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## **Maternal Education and Fertility: An Analysis based on Vietnamese Censuses, 1989 and 2009**

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### **Introduction**

Vietnam is one of the Asian countries currently experiencing a rapid demographic transition and is at the end of the first stage of realizing the demographic dividend. Not only does Vietnam have a relatively large population size, but it also has quite a high population growth rate. As reported in the Census of Population and Housing in 2009, the population of the country was 85.78 million that year. Rural areas accounted for 70.4 percent of the population; urban areas, the remaining 29.6 percent. Vietnam is currently ranked as having the third largest population in Southeast Asia, and fourteenth largest in the world. The population of the country increases by about 1.1 million people every year. According to the General Statistics

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Office, the Vietnamese population will exceed 100 million by 2024, and the population density at that time will be about 335 people/km<sup>2</sup>.

Although the total fertility rate (TFR) of Vietnam is currently at the replacement level (TFR = 2.1 in 2014), the country faces differential fertility across its various regions. As reported in 2012 by the Ministry of Health, Vietnam faces two major fertility challenges.<sup>4</sup> First, the birth rate is still volatile and unpredictable; second, differences in fertility among various localities and regions of the country pose a number of disadvantages (Ministry of Health, 2011). The Ministry reported that the country's policy on fertility is to maintain a reasonably low TFR of about 1.9 children per woman in order to stabilize population size at approximately 115-120 million people in 2050. This task was identified as urgent to ensure that the advantages of economic growth would accrue to the society both now and in the future through identification of the causes and construction of fertility adjustment plans so that they would fit with the reality in each locality. Thus, to deal with differential patterns of fertility, a study on the factors relating to fertility and appropriate policies for each region should be considered (Ministry of Health, 2012).

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<sup>4</sup> The Ministry reported on the "measures and policies to maintain low and reasonable fertility," which would involve a long-term strategy concerning the country's fertility in response to the "Strategy about Population and Reproductive Health Vietnam in 2011-2020."

Furthermore, fertility rates have been found to be inversely related to socio-economic factors. For example, using cross-sectional data from developing and transitional countries, it was found that increased fertility is likely to be associated with poverty through impeding economic growth and skewing the distribution toward the poor (Eastwood and Lipton, 1999). As a result, research on Vietnam's current fertility rate could be significant in helping to ensure its sustainable socio-economic development. In many poor areas of the country with low living standards, fertility rates remain high. For instance, on average mothers from Kon Tum in the Central Highlands have 3.45 children, whereas in developed localities with high living standards, fertility rates are below the replacement level; for example, according to findings in the 2009 census, on average mothers in Ho Chi Minh City have only 1.45 children. Currently, of the country's 58 provinces and 5 centrally controlled municipalities (considered as provinces), 35 provinces have reached the replacement level of fertility ( $TFR < 2.1$ ) while 28 provinces have not done so ( $TFR > 2.1$ ) (Ministry of Health, 2012). If these trends continue, they could cause adverse demographic outcomes in the future and further increase the wealth gap between localities.

Many factors, including education, have been found to be related to fertility. Education is an indicator of human capital. It is also an important factor in decisions concerning fertility, especially education for women

(Breierova and Duflo, 2003; Cochrane, 1979). During the period of fertility decline in Vietnam, significant changes in women's education were also observed. Likewise, as is the case with the fertility pattern, differentials in literacy rates and women's education still exist across regions in Vietnam (Cu, 2007). As a result, this study is aimed at investigating whether the variations in education, both over time and across regions in Vietnam, may be associated with variations in fertility also over time and across regions. Although a number of quantitative studies on the association between fertility and education have been carried out, there is an absence of quantitative insights based on the evidence from Vietnam, where both fertility and education have undergone significant change. Thus, data from the Vietnam Population and Housing Censuses, 1989 and 2009, are used to study these research questions.

The rest of the paper is organized as follows. After the introduction, the results of a literature review are furnished. Data, including variable construction and descriptive statistics, are then explained. The empirical strategy and findings are subsequently deliberated. Finally, the results of the study are discussed and the conclusions provided.

## **Literature review**

### **Relationship between women's education and fertility**

The association between women's education and fertility is a rather complex and multifaceted. Impacts can occur through several channels, from education being the cause of delays in marriage to its role in providing knowledge about child care. Women's schooling may influence fertility both indirectly, by affecting marriage duration, age at marriage, and delayed marriage, and directly, through its effect on marital fertility (Bratt, 2003; Smith, 1996). The economic theory of fertility suggests that educated women lose more income during pregnancy and child-rearing compared with their non-educated peers (Pradhan, 2015). The influence of maternal education on fertility can occur in many forms, as was extensively reviewed by Osili and Long (2008). The following is a summary of the literature that has been reviewed (Osili and Long, 2008).

First, women's education potentially delays age at marriage, resulting in a shorter period for reproduction and hence a smaller number of children (Becker, 1960). According to Cochrane (1979), going to school for a longer period leads to an increase in the age at marriage, and in some countries, to a reduction in the probability of ever marrying. Earlier studies documented extensively that increased female education has a positive relationship with age at marriage. This result is verified by World Fertility Surveys undertaken

in 38 developing countries, such as Bangladesh, Egypt, Mexico, Morocco and Yemen (Weinberger, 1987). Moreover, Brien and Lillard (1994) found that female education and age at marriage are associated both at the individual and the societal levels. In Malaysia, women with a secondary education are considerably less likely to experience early marriage than lower educated women (Brien and Lillard, 1994). Later age at marriage is often related to later school-leaving; for this reason, with more education, women in Germany and Venezuela were found to delay marriage longer than women in other countries (Cheal, 2008).

Second, education gives women the ability to earn higher incomes so that they can have fewer children but of higher quality (Becker, 1960). Schooling associated with high income increases the opportunity cost of bearing children. Thus, women may decide to have fewer children due to the higher potential for forgone income. More highly educated women earning a higher income may depend less on children, which limits the resource flow from children to women. Having children no longer provides more educated women with sources of income (that is, from child labour) but represents a burden to them. Thus, fertility among women with more education is potentially lower than among less educated women (Caldwell, 1976; 1994; Robinson and Horlacher, 1971).

Third, education improves knowledge and attitudes that relate to reproduction and fertility, such as contraception, healthy pregnancy behaviors, and the value of children (Becker, 1960; Bongaarts and San, 1994; Brien and Lillard, 1994; Cochrane, 1979). It is also suggested that education has a positive relationship with attitudes toward preferring birth control measures, with better understanding of contraception, and strengthened couple relationships (Cochrane, 1979). By enhancing women's position within the family and society, schooling increases women's control over their reproductive choices. According to 26 Demographic and Health Surveys, it has been shown that in North African countries highly educated women have contraceptive prevalence rates that are between 27 and 38 percentage points higher than women with no formal education (Martin, 1995).

In addition, education may lower fertility through improvements in child health and reduced rates of child mortality, as women would need to have fewer births to yield the same desired family size (Schultz, 1997). Women with higher educational attainment have lower fertility rates because of their knowledge of antenatal and postnatal care for children, thus increasing their children's survivability. Such women would not think they need to have many children because of fear that one (or more) of their children might die in the future (Pradhan, 2015). Women's education



capability also enhances female autonomy and their bargaining power in fertility decisions (Mason, 1987), leading to a drop in fertility.

The majority of studies described above demonstrated that there is an inverse association between women's education and fertility based on evidence from around the world. Based on information from the General Statistics Office (2011), Table 1 shows that the Vietnamese TFR has declined over time, with the numbers in rural areas being consistently higher than those in urban areas. In this context, an attempt will be made in this paper to investigate whether education is related to this drop in fertility in Vietnam.

Table 1: Total fertility rate in Vietnam from 1999 to 2009

Year	Whole country	Rural	Urban
1989	3.8	-	-
1999	2.33	2.57	1.67
2001	2.25	2.38	1.86
2002	2.28	2.39	1.93
2003	2.12	2.3	1.7
2004	2.23	2.38	1.87
2005	2.11	2.28	1.73
2006	2.09	2.25	1.72
2007	2.07	2.22	1.7
2008	2.08	2.22	1.83
2009	2.03	2.14	1.81

*Source:* General Statistics Office (2011).

## **Data, variable construction, and descriptive statistics**

### **Data and sample**

The objective of this study is to investigate associations between maternal educational attainments and fertility. For this purpose, secondary data from the Census of Population and Housing in 1989 and 2009 are used. In particular, the samples of the censuses provided by the IPUMS-International Database (Minnesota Population Center, University of Minnesota) are used.

Vietnam conducts a census of the entire population every decade at a specified time. The purpose of the census is to collect basic data on the population and housing for the entire territory of the Socialist Republic of Vietnam in order to serve the needs of national development planning. The Population and Housing Census provides the fullest and most reliable picture of the country's population at a particular point in time. Although there are some limitations with regard to sampling and method, the census is one of the most important sources of data and information that provide a basis for compiling official statistics on the country (Coleman, 2013).

Table 2: Sampling from censuses in 1989 and 2009

	<b>1/4/1989</b>	<b>1/4/2009</b>
Total number of households	534,177	3,692,042
Number of persons	2,626,988	14,177,590
Percentage sampled	3%	15%
Number of mothers aged from 15 to 49	116,153	2,098,186

*Source:* Data from the Population and Housing Censuses, 1989 and 2009.

Based on the Population and Housing Censuses in 1989 and 2009, Table 2 shows that there were 2,626,988 individuals (in 1989) and 14,177,590 (in 2009) who were surveyed in those years. Because the research question for the present paper is related to maternal fertility, the focus is only on woman aged from 15 to 49 years who have ever given birth, which is also the unit of analysis. As a result, 116,153 and 2,098,186 women of childbearing age who had children and were between the ages of 15 and 49 years in 1989 and 2009, respectively, were selected for the study.

### **Construction of measurements**

As the paper contains an analysis of the association between maternal education and fertility, the main variables are fertility (dependent variable) and women's education (main explanatory variable). In this part of the paper, how the main variables are measured is covered and compared with findings of some previous studies.

### **Measures and descriptive statistics of fertility**

Fertility is the actual level of reproduction of a population. Its measure depends on the number of live births, or a simple interpretation about how many children women have during their childbearing years (Palmore and Gardner, 1994). Fertility is normally applicable to women of childbearing age, usually defined as those 15–49 years old, although births to women outside this age range can, and do, occur. Furthermore, measuring fertility has connections with the number of live births among a specific population and time reference period (Palmore and Gardner, 1994). Fertility is measured by the number of children born to each child's mother. By convention, fertility is measured in relation to mothers (Pressat and Wilson, 1988).

In particular, information about children ever born is used in the present paper. To be more specific, question 32 of the census questionnaire asked: “How many children do you have?” Depending on the age of the female respondent, answers to this question would capture both incomplete and completed fertility. This question was used to ask women aged 15-49 years old in each household about their reproductive histories. Those who had given birth to a live child (that is, after delivering the child, he or she showed at least one of the signs of life, such as crying, breathing, heartbeats, and placenta cord movement) were included in the study. Women having a

stillbirth (the child had died in the mother's womb prior to delivery) were not included (General Statistics Office, 2010). It is often the case in population studies that, when fertility is discussed, it refers to all women of childbearing age. In this study, however, to be in line with the calculations by the General Statistics Office, the authors were advised by the Office and IPUMS to focus on women of childbearing age who had given birth to at least one child. Moreover, as they were interested in maternal education, it seemed appropriate to also focus on women with at least one child (mothers).

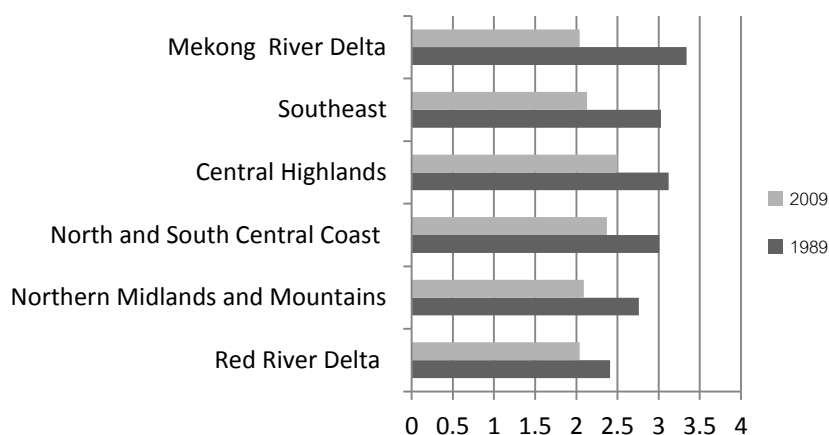
Table 3 provides descriptive statistics of the measures of fertility. It shows that the average number of children ever born dropped from 3.09 children in 1989 to 2.16 children in 2009. Based on the country's achievements in terms of fertility decline, population growth has slowed and the population size of Vietnam in 2009 was 85.8 million people, much lower than the target under the Population Strategy, which was 89 million people by 2010 (Nguyen Dinh Cu and Pham Tri Thuc, 2010).

Table 3: Average number of children per mother in Vietnam in 1989 and 2009

	Mean		Minimum		Maximum	
	1989	2009	1989	2009	1989	2009
Children ever born	3.09	2.16	1	1	30	13

*Source:* Authors' own calculations.

Figure 1: Average number of children per mother, by region of Vietnam



*Source:* Authors' own calculations.

Figure 1 illustrates the average number of children by region. Vietnam has 63 provinces divided into eight economic regions. However, since 2006, the country has been divided into six economic regions. Based on the two Population and Housing Censuses, fertility was found to have decreased during the 10 year period between both censuses, and to have reduced evenly across the regions of the country. However, there was a significant change in fertility in the Mekong River Delta. While the average number of children ever born in that Delta was the highest in Vietnam in 1989 (3.34 children), it had fallen to the lowest level in 2009 (2.04 children). This is in contrast with the region of the Central Highlands and the North and South Central Coast, where the average numbers of children per mother were still high at 2.50 children and 2.37 children, respectively.

### **Measure and descriptive statistics of women's education**

In the existing studies, there are various measures of education depending on the purpose of research. Education, especially maternal education, is normally assessed in the following major ways: (a) by the dichotomy between the illiterate and the literate; (b) by the number of years of schooling completed; (c) by the highest level of schooling attained (e.g. none, some primary, completed primary, some secondary); and (d) by qualifications or degree obtained (e.g. no schooling, some schooling, school-leaving certificate) (Cronkhite, 1972; McBride, 1947; Ware, 1984).

Within the scope of this paper, maternal education is measured by the level of education attained. Levels of education were used instead of years of education because over the two decades studied the education system in Vietnam changed substantially in terms of the number of years that constitute each level of education. For instance, in the past by completing seven years of schooling, students were regarded as being in upper secondary school. However, in 2009 seven years of schooling were equivalent to lower secondary school. The level of education is used to explore each educational stratum that affects fertility. The assumption is that women with a primary school education are more likely to have more children than those with a university education. Data on level of education were extracted from census question 13: "What is the highest education

level that you are attending or have attained?” Maternal educational attainment is measured by the levels of education, which the women were currently pursuing or had attained by 1989 and by 2009.

Table 4: Level of education of mothers, aged 15 to 49, with at least one child

	1989	2009
	percentage	
Less than primary	36.27	26.50
Primary completed	45.48	56.35
Secondary completed	14.45	11.17
University completed	3.80	5.97

*Source:* Authors' own calculations.

From Table 4, it can be seen that maternal education increased during the past 20 years. The percentage of those whose level of education was less than completion of primary education decreased from 36.27 percent in 1989 to 26.50 percent in 2009. In addition, other levels of education, such as “primary completed” and “university completed” increased, from 45.48 percent to 56.35 percent, and from 3.80 percent to 5.97 percent, respectively, between 1989 and 2009. Table 5 illustrates the average number of children per mother by level of education and age group. In line with the hypothesis of this study, the descriptive statistics show that education level had an inverse relationship with the number of children born per mother in both years. Moreover, as expected, mothers in the older age groups bore more children than younger women.



Table 5: Average number of children per mother with at least one child, by level of education and age group

<b>1989</b>					
Age group	< Primary	Primary	Secondary	University	Average by age group
15-19	1.19	1.12	1.05		1.15
20-24	1.67	1.39	1.14	1.11	1.45
25-29	2.58	1.95	1.44	1.25	2.02
30-34	3.55	2.65	2.02	1.68	2.81
35-39	4.45	3.28	2.57	2.28	3.62
40-44	5.23	3.72	3.07	2.58	4.30
45-49	5.60	4.23	3.45	2.86	5.07
Average	3.93	2.59	2.01	1.99	3.02

<b>2009</b>					
Age group	< Primary	Primary	Secondary	University	Average by age group
15-19	1.17	1.08	1.05		1.10
20-24	1.48	1.27	1.12	1.05	1.29
25-29	1.86	1.60	1.33	1.18	1.59
30-34	2.22	2.00	1.73	1.56	1.99
35-39	2.61	2.33	2.08	1.86	2.33
40-44	3.00	2.62	2.26	1.96	2.64
45-49	3.41	2.88	2.48	2.03	2.90
Average	2.51	2.17	1.86	1.62	2.18

*Source:* Authors' own calculations.

### **Empirical methodology**

The authors considered each year of the samples separately, thereby yielding two separate cross-sectional analyses. For 1989 and 2009, the empirical model is as follows:

$$y_i = \alpha_i + \beta educ_i + \gamma' X_i + \varepsilon_i$$

where  $y_i$  is the measure of fertility (number of children) of each mother with at least one child;  $educ_i$  is the measure of maternal education (level of education); and  $X_i$  is a vector of control variables, including (a) ages, in order to control for physical attributes and the timing of fertility, (b) economic region dummies, in order to control for exogenous economic forces that may relate to fertility, for instance the southern regions are more economically advanced than other regions, resulting in higher average income and employment, (c) dummies for sector of workers, in order to consider, for example the difference between the private sector and the public sector, (d) rural and urban dummies, to control for urbanization, (e) dummies for marital status, that is, single, married, divorced and separated, (f) a dummy variable indicating whether the women owned a house, to control for wealth, (g) dummies for migration, to control for internal migration within Vietnam, and (h) basic amenities and so-called white goods or durable goods, in order to control for wealth.

Of note is the use of migration as a dummy variable taking the value of one if the woman lived in Vietnam but resided in a different region, province, or district from the current place of residence five years prior to the time of the census. Basic amenities refer to electricity, water supply, and toilet. The variable takes the value of one if the household possess all three measures, and takes the value of zero if it is short of at least one measure. Moreover, the term durable goods covers such items as televisions, radios, telephones, computers, washing machines, and refrigerators. The variable takes the value of one if the household has at least three of the above-mentioned goods, and takes the value of zero if it has two or fewer of the above-mentioned durable goods.

### **Empirical findings**

In this sub-section, the above regression model is used to assess the relationship between the level of maternal education on fertility. Analysis of the relationship between maternal education and fertility is quite complicated, especially by the fact that there could be endogeneity problem. Within the ambit of this paper, the focus is on correlation rather than causation between the levels of maternal education and fertility. As shown in Table 6, all education levels have a negative and statistically significant relationship with fertility. Moreover, the higher the level of education, the lower is the fertility level of the women (with at least one child). It is

interesting to observe that the coefficients of education levels increase as the level of education goes from primary to secondary and university (more so in 1989). One explanation is that people with higher levels of education may be concerned more about the quality of their children instead of the quantity of children, so they might tend to prefer a smaller size family than others (McCrary and Royer, 2006). The empirical results show that, while mothers who have a primary school education are likely to have 0.7 fewer children than mothers with less than a primary level of education, mothers with a university education in 1989 are likely to have 1.5 fewer children than mothers with less than a primary level of education. This situation illustrates that a higher level of education has a much stronger effect on fertility than a lower level of education, and this can be seen from the census sample over the two decades studied.

Nevertheless, the empirical results also show that each additional level of education attained led to a decrease in fertility by approximately 0.5 and 0.2 children in 1989 and 2009, respectively. This implies that a lower level of education, i.e. primary school, has a greater correlational incremental impact on reducing fertility among the Vietnamese women than a higher level of education, such as secondary school and university. While a higher level of education delays marriage and hence the period for having children, a lower level of education still equips women with basic knowledge of how

to read, write and calculate, which could be crucial for women in obtaining and processing information and knowledge on fertility and contraception.

Moreover, there are statistically significant links between most control variables and fertility. Compared with people who are single, those who are married or widowed/divorced had more children in 1989 and 2009. It is interesting to note that in 1989 women who were widowed or divorced were more likely to have had a smaller number of children than those who were single. One possible explanation is that in 1989 the widows had lost their husband during the earlier Vietnam War. They had become widows, but before they had any children. During this time, some villages were even called “widows’ towns” (Dung, 2014).

Regarding the areas of residence, those living in the Red River Delta or Northern Midlands and Mountains had a smaller number of children compared with women living in the Southeast. In contrast, women living in the Central Highlands or the North and South Central Coast were more likely to have more children than women living in the Southeast. Compared with those living in rural areas; those living in urban areas tended to have fewer children.

Table 6: Maternal level of education and fertility

	1989		2009	
<b>Level of education (baseline for education is less than primary school)</b>				
Primary	-0.702	(0.011)***	-0.319	(0.001)***
Secondary	-1.136	(0.015)***	-0.503	(0.002)***
University	-1.532	(0.025)***	-0.442	(0.003)***
<b>Age group (baseline for age: 15-19 years old)</b>				
Between 20 and 24	0.519	(0.043)***	0.286	(0.006)***
Between 25 and 29	1.268	(0.042)***	0.652	(0.006)***
Between 30 and 34	2.072	(0.042)***	1.047	(0.006)***
Between 35 and 39	2.87	(0.043)***	1.387	(0.006)***
Between 40 and 44	3.579	(0.0433)***	1.696	(0.006)***
Between 45 and 49	4.19	(0.044)***	2.002	(0.006)***
<b>Region/area of living (baseline for region is Southeast)</b>				
Red River Delta	-0.509	(0.016)***	-0.083	(0.002)***
Northern Midlands and Mountains	-0.223	(0.018)***	-0.061	(0.002)***
North and South Central Coast	-0.062	(0.015)***	0.143	(0.002)***
Central Highlands	0.464	(0.028)***	0.362	(0.003)***
Mekong River Delta	0.156	(0.015)***	-0.298	(0.002)***
<b>Urban</b>	-0.239	(0.011)***	-0.178	(0.001)***
<b>Marital status (baseline for marital status is single)</b>				
Married	1.147	(0.040)***	1.101	(0.008)***
Divorced	-0.059	(0.047)	0.466	(0.009)***
Widowed	-0.180	(0.045)***	0.685	(0.009)***
<b>Sector of employment (baseline for sector of employment is public)</b>				
Private, not elsewhere classified	0.834	(0.394)	0.135	(0.004)***
Individual/family enterprise, and self-employed	0.256	(0.011)	0.334	(0.002)***
Foreign	-	-	0.130	(0.005)***
Collective or cooperative	0.276	(0.013)	0.149	(0.015)***
Mixed: public-private	-0.390	(0.140)	-	-
Owned housing	-	-	0.090	(0.003)***
Basic amenities	-	-	-0.100	(0.002)***
Durable goods	-	-	-0.042	(0.001)***
Migration	-	-	-0.157	(0.004)***

	<b>1989</b>	<b>2009</b>
Number of observation	116153	2098186
R-squared	0.4639	0.3384

*Note:* Standard errors are in parentheses. \*\*\* Denotes significance at the 1 percent level.

In addition, socio-economic variables were found to be correlated with fertility. For sector of employment, women who worked in other sectors had more children than those who worked in the public sector or as government officers. This may not be surprising because people who work in the public sector are subject to Vietnam's two-child policy; they could not have third or higher order births. According to Decision No. 09, people who work in public service and have a third child or more shall be disciplined by not being promoted and by being subject to removal from leadership positions (Committee for Population, Family and Children (Vietnam), 2003).

Furthermore, the relationship between the migration variable and fertility is statistically significant at the 1 percent level. In other words, migrants tended to have a smaller number of children than those who were not migrants by 0.2 children. Regarding economic status, besides basic amenities showing a strong and significant relationship with fertility, durable goods also appear to be correlated with a drop in fertility. Overall, women who lived in the households that owned durable goods and basic amenities were more likely to have a smaller number of children by about 0.1 and

0.04, respectively, compared with those who lived in households with less household wealth.

Additionally, the study provides empirical results using years of education instead of levels of education (see Table A1 in the Annex). Similarly, mothers (with at least one child) with more years of education tended to have a smaller number of children. In particular, one more year of maternal education was associated with 0.139 fewer children in 1989, while one more year of maternal education in 2009 was related to a drop of 0.057 children. The analysis also shows that the correlation between the level of maternal education and the decline in fertility was weaker in the more recent period.

### **Discussion and conclusion**

The empirical results from both Table 6 and Table A1 suggest a strong negative and statistically significant correlation between maternal education and fertility measured by the number of children per mother. Such a pattern was found in both 1989 and 2009. In particular, if the relationship over time is considered, it was found that this relationship was weaker in the more modern period (2009) (for example, see Table A1). Even though it has been generally observed that both female education and fertility in Vietnam have undergone significant changes and both factors are of policy interest,



this is the first study that quantitatively shows that both factors could be related.

Despite a weaker correlation over time, such findings can potentially have some implications for development policies in Vietnam. In the introduction, it was seen that unequal fertility rates among different regions is of concern to the Vietnamese government. Thus, identifying factors related to fertility differentials could potentially be useful for policy initiation and implementation. From Table 6 and Table A1, even when the regional differences are controlled in the regression analyses by the regional dummies, the negative relationship between maternal education and fertility is still robust. This suggests that through basic development components, such as ensuring more education for women, such objectives as lowering the fertility rate could in turn be achieved without further regional policy intervention.

Nevertheless, when compared with studies conducted in other countries, the magnitudes found in this study appear smaller. For example, Osili and Long (2008) found that from the instrumental variables (IV) regression, a one-year increase in female schooling in Nigeria was found to reduce fertility by 0.26 to 0.48 births. Similarly, by using cross-country panel data from low-income countries, Schultz (1997) estimated that a one-year increase in female schooling reduced fertility by 13 percent or about 0.5

children per woman. These magnitudes are much higher than what was found in Vietnam: 0.139 in 1989 and 0.057 in 2009. Although most countries studied by Schultz were low-income and low-growth sub-Saharan African countries, according to World Bank annual reports, Vietnam in 2009 and Nigeria in 1999 (the year studied by Osili and Long (2008)) had very similar growth rates: 5.4 percent in 2009 in Vietnam and 5.3 percent in 1999 in Nigeria. As a consequence, such statistics do not appear to suggest that economic growth could be a factor that contributes to the erosion of the relationship between maternal education and fertility. As such, further studies need to be conducted to clarify this matter.

Nonetheless, one of the explanations for a relatively weaker result in the present study could come from the focus and the main limitation of the study. In this paper, the focus was on mothers aged 15 to 49 years with at least one child, while most studies have looked at women in general, which includes those who are childless. The narrow focus of this paper could potentially bias the results downwards, resulting in a smaller magnitude in the correlation between higher education and lower fertility than is usually found in the literature.

In addition, the main limitation of the present paper is that the authors can claim only that their results suggest a correlation between maternal education and fertility, but not causation. Endogeneity problems

arose from, for example omitted variables, such as unobserved individual characteristics that could produce both higher education and lower fertility; these could not be addressed with the OLS estimation performed in this study. Indeed, Osili and Long (2008) found that, when comparing the results from the OLS analysis and IV analysis (corrected for endogeneity problem), the OLS estimates underestimate the magnitude of the relationship between female schooling and fertility. Thus, the finding that the results of the present study are small in comparison with existing studies could possibly be due to such underestimation. As this study is the first attempt to address this research question in the Vietnamese context, in a future study the authors plan to employ analysis such as the instrumental variable strategy to overcome the endogeneity problem.

**Annex**

Table A1: Maternal education (years of education) and fertility

	<b>1989</b>		<b>2009</b>	
Years of schooling	-0.139	(0.001)***	-0.057	(0.00021)***
<b>Age group (baseline for age: 15-19 years old)</b>				
Between 20 and 24	0.549	(0.043)***	0.282	(0.006)***
Between 25 and 29	1.305	(0.042)***	0.652	(0.006)***
Between 30 and 34	2.11	(0.042)***	1.04	(0.006)***
Between 35 and 39	2.893	(0.042)***	1.38	(0.006)***
Between 40 and 44	3.591	(0.043)***	1.689	(0.006)***
Between 45 and 49	4.18	(0.043)***	1.997	(0.006)***
<b>Region/area of living (baseline for region is Southeast)</b>				
Red River Delta	-0.506	(0.016)***	-0.061	(0.002)***
Northern Midlands and Mountains	-0.214	(0.017)***	-0.049	(0.002)***
North and South Central Coast	-0.061	(0.015)***	0.156	(0.002)***
Central Highlands	0.459	(0.028)***	0.362	(0.003)***
Mekong River Delta	0.124	(0.015)***	-0.291	(0.002)***
<b>Urban</b>	-0.194	(0.011)***	-0.171	(0.001)***
<b>Marital status (baseline for marital status is single)</b>				
Married	1.165	(0.040)***	1.103	(0.008)***
Divorced	-0.044	(0.047)	0.465	(0.009)***
Widowed	-0.203	(0.045)***	0.685	(0.0009)***
<b>Sector of employment (baseline for sector of employment is public)</b>				
Private, not elsewhere classified	0.741	(0.392)**	0.016	(0.003)***
Individual/family enterprise, and self-employed	0.241	(0.012)	0.176	(0.006)***
Foreign	-	-	-0.016	(0.004)***
Collective or cooperative	0.269	(0.013)	0.044	(0.015)***
Mixed: public-private	-0.338	(0.159)	-	-
Owned housing	-	-	0.09	(0.003)***
Basic amenities	-	-	-0.09	(0.002)***

	<b>1989</b>		<b>2009</b>	
Durable goods	-	-	-0.025	(0.001)***
Number of observation	116153		2098186	
R-squared	0.4639		0.3384	

*Note:* Standard errors are in parentheses. \*\*, \*\*\* Denote significance at the 5 percent, and 1 percent levels, respectively.

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