get 26 weeks.

The effect of children on FLFP decisions are also relatively small in comparison to the effect of other determinants of FLFP such as education or ethnicity in Vietnam. This may be due to the availability of childcare support from grandparents or childcare services as well as the lower costs of childcare services in Vietnam. It also may be that a large proportion of women are working in agricultural areas. With the characteristics of agricultural field work, they can work part time. All of these factors may reduce the tensions of having more children, so the effect of having additional children may not significantly affect the labour supply decisions of mothers. These may also be reasons why the Vietnamese women's labour force participation rate has stagnated, even though the country has experienced a continuous decline in fertility rates and an increase in female education levels over the last two decades. This suggests that there may be other factors, such as discrimination in the labour market, that have negative effects on the FLFP rate. However, the study cannot investigate this factor because of the limitations of data availability. The next section will examine how the effect of children on female labour supply may vary with parents' socioeconomic characteristics.

6 Heterogeneity in the impact of children on female labour supply

The impact of children on labour supply may vary with wages or educational attainments of mothers and fathers. This prediction has been shown in a number of theoretical models that describe how a mother's labour supply response may vary with her wage rate or schooling as well as her husband's. Gronau (1977) describes a theoretical model that provides a unifying explanation of different behaviour patterns of people with different wages, income, education, and the impact of children on the allocation of time. Angrist and Evans (1996) also use a theoretical framework that incorporates Becker and Lewis (1973) child quantity/quality model into Gronau (1977) model to explore what factors affect the relationship between children and labour supply of parents. This model predicts that the labour supply response of childbearing will be exaggerated as the wages of parents are higher. This can be explained as, at equilibrium, higher wage earning women have greater marginal returns for an hour spent at home than lower wage earning women.

There are also many empirical studies that are consistent with this theoretical prediction. According to a survey conducted by Strauss and Thomas (1995), most economists find that better educated women spend more time with child care as well as housework than less educated women.

Consequently, the labour supply of better educated mothers is more sensitive to the presence of children in comparison with less educated mothers (Gronau 1973; Leibowitz 1975; Hamoudi and Sachs 1999; Gayle et al. 2012). For example, Hamoudi and Sachs (1999) estimate the time parents allocate to preschool children for different socioeconomic groups and suggest that mothers who have high status and high potential wages tend to spend two or three times as much time with their children than mothers with lower status do. Gronau (1973) finds that the effect of a child on his/her mother's value of time varies with the child's age and the mother's education. For a given age of a child, the effect of a child on his/her mother's value of time increases with the mother's education.

Since data about parents' earnings is unavailable, the study explores how the impact of children on a mother's labour supply varies with the level of schooling of the mothers and their husbands, schooling being an important predictor of potential earnings. The first part of Table 10 reports the OLS and 2SLS regression results of the impact of having more than two children on married women's labour supply in the 2009 sample, conditional on the education levels of these women. In this section, *Twogirl* is used as an instrument for having more than two children. The second column shows results of OLS estimates, while the first and third columns present 2SLS estimates results. The OLS results show that the effect of having more than two children on labour supply increases with the mother's education. For example, the effect of the presence of a third child reduces his/her mother's labour force participation by only 1.6 percentage points if the mother has not completed primary education. However, the mother's probability of working decreases by 7.5 percentage points when the mother has at least completed secondary education.

The 2SLS estimates are presented in the first and third columns of panel 1. The first column reports the first stage results of the effect of *Twogirl* on *Moretwo* by the different education levels of mothers (such as less than primary education completed, primary education completed, secondary completed or university completed). The results show a strong and significant connection between *Twogirl* and *Moretwo* in all schooling groups. In families with two girls as the first two children, the probability of having an additional child among women with primary education or less is around 19 percentage points but the probability of having more than two children becomes smaller for mothers with higher education categories (secondary or university education completed) with 8.6 percentage points.

The second stage results of 2SLS estimates on labour supply equations (as seen in column 3) show that the impact of children on labour supply rises with the educational attainments of mothers. Having an additional child causes a decline of 8.7 percentage points in their probability of working

if the women completed general universal education (year 12) or university or higher degrees, while the presence of an additional child decreases the participation by around 2 percentage points if the woman's education is at primary level or less. In other word, the better educated women experience the largest impacts of childbearing on labour supply. This finding is consistent with the theoretical prediction and the OLS estimates but contradict the finding of Angrist and Evans (1998) that suggest that the effect of childbearing on female labour supply declines with women's educational attainments.

Table 8 - Heterogeneity in the impact of children on female labour supply by interaction terms

Dependent variables	More than 2 children	Labour supply response of mothers		
	First stage	OLS	2SLS	No of obs
1. Labour supply responses of mothers by educational level				
Less than primary completed	0.198*** (0.003)	-0.016*** (0.0014)	-0.020** (0.009)	182,622
Primary completed	0.188*** (0.0015)	-0.031*** (0.0012)	-0.026*** (0.007)	419,642
Secondary and/or university completed	0.086*** (0.0025)	-0.075*** (0.005)	-0.087** (0.039)	66,798
2. Labour supply responses of mothers by father's educational levels				
Less than primary completed	0.187*** (0.003)	-0.021*** (0.0016)	-0.036*** (0.011)	156,060
Primary completed	0.190*** (0.0016)	-0.031*** (0.0012)	-0.022*** (0.0068)	431,215
Secondary and/or university completed	0.124*** (0.0028)	-0.054*** (0.0037)	-0.052** (0.025)	81,787
3. Labour supply responses of mothers by educational level of mothers whose husbands completed primary education.				
Less than primary completed	0.208*** (0.004)	-0.017*** (0.0025)	-0.0088** (0.015)	73,875
Primary completed	0.193*** (0.0017)	-0.027*** (0.0014)	-0.018** (0.0076)	327,824
Secondary and/or university completed	0.105*** (0.0032)	-0.070*** (0.0057)	-0.156*** (0.051)	29,516
4. Regions				

Urban	0.116***	-0.063***	-0.055**	123,608
	(0.0026)	(0.0034)	(0.028)	
Rural	0.196***	-0.027***	-0.025***	545,518
	(0.0015)	(0.0009)	(0.0053)	
5. Co-residence with parents				
Co-residence	0.257***	-0.0115***	-0.0014	55,893
	(0.0048)	(0.002)	(0.0094)	
Non co-residence	0.183***	-0.034***	-0.030***	523,063
	(0.0015)	(0.001)	(0.0065)	

Notes: Standard errors are reported in brackets. * denotes statistical significance at 10 percent; ** denotes significance at 5 percent; *** denotes significance at 1 percent. Data are from the 2009 married women and husband samples. Other covariates in the models are as listed in the notes of Table 8. *Twogirl* is used as an IV in the 2SLS estimation.

In economic theory, the income of husbands is an important factor affecting wives' labour supply. Since there is no available data on husbands' wages or incomes to analyse female labour supply effects conditional on husbands' wages, the study uses the condition of the schooling of husbands which is a good prediction of potential earnings. Panel 2 of Table 10 describes the labour supply consequences for married women with at least two children, conditional on their husbands' education. The OLS estimates in the second column show that the effect of childbearing on women's labour supply increases as their husband's education level is higher. The first stage results of the 2SLS estimates suggest that the effect of *Twogirl* on having more than two children reduces with their husbands' education. For women with husbands in the low education categories, the probability of having an additional child is about 19 percentage points, while this probability is only 12 percentage points for women with better educated husbands. The 2SLS estimates of the labour supply equation show the labour supply of women whose husbands are better educated is more sensitive to the presence of an additional child.

In general, the variation in 2SLS results by both mother's and father's educational levels are similar to the variation in OLS estimates which implies that the effect of children on women's labour supply rises as education levels increase.

In order to distinguish more clearly how labour supply responses to childbearing vary with educational levels of women or their husbands, the sample is then restricted to women whose husbands completed primary education. This is interesting because with this restriction, we can see how women's labour supply may change in response to an increase in the number of children by their different education levels. Panel 3 of Table 10 reports on the labour supply consequences by women's education levels with the restricted sample including married women with husbands

who completed primary education. The 2SLS estimates show that the effect of childbearing on women's labour supply increases with their education levels. These findings are consistent with the theoretical prediction and the OLS results which suggest that the labour supply of better educated women is more sensitive to childbearing.

The effect of childbearing on women's labour supply also varies between urban and rural areas. As can be seen from Table 10, mothers who live in urban areas are more sensitive to the presence of additional children than mothers living in rural areas. The 2SLS estimates show that the probability of working reduces by 5.5 percentage points when a woman residing in an urban area has an additional child, while the figure is only 2.5 percentage points for a woman living in a rural area. This may be explained by the majority of women in rural areas working in agricultural field work (about 72%), while only 21% of women living in urban areas work in agricultural areas. They can work part time because of the nature and characteristics of agricultural jobs in the field, so the presence of a child may not affect their labour supply as much as women working in other fields. Moreover, in rural areas, women often have support from their parents who can help to take care of their children. In contrast, in urban areas, women often work in full time paid jobs such as accountants, doctors, teachers and so on. They also have better economic conditions. In addition, urban areas mainly include nuclear families, so it is more difficult to get support from grandparents for childcare. Therefore, having more children will have more influence on their labour supply decisions.

It is interesting to note that the reduced form first stage results in column (1) of panel 4 suggest that the effect of *Twogirl* on fertility is greater among rural families than urban families. Again this can be explained as the son preference is stronger in rural areas where the traditional idea is that a boy belongs to us and a daughter belongs to someone else (Mont and Nguyen 2013, pp.61) and where sons are needed to maintain the family line according to the Confucian tradition which remains strongly influental among many Vietnamese people. Moreover, sons are often responsible for financially supporting their parents' old age. Therefore, sons are highly desirable for social, symbolic and economic reasons.

The final panel of Table 10 reports on the labour supply responses of married women in families with two or more children and whether the women reside with their parents or in-laws as an interaction term. The OLS results suggest that the presence of a third child has a greater significant negative impact on women's participation in the labour market when they do not live with their parents or in-laws. In other words, when there is no help from parents and parents-in-law, the effect of having more children on the labour force participation of women is greater than on women who

do receive such help. Similar results can also be seen in the 2SLS estimates for women who do not reside with their parents/in-laws, where having a third child reduces their probability of working by 3 percentage points. However, this effect is small and insignificant in the case of women who co-reside with their parents or parents-in-law.

7 Conclusion and policy implications

This study explores the issue of causal effects of fertility on FLFP in Vietnam. Understanding the linkage between variations in fertility and female labour supply is important for predicting changes in the structure of the labour force in the future as well as for identifying potential sources of gender wage differentials. The endogeneity problem of the relationship between fertility and female labour supply is a challenge. To deal with this problem, the study uses an IV strategy which exploits exogenous variations in family size of moving from two to three children to investigate the causal effect of both planned and unplanned births on women's labour force participation decisions.

This study is the first attempt to investigate the effect of fertility on the labour supply of Vietnamese women using the IV method, based on the existence of a son preference among families in Vietnam. It has been shown that the first two children being girls is a good instrument for having a third child. The study also uses twins at second birth as an IV.

Results show that having a third child decreases the probability of labour force participation of women by about 3-5 percentage points following the presence of the additional child.

The study also finds that the impact of fertility on labour supply may vary with the educational attainments of mothers and fathers. The effect of children on labour supply rises as educational attainments of mothers rise. It suggests that the better educated women experience the greatest impacts of childbearing on labour supply. This finding is consistent with predictions of some theories of household time allocation and OLS estimates. The 2SLS estimates also show that the labour supply responses of women whose husbands are better educated are also more sensitive to the presence of additional children.

These findings suggest that reduction in fertility is one of channels to increase the labour supply of women in Vietnam. However, this is not the only channel. Other factors such as better education, reductions in gender discrimination in the workplace and women's empowerment could be driving both trends. As mentioned above, although fertility rate in Vietnam dropped rapidly and female education also has achieved remarkable progress during past years, labour force participation rate of women has not changed much, even slightly decreased. This may be due to

these impacts of fertility have been offset by other factors such as gender inequality in higher education, in employment. Because there is a fact that even though Vietnam has achieved universal primary education, enrolment rates for girls in higher education and among disadvantaged groups such as rural and remote areas, and among ethnic minority communities is still lower than for boys. Policies to aim improvement and better access to higher education for girls, especially for disadvantaged groups will help girls attain higher levels of education and this is also an important factor to enhance the role of women in society. To implement this target, the government can provide financial solutions such as school facilities, school fees to support for students in disadvantaged socioeconomic areas.

Moreover, higher level of education achieved by girls can also be a useful channel to reduce gender inequality in the labour market. In Vietnam, gender inequality still persists in the labour market with the rate of participation in the labour market is higher for men and women account for a high rate in vulnerable types of jobs such as informal sector, or jobs in the short term and without social security. Therefore, to improve and reduce gender disparity in the labour market, the government can issue anti-discrimination decrees in the workplace. However, this is difficult because discrimination is intangible and hard to measure. Therefore, this study suggests policies should aim to improve female education. As women with better level of education can have more opportunities to choose good jobs as well as better positions at work with higher income. Their knowledge also helps them have the desired family size as well as doing well other roles in the family.

Although this study focuses on the population of Vietnamese women, the approach and method of this study may also be applicable to other developing countries where cultural and social traditions are similar to Vietnam and the existence of a son preference is still a dominant theme.

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