Int J Health Econ Manag (2018) 18:277–299
https://doi.org/10.1007/s10754-018-9233-4

RESEARCH ARTICLE

Do the more educated utilize more health care services? Evidence from Vietnam using a regression discontinuity design

Thang Dang[1,2]

Received: 11 April 2017 / Accepted: 3 January 2018 / Published online: 10 January 2018

Abstract In 1991, Vietnam implemented a compulsory primary schooling reform that provides this study a natural experiment to estimate the causal effect of education on health care utilization with a regression discontinuity design. This paper finds that education causes statistically significant impacts on health care utilization, although the signs of the impacts change with specific types of health care services examined. In particular, education increases the inpatient utilization of the public health sector, but it reduces the outpatient utilization of both the public and private health sectors. The estimates are strongly robust to various windows of the sample choice. The paper also discovers that the links between education and the probability of health insurance and income play essential roles as potential mechanisms to explain the causal impact of education on health care utilization in Vietnam.

Keywords Education · Health care utilization · Regression discontinuity design · Vietnam

JEL Classification I12 · I21 · J13

Introduction

Education can have massive positive impacts on health (Eide and Showalter 2011; Grossman 1976, 2006, 2008). Previous studies on the health impacts of education mainly focus on health status or health outcomes, for examples health knowledge (Altindag et al. 2011), nutritional status (Webbink et al. 2010), illness risk (Leuven et al. 2016; Silles 2009), health behaviors (Cutler and Lleras-Muney 2008; Li and Powdthavee 2015) and mortality (Albouy and Lequien 2009; Gathmann et al. 2015). However, few studies investigate the causal link between education and health care utilization, such as doctor visits and medical expenditures.

✉ Thang Dang
thang.dang@thangdang.org

[1] Department of Economics and Related Studies, University of York, York, UK

[2] School of Economics, University of Economics Ho Chi Minh City (UEH), Ho Chi Minh City, Vietnam

This study probes how people make their choices of health care utilization based on schooling, and provides the first empirical evidence on the causal impact of schooling on health care utilization in Vietnam.

Assessing health care utilization is pivotal for evaluating the functioning performance of a health care system (Kruk and Freedman 2008; Murray and Frenk 2000; World Health Organization 2011), especially in developing countries (United Nations 2015). This paper examines whether education plays an important role in making medical care decisions because people with different education probably have different health knowledge or information that might determine health care utilization as indicated in Grossman's demand-for-health model (Grossman 1972, 1976, 2000). In other words, educated people can enhance their ability to efficiently allocate given resources for the production of health outcomes.

Estimating the causal relationship between education and health outcomes is difficult because there are unobserved factors that determine both. Addressing this problem, using compulsory schooling laws to instrument for exogenous variations in schooling has been increasingly applied in recent years (Dickson et al. 2016). For example, Li and Powdthavee (2015) employ a regulation that raised the minimum age for leaving schools from 14 to 15 years after World War II to instrument for exogenous changes in education in Australia. They find that more schooling increases diets and exercise, and reduces drinking. Grépina and Bharadwaj (2015) utilize the 1980 compulsory schooling reform in Zimbabwe and find that maternal education improves child survival. Leuven et al. (2016) exploit a compulsory educational expansion during the 1960s in Norway and show that education lowers the risk of lung and prostate cancers among Norwegian men.

This study employs the Law on Universal Primary Education (LUPE), which was introduced in 1991 in Vietnam, to instrument for exogenous shifts in education to estimate the causal impact of schooling years on health care utilization. Before 1991, opportunities to access to education were not given to all Vietnamese people, especially those in rural and remote areas because of widespread poverty and resource deficiencies. The LUPE provides more chances for Vietnamese children to engage in schooling, at least at the primary level because the LUPE mandates that all Vietnamese children aged 14 or less complete primary education starting in 1991. The LUPE has been regarded as an important policy to improve education for Vietnamese people.[1]

This study finds robust evidence that education does influence health care types, including inpatient and outpatient services. The more educated likely utilize more inpatient and fewer outpatient services in both public and private health sectors. On average, an additional schooling year increases inpatient utilization outcomes, including the likelihood of a doctor visit by 1–1.1% points in the public health sector and the number of doctor visits by approximately 0.009–0.011 visits in the public sector. In contrast, the adverse impacts of an additional year of schooling are reductions in the probability of an outpatient visit by approximately 2.2–2.3% points and 1.7–1.8% points in the public and private health sectors, respectively, and the number of outpatient medical visits by approximately 0.080–0.082 visits and 0.087–0.094 visits in the public and private health sectors, respectively. Furthermore, this study finds that health insurance and income play the roles as primary mediators for the establishment of the causal relationship between education and health care utilization in Vietnam.

This paper contributes to the existing literature in multiple ways. First, the paper provides the first empirical evidence on the causal impact of education on health care utilization.

[1] Previous studies also use LUPE as an instrument for exogenous changes in education to estimate the causal effects of education on political outcomes and labor market outcomes in Vietnam (Dang 2017a, b).

Importantly, the paper provides new insights into the causal link between schooling and health care utilization, finding that the causal impacts of education on inpatient and outpatient health care services are different. In addition, this study is significantly conducted in a developing country, where there is an increasing demand for evidence-based information on health care utilization. Finally, this study gives more evidence on the health impacts of compulsory schooling reforms, the topic has received growing interest over the last several years.

Context of the study

The 1991 compulsory schooling reform in Vietnam

Vietnam launched an economic reform (called *Doimoi*) in 1986 through which a centrally planned economy was proposed to be transitioned towards a market-oriented economy. In parallel with economic modifications, Vietnam also made changes in education. One of the most important education policies is the policy of compulsory primary education that was formally implemented in 1991 under the LUPE. According to the LUPE, all Vietnamese children aged 6 must participate in the first grade (grade 1) and complete the last grade (grade 5) of the primary education at the maximum age of 14. Prior to the reform, there was no any formal compulsory education policy in Vietnam, and Vietnamese children were not forced to go to schools at any level. An individual's educational attainment depended on his or her family's own choice. Hence, the LUPE changed the number of compulsory schooling years from 0 to 5 years in Vietnam.

Under this legal framework, the public budget for the education system, particularly for primary education, has increased in Vietnam. In addition, the government of Vietnam attracted the financial support from private agencies and organizations in the society for the implementation of universal primary education. The reform of the education system was accompanied by the transformation of the academic curriculum. The LUPE mandated that the school curriculum emphasizes the provision of foundations for pupils' early understanding of people, nature and the society around them in addition to the core skills of speaking, reading, writing, and basic mathematics. Such a pedagogical content generated the important encouragement for pupils' further studies. Therefore, the reform related to the academic curriculum aimed at promoting educational attainment for succeeding levels of post-primary education.

Moreover, the LUPE mainly targerted children from rural and isolated areas where citizens traditionally had less schooling compared to urban areas in Vietnam. The implementation of the LUPE, therefore, generated some educational improvements. The statistics from World Bank (2017) shows that the numbers of children who completed primary school increased over time in Vietnam. For example, the numbers of Vietnamese children who enrolled in primary school were approximately 8.1 million and 8.7 million in 1986 and 1989, respectively, and the corresponding figures were approximately 9.1 million and 10 million in 1992 and 1995, respectively. In addition, as of 2000, almost all children aged 14 completed primary school. Apparently, the LUPE in 1991 is useful as a sharp transition point that marks a discontinuous change in schooling for Vietnamese people who were around the age of 14 in 1991. This discontinuity is used to create the treatment and control groups for examining the causal effect of education on health care utilization in this study.

Health care system and health care utilization in Vietnam

After the 1975 unification of the nation, Vietnam undertook its strategy of development based on a centrally planned economy. In this context, Vietnam maintained a fully state-based health care system in which the government delivered and financed almost medical care services. As a result, numerous health care practices were functioned under the control of the state (Ladinsky and Levine 1985). However, the government-based health system did not work as well as initially expected, in terms of both the quality and the quantity of health care services, because of the lack of investment resources facing this low-income country (Matsuda 1997).

When Vietnam carried out its economic reform in 1986, there were changes in the functioning structure of health care system towards a market-based mechanism. Some key policies such as the application of user fees for public health providers in 1989 and the introduction of health insurance in 1992 were implemented to govern the health care system (Lönnroth et al. 1998). These policies significantly mobilized resources for improving health care practices (Thanh et al. 2014). Between the early 1990s and mid-2000s, Vietnam had maintained a relatively stable health care system compared to that during the period between 1986 and 1990 (Ministry of Health of Vietnam and Health Partnership Group 2008). For example, health care expenditure as a percentage of GDP was stably around 5% between 1995 and 2005 (World Health Organization 2017).

Furthermore, the following partial privatization of health care system that has promoted more market-based medical practices raised health care utilization in Vietnam (Hoai and Dang 2017; Ladinsky et al. 2000; Wolffers 1995). The development of the private sector has been regarded as a key complement to the public sector to provide sufficient health care services in terms of both the volume and the quality (Uplekar 2000). Vietnam has, so far, retained a two-sector health care system in which both public and private sectors have worked together to provide medical care services (Tat and Barr 2006; Thanh et al. 2014). Therefore, it is essential to emphasize health care utilization outcomes from public and private sectors separately when investigating health care utilization in Vietnam (Nguyen 2016).

The health care utilization in Vietnam might be determined by some factors that were examined by previous studies (Nguyen 2016; Palmer et al. 2015). For example, the policy of universal health insurance for children aged five and under, which was launched in 2005, considerably improves the use of health care services from public health facilities for eligible children, especially those from disadvantaged families (Palmer et al. 2015). This study contributes to the understanding of health care utilization in Vietnam by investigating the role of education.

Estimation methods

To examine the association between schooling years and health care utilization, one typically estimates the following regression equation:

$$U_i = \varphi_1 + \varphi_2 S_i + \varphi_3 \boldsymbol{X}_i' + \tau_t + g\,(age_i) + \varepsilon_i \tag{1}$$

where U_i indicates health care utilization for an individual i in year t; S_i is schooling years of the individual i; $\boldsymbol{X}_i'$ is a vector of characteristics of the respondent, such as dummies for male, urban, ethnic majority, and six geographical regions; τ_t indexes fixed effects of the

survey year; $g\,(age_i)$ is a quadratic function of age;[2] and ε_i is an error term. The coefficient of interest from Eq. (1) is φ_2, which indicates the impact of schooling years on health care utilization. However, the ordinary least squares (OLS) estimate using Eq. (1) likely yields a biased estimate of φ_2 due to the problem of endogeneity. The problem potentially originates from the existence of unobserved characteristics that affect both education and health care utilization.

To address this problem, this paper uses the 1991 compulsory schooling reform as a source of exogenous changes in education and employs regression discontinuity design (RDD) as the identification to establish the causal impact of education on health care utilization using the two-stage least squares (2SLS) estimation. The RDD is arguably appropriate for the estimation in this study (Imbens and Lemieux 2008; Lee and Lemieux 2010). In the first stage, the paper estimates the following regression equation:

$$S_i = \alpha_1 + \alpha_2 R_i + \alpha_3 \boldsymbol{X}_i' + \tau_t + g\,(age_i) + \varsigma_i \tag{2}$$

where R_i indicates the exposure to schooling reform, or a dummy for being that the age of respondent in 1991 (age_{1991}) is equal to or less than 14; mathematically $R_i = \begin{cases} 1 \text{ if } age_{1991} \leq 14 \\ 0 \text{ if } age_{1991} > 14 \end{cases}$. Equation (2) is used to obtain the predicted values for S_i, which are then used in the second stage estimation.

In the second stage, the paper estimates the following regression function:

$$U_i = \beta_1 + \beta_2 S_i + \beta_3 \boldsymbol{X}_i' + \tau_t + g\,(age_i) + \zeta_i \tag{3}$$

where the coefficient of interest (β_2) is inferred as the causal impact of schooling years on health care utilization. This coefficient indicates the local average treatment effect (LATE) of the impact of schooling years on health care utilization.

In addition, the study also estimates an intent-to-treat (ITT) model as a reduced-form regression using the following regression form:

$$U_i = \gamma_1 + \gamma_2 R_i + \gamma_3 \boldsymbol{X}_i' + \tau_t + g\,(age_i) + \xi_i \tag{4}$$

where γ_2 represents the effect of the 1991 compulsory schooling reform on health care utilization or the intent-to-treat effect.

Importantly, the choice of an econometric model for the estimation in this study depends on the data type of the dependent variable. In particular, when the dependent variable is a binary variable (the probability of a doctor visit), the paper estimates an IV-Probit model. Meanwhile, when a dependent variable is a count data variable (the frequency of doctor visits), the paper estimates an IV-Poisson model. The rationale for using such non-linear regression forms is that these forms can capture the variation in health care utilization with the age of the respondent.

Furthermore, health insurance status typically plays an important role in explaining health care utilization (Card et al. 2008; Dang 2017c; Palmer et al. 2015). However, this study does not include health insurance status in the set of control variables. This is because the probability for an individual to be insured is likely correlated with his or her education, and health insurance is probably an endogenous source of health care utilization (Card et al. 2008; Nguyen 2012). By excluding health insurance from the set of control variables, this

[2] This paper uses a quadratic function of age to control for the possible effects of potential age-related confounding differences.

paper prevents a potential threat to the identification from the endogeneity problem induced by health insurance status.[3]

Data and the sample

The paper uses three waves of the Vietnam Household Living Standards Survey (VHLSS): 2010, 2012 and 2014. VHLSS is a nationally representative survey in Vietnam that is conducted biannually to elicit Vietnamese households' socio-economic, demographic and living conditions infomation. The VHLSS has been used in numerous previous studies in economics, sociology, public health and development.

To establish the sample, this study limits observations whose age in 1991 was between 6 and 23, corresponding an age at the time of the survey between 25 and 46 for the analysis. This is equivalent to a bandwidth of ± 9. As a consequence, the main sample has 27,271 observations who were born between 1968 and 1985. Among them, there are 12,909 individuals in the treatment group and 14,362 in the control group. Equivalently, approximately 47.3% of the main sample are exposed to the 1991 compulsory schooling reform. The summary statistics of the sample are specifically presented in Table 1.[4]

Importantly, the VHLSS contains both information about completed schooling years (between 0 and 12 years) and the highest level of schooling that allows this study to create a variable of full schooling years, which is arguably appropriate to capture the whole duration of the formal education in Vietnam (Coxhead and Phan 2013). This study defines schooling years as full schooling years rather than completed schooling years. Schooling years for the whole sample range from 0 to 22 years, with a mean value of approximately 8.4. Meanwhile, average schooling years for the treatment and control groups are, respectively, 9.3 and 7.7. Intuitively, on average observations from the treatment group who are fully exposed to the 1991 compulsory schooling reform have more schooling than those from the control group.

Main results

This section reports the result of the main estimates. In particular, the estimates of the first stage, which show the impact of the 1991 compulsory schooling reform on the educational outcome, are presented. For the causal impact of education on health care utilization in the second stage, the paper presents the estimates for two utilization measures: (i) the probability of a doctor visit using an IV-Probit model, and (ii) the frequency of doctor visits using an IV-Poisson model. The estimates are presented for public and private health sectors separately.

The effect of the 1991 compulsory schooling reform on education

Table 2 presents the results of the effect of the 1991 compulsory schooling reform on schooling years using two estimation models: (i) a simple model that excludes all control variables, and (ii) a full model that includes all key control variables. Both models include the survey year-fixed effects and a quadratic function of age. The results indicate that the 1991 compulsory

[3] See Angrist and Pischke (2009) for a more detailed explaination.

[4] The definitions of all variables are specifically presented in "Appendix 1".

Table 1 Descriptive statistics of the sample

Variable	Full sample		Treatment		Control	
	Mean	SD	Mean	SD	Mean	SD
Health care utilization outcomes						
Public health care services						
Probability of an inpatient visit	0.066	0.248	0.075	0.263	0.057	0.232
Probability of an outpatient visit	0.208	0.406	0.188	0.391	0.225	0.418
Frequency of inpatient visits	0.086	0.397	0.094	0.399	0.079	0.396
Frequency of outpatient visits	0.561	1.742	0.490	1.566	0.624	1.883
Private health care services						
Probability of an inpatient visit	0.005	0.068	0.005	0.068	0.005	0.067
Probability of an outpatient visit	0.143	0.350	0.128	0.334	0.157	0.363
Frequency of inpatient visits	0.007	0.167	0.005	0.084	0.009	0.216
Frequency of outpatient visits	0.441	1.726	0.366	1.431	0.509	1.951
Main control variables						
Male	0.495	0.500	0.501	0.500	0.490	0.500
Urban	0.308	0.462	0.319	0.466	0.299	0.458
Majority	0.836	0.370	0.842	0.365	0.831	0.375
Red River delta	0.192	0.394	0.199	0.400	0.186	0.389
Midlands and northern mountainous areas	0.177	0.382	0.170	0.375	0.184	0.388
Northern and coastal central region	0.216	0.411	0.207	0.405	0.223	0.417
Central Highlands	0.072	0.258	0.069	0.254	0.074	0.261
Southeast area	0.126	0.332	0.134	0.341	0.118	0.323
Mekong River delta	0.217	0.412	0.220	0.415	0.214	0.410
Survey 2010	0.341	0.474	0.345	0.475	0.338	0.473
Survey 2012	0.333	0.471	0.329	0.470	0.336	0.472
Survey 2014	0.326	0.469	0.326	0.469	0.326	0.469
Potential mechanisms						
Health insurance	0.478	0.500	0.504	0.500	0.456	0.498
Income	1191.557	2033.040	1422.818	2164.166	983.692	1883.500
Schooling variables						
Reform exposure	0.473	0.499	1.000	0.000	0.000	0.000
Schooling years	8.449	3.948	9.337	3.703	7.652	3.991
Observations	27,271		12,909		14,362	

schooling reform has considerable a positive impact on schooling years for both simple and full models. The estimated coefficients are statistically significant at 1%.

The impact magnitudes are nearly similar for both models. In particular, a respondent, who was exposed to the 1991 compulsory schooling reform, tends to have more schooling years by an average of 1.7 years using a simple model (column 1) or 1.6 years using a full model (column 2) compared to an individual from the control group, whose age in 1991 are over 14. These findings even show the larger impacts compared to other previous studies. For example, Dang (2017a) discovers that the 1991 compulsory educational reform in Vietnam only created

Table 2 The impact of the 1991 compulsory schooling reform on schooling years: first stage

	Dependent variable: schooling years	
	(1)	(2)
Reform exposure	1.685***	1.613***
	(0.136)	(0.104)
Male		0.494***
		(0.056)
Urban		2.235***
		(0.165)
Majority		2.709***
		(0.253)
Red River delta		2.760***
		(0.338)
Midlands and northern mountainous areas		1.941***
		(0.235)
Northern and coastal central region		1.509***
		(0.308)
Central Highlands		1.275***
		(0.222)
Southeast area		1.009***
		(0.319)
Mekong River delta		Omitted
Survey year fixed effects	Yes	Yes
Quadratic function of age	Yes	Yes
Constant	7.576***	3.019***
	(0.228)	(0.313)
F-statistic	54.05	54.29
R-squared	0.046	0.248
Observations	27,271	27,271

Ordinary least squares are used. Robust standard errors are clustered at the provincial level and reported in parenthesis. Controls consist of male, urban, majority, and dummies for six geographical regions
$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$

an increase of 1.12–1.27 schooling years. However, Dang (2017a) uses a comparatively small sample from the World Values Survey that only consisted of 1000–1500 observations. This study takes an advantage of a large and nationally representative sample from the VHLSS with 27,271 observations to examine the impact of the 1991 compulsory schooling reform on education (Table 2).

The impact is graphically demonstrated in Fig. 1. There is a substantial jump in schooling years from the control group to the treatment group. Intuitively, the 1991 compulsory schooling reform in Vietnam provides a discontinuity in the trend of schooling years that is feasibly employed as an instrument for exogenous changes in education as implemented in this study. More importantly, the F-statistic values for the first stage regressions, which are larger than 10, indicate the validity of the instrument (Stock et al. 2002). Specifically, the F-stat values are 54.05 and 54.29, respectively, for simple and full models.

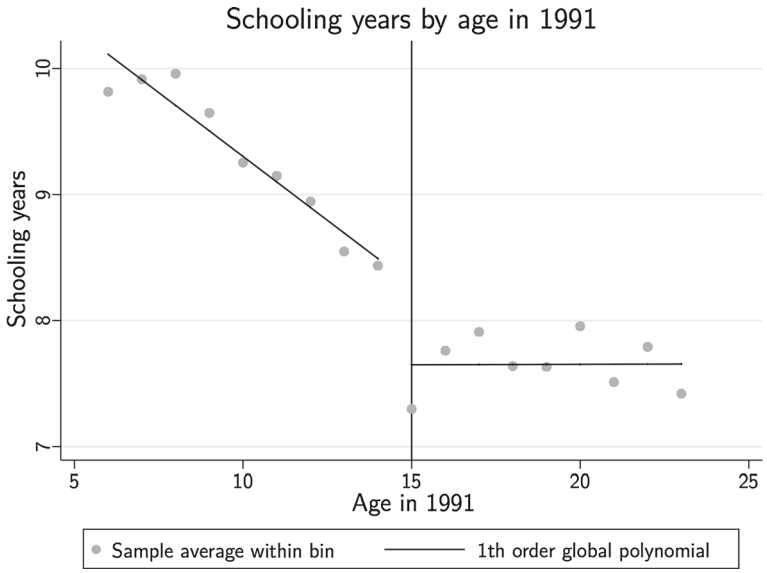

Fig. 1 The impact of the 1991 compulsory schooling reform on schooling years

The causal effect of education on health care utilization outcomes

Table 3 represents the marginal coefficients of the causal impact of education on the probability of a doctor visit using a IV-Probit model. The findings indicate that education has a causal link with the probability of a doctor visit for both inpatient and outpatient services in both public and private health sectors. However, the directions of the impacts are reverse for two distinct types of health care services. In particular, education increases the probability of a doctor visit for inpatient services. The more educated on average tend to have a higher probability of an inpatient visit by 1% point using a simple model (column 1) or 1.1% point using a full model (column 2) in the public sector (Panel A). These estimated coefficients are both statistically significant at 1%. Meanwhile, the corresponding figures for the private sector (Panel B) are 0.01% points using a simple model (column 1) and 0.01% points using a full model (column 2) compared to the control group. However, the estimated coefficients for private inpatient services are statistically non-significant.

In contrast, education reduces the probability of an outpatient visit. On average, one year of schooling results in a 2.2% point decrease in the probability of an outpatient visit using a simple model (column 1) or 2.3% points using a full model (column 2) in the public health sector (Panel A), and 1.7% points using a simple model (column 1) or 1.8% points using a full model (column 2) in the private health sector (Panel B). Although the impacts in the public health sector are larger than the impacts from the private health sector, these gaps is not considerable.

Next, Table 4 shows the marginal impacts of schooling years on the number of doctor visits using an IV-Poisson model. Like the effect on the probability of a doctor visit, education has a causal impact on the frequency of health care visits. All estimated coefficients are statistically significant at 1 and 5%, except for the frequency of private inpatient visits. Specifically, an additional year of schooling raises the average number of inpatient visits by approximately 0.009 times using a simple model (column 1) and 0.011 times using a full model (column 2)

Table 3 The impact of schooling years on the probability of a doctor visit: main estimates

Dependent variable	Panel A: Public health sector		Panel B: Private health sector	
	(1)	(2)	(1)	(2)
Probability of an inpatient visit	0.010***	0.011 ***	0.0001	0.0001
	(0.003)	(0.003)	(0.0005)	(0.0005)
Probability of an outpatient visit	−0.022***	−0.023***	−0.017***	−0.018***
	(0.005)	(0.004)	(0.004)	(0.004)
Controls	No	Yes	No	Yes
Survey year fixed effects	Yes	Yes	Yes	Yes
Quadratic function of age	Yes	Yes	Yes	Yes
Observations	27,271	27,271	27,271	27,271

Robust standard errors are clustered at the provincial level and reported in parenthesis. IV-Probit regressions are used. Reported coefficients are marginal effects. Controls consist of male, urban, majority, and dummies for six geographical regions
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

Table 4 The impact of schooling years on the frequency of doctor visits: main estimates

Dependent variable	Panel A: Public health sector		Panel B: Private health sector	
	(1)	(2)	(1)	(2)
Frequency of inpatient visits	0.009**	0.011***	−0.002	−0.002
	(0.004)	(0.004)	(0.001)	(0.001)
Frequency of outpatient visits	−0.080***	−0.082***	−0.087***	−0.094***
	(0.017)	(0.017)	(0.019)	(0.016)
Controls	No	Yes	No	Yes
Survey year fixed effects	Yes	Yes	Yes	Yes
Quadratic function of age	Yes	Yes	Yes	Yes
Observations	27,271	27,271	27,271	27,271

Robust standard errors are clustered at the provincial level and reported in parenthesis. IV-Poisson regressions are used. Reported coefficients are marginal effects. Controls consist of male, urban, majority, and dummies for six geographical regions
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

in the public health sector (Panel A), and approximately 0.005 times using a simple model (column 1) in the private health sector.

In contrast, schooling is negatively linked to the frequency of outpatient visits. In particular, one more schooling year on average reduces the number of outpatient visits by nearly 0.080 times using a simple model (column 1) or 0.082 times using a full model (column 2) in the public health sector (Panel A), and 0.087 times using a simple model (column 1) or 0.094 times using a simple model (column 2) in the private health sector (Panel B). Obviously, there are small differences between the impacts of education on the number of outpatient visits to private and public health providers.

In addition to the estimates from the 2SLS estimation, the paper finds statistically significant impacts of the 1991 compulsory schooling reform on almost all outcomes of health care utilization, except for the probability of an inpatient visit at private health facilities, using a

Table 5 The impact of schooling years on the probability of a doctor visit: robustness, various windows

Dependent variable	Panel A: Public health sector		Panel B: Private health sector	
	(1)	(2)	(1)	(2)
Probability of an inpatient visit				
Age in 1991: 7–22	0.010***	0.011***	−0.0004	−0.0004
(Observations: 24,131)	(0.003)	(0.003)	(0.0005)	(0.0005)
Age in 1991: 8–21	0.010***	0.011***	−0.0004	−0.0004
(Observations: 21,107)	(0.003)	(0.003)	(0.0006)	(0.0006)
Age in 1991: 9–20	0.010**	0.011***	−0.00006	−0.00004
(Observations: 17,798)	(0.004)	(0.004)	(0.0008)	(0.0008)
Age in 1991: 10–19	0.009**	0.012***	−0.0002	−0.0002
(Observations: 14,598)	(0.004)	(0.004)	(0.0009)	(0.001)
Probability of an outpatient visit				
Age in 1991: 7–22	−0.020***	−0.020***	−0.015***	−0.017***
(Observations: 24,131)	(0.005)	(0.005)	(0.004)	(0.004)
Age in 1991: 8–21	−0.017***	−0.018***	−0.014***	−0.016***
(Observations: 21,107)	(0.005)	(0.005)	(0.004)	(0.004)
Age in 1991: 9–20	−0.015**	−0.015**	−0.010**	−0.014***
(Observations: 17,798)	(0.006)	(0.006)	(0.005)	(0.005)
Age in 1991: 10–19	−0.012*	−0.012*	−0.007	−0.011**
(Observations: 14,598)	(0.006)	(0.007)	(0.005)	(0.005)
Controls	No	Yes	No	Yes
Survey year fixed effects	Yes	Yes	Yes	Yes
Quadratic function of age	Yes	Yes	Yes	Yes

Robust standard errors are clustered at the provincial level and reported in parenthesis. IV-Probit regressions are used. Reported coefficients are marginal effects. Controls consist of male, urban, majority, and dummies for six geographical regions

***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

reduced-form regression. The estimated coefficients for the impacts on the probability of a doctor visit and the number of doctor visits are, respectively, reported in Tables 8 and 9 of Appendices.

Robustness checks

The results of robustness checks for the main estimates using various sub-samples established by using different bandwidths are presented in Tables 5 and 6, corresponding to IV-Probit and IV-Poisson models for the impacts of schooling years on the probability of a doctor visit and the frequency of doctor visits. The paper employs four bandwidths of the age range in 1991: (i) 7–22, with 24,131 observations; (ii) 8–21, with 21,107 observations; (iii) 9–20, with 17,798 observations; and (iv) 10–19, with 14,598 observations.[5]

[5] When using various sub-samples, the paper also finds statistically significant impacts of the 1991 compulsory primary schooling reform on schooling years, although the magnitudes of the impact are smaller than the estimates obtained using the main sample. The results of the first stage estimates using various sub-samples are presented in Table 10 of Appendices.

Table 6 The impact of schooling years on the frequency of doctor visits: robustness, various windows

Dependent variable	Panel A: Public health sector		Panel B: Private health sector	
	(1)	(2)	(1)	(2)
Frequency of inpatient visits				
Age in 1991: 7–22	0.008*	0.010**	−0.003*	−0.003**
(Observations: 24,131)	(0.004)	(0.004)	(0.002)	(0.002)
Age in 1991: 8–21	0.008*	0.010**	−0.004*	−0.004*
(Observations: 21,107)	(0.005)	(0.005)	(0.002)	(0.002)
Age in 1991: 9–20	0.007	0.010*	−0.005	−0.005
(Observations: 17,798)	(0.006)	(0.006)	(0.003)	(0.003)
Age in 1991: 10–19	0.006	0.008	−0.004	−0.004
(Observations: 14,598)	(0.006)	(0.006)	(0.003)	(0.004)
Frequency of outpatient visits				
Age in 1991: 7–22	−0.077***	−0.082***	−0.087***	−0.099***
(Observations: 24,131)	(0.019)	(0.019)	(0.019)	(0.017)
Age in 1991: 8–21	−0.071***	−0.075***	−0.085***	−0.097***
(Observations: 21,107)	(0.020)	(0.025)	(0.020)	(0.017)
Age in 1991: 9–20	−0.059**	−0.066***	−0.081***	−0.101***
(Observations: 17,798)	(0.025)	(0.025)	(0.022)	(0.020)
Age in 1991: 10–19	−0.047*	−0.052**	−0.059**	−0.080***
(Observations: 14,598)	(0.028)	(0.029)	(0.025)	(0.026)
Controls	No	Yes	No	Yes
Survey year fixed effects	Yes	Yes	Yes	Yes
Quadratic function of age	Yes	Yes	Yes	Yes

Robust standard errors are clustered at the provincial level and reported in parenthesis. IV-Poisson regressions are used. Reported coefficients are marginal effects. Controls consist of male, urban, majority, and dummies for six geographical regions

***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

Table 5 provides the robustness checks for the probability of a doctor visit. First, when the outcome is the probability of an inpatient visit, the estimated coefficients are strongly robust to main estimates for both the public health sector (Panel A) and the private health sector (Panel B). In particular, one more year of schooling causes increases in the probability of an inpatient visit by 0.9–1% points when using a simple model (column 1) or 1.1–1.2% points when using a full model (column 2) in the public health sector. These estimated coefficients are statistically significant at 5% or 1%. Moreover, the directions and the amplitudes of the impacts are similar to the main effects shown in Table 3. Like the main results, the study also fails to find a statistically significant impact of schooling years on the probability of an inpatient visit in the private health sector, as presented in Panel B of Table 5.

Second, the coefficients of the impact of schooling years on the probability of an outpatient visit are strongly robust to the main estimates in terms of both the signs and the magnitudes for both public and private health sectors. The coefficients are statistically significant at conventional levels for almost sub-samples with the exception of a sub-sample using an age range in 1991 of 10–19 and a simple model for the private health sector (column 1 of Panel B). Generally, education has a negative effect on the probability of an outpatient visit. In

particular, an additional year of schooling is causally related to a 1.2–2.0% point decrease in the probability of an outpatient visit when using both a simple model (column 1) and a full model (column 2) in the public health sector (Panel A), and a 1–1.5% point decrease when using a simple model (column 1) or a 1.1–1.7% point decrease when using a full model (column 2) in the private health sector (Panel B).

The robustness check results for the frequency of doctor visits are illustrated in Table 6. In terms of the number of inpatient visits to the public health facilities, some estimated coefficients lose their statistical significance at conventional levels, as shown in Panel A. Exceptionally, the paper finds the statistically significant impacts for sub-samples of ages 7–22 and 8–21 in 1991 using both a simple model and a full model. In particular, the positive impacts from having an additional schooling year are an increase of 0.008 visits using a simple model (column 1) or 0.01 visits using a full model (column 2) for these two sub-samples. Education also increases the number of inpatient visits for the sub-sample of age 9–11 in 1991 only using a full model (column 2) by 0.01 times, whereas the corresponding coefficient using a simple model loses its statistical significance at any traditional level.

Meanwhile, the paper finds the adverse impacts of education on the frequency of inpatient visits to private health care providers at the 10 or 5% levels of statistical significance for sub-samples of ages 7–22 and 8–21, as indicated in Panel B of Table 6. Specifically, one more year of schooling is causally associated with an average decrease of approximately 0.003 visits using both a simple model and a full model for the 7–22 sub-sample, and 0.004 visits using both a simple model and a full model for the 8–21 sub-sample. The other estimates are statistically non-significant, even though they show negative signs of the impacts.

This paper also obtains the negative impacts of schooling years on the frequency of public and private outpatient visits for all available sub-samples with statistical significance at any conventional level. In particular, one year of schooling is causally connected to a decrease of approximately 0.047–0.077 visits using a simple model (column 1) or 0.052–0.082 visits using a full model (column 2) for the number of doctor visits in the public health sector (Panel A). The corresponding figures for the private health sector are a decrease of approximately 0.059–0.087 visits using a simple model (column 1) or 0.080–0.101 visits using a full model (column 2), as shown in Panel B.

Potential mechanisms

Having recognized the causal effect of education on various outcomes of health care utilization in Vietnam, this section highlights potential pathways through which increased education could be linked to changes in health care utilization outcomes. In particular, two main mediators that can explain the causal effect include the probability of health insurance and income. The marginal coefficients are presented in detail in Table 7. Essentially, the paper finds the positive associations between schooling years and the probability of health insurance and income. The estimated coefficients all are significant at 1%.

First, the results from Panel A of Table 7 show that education causes favorable impacts on the probability of being insured using a IV-Probit estimator. In particular, one year of schooling on average increases the probability of health insurance by approximately 2.9% points using a simple model (column 1) or 3.2% points using a full model (column 2). Moreover, using a reduced-form regression, the paper finds positive and statistically significant effects of the 1991 compulsory schooling reform on the probability of health insurance, as demonstrated in Panel A of Table 11 of Appendices. Specifically, the 1991 compulsory

Table 7 The impact of schooling years on the probability of health insurance and monthly income

	Panel A: Health insurance		Panel B: Income	
	(1)	(2)	(1)	(2)
Schooling years	0.029***	0.032***	227.063***	201.595***
	(0.006)	(0.006)	(39.738)	(29.244)
Model	IV-Probit	IV-Probit	IV	IV
Controls	No	Yes	No	Yes
Survey year fixed effects	Yes	Yes	Yes	Yes
Quadratic function of age	Yes	Yes	Yes	Yes
Observations	27,271	27,271	27,271	27,271

Robust standard errors are clustered at the provincial level and reported in parenthesis. Reported coefficients are marginal effects. Controls consist of male, urban, majority, and dummies for six geographical regions
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

schooling reform raises the probability of health insurance by 4.8% points using a simple model (column 1) or 5.2% points using a full model (column 2). Figure 2 in Appendices also demonstrates that the 1991 compulsory schooling reform creates a major leap in the probability of health insurance for respondents from the treatment group in comparison with those from the control group.

Previous studies confirm that health insurance has considerable positive impacts on health care utilization outcomes, for example, Card et al. (2008) in the United States, and Kondo and Shigeoka (2013) in Japan. Moreover, the existing literature on health economics and public health as well emphasize the positive role of education in improving health-related outcomes because the more educated tend to care more about their health status than the less educated (Cutler and Lleras-Muney 2008). Therefore, education increases the probability of health insurance, which in turn increases utilization of health care services with superior quality.

The affirmative impact of health insurance on health care utilization in Vietnam are already well-documented. For instance, Sepehri et al. (2006) find that health insurance increases the likelihood of hospital admission and prolongs patients' inpatient medical care duration. Thanh et al. (2014) indicate that insured patients are more likely to use inpatient services than patients without health insurance in Vietnam. Generally speaking, the probability of health insurance might play a role as a potential mediator explaining the causal link between education and health care utilization in Vietnam as shown in this study.

Second, income is another potential mediator accounting for the causal impact of education on health care utilization. The results of the impact of schooling years on income using an IV model are specifically presented in Panel B of Table 7. Education apparently increases monthly income at an 1% level of statistical significance. One schooling year is linked to an increment of VND 227 thousand using a simple model (column 1) or VND 202 thousand using a full model (column 2) in monthly income.[6] Furthermore, employing a reduced-form model, the paper also finds a favorable impact of the 1991 compulsory schooling reform on monthly income, with corresponding rises of nearly VND 440 thousand using a simple model (column 1) or VND 385 thousand using a full model (column 2), as depicted in Panel B of Table 11 of Appendices. Graphically, Fig. 3 reveals a considerable shift of

[6] Exchange rate: VND/USD = 22.8 thousand at the time of the study.

monthly income for respondents from the treatment group compared to those from the control group.

Income plays an essential role in improving health-related outcomes (Ettner 1996; Frijters et al. 2005; Marmot 2002). Richer people have a better financial condition to access more health care services than poor people. More importantly, people with higher income also care more about the quality of medical services, and they likely have a higher willingness to pay for more desirable health care services. Ministry of Health of Vietnam (2007) concludes that poor citizens have considerably lower health care utilization and pay less for medical services than rich ones in recent decades in Vietnam. This study specifically provides a more specific insight into the choice of health care utilization based on schooling level in Vietnam: more educated people, who have higher incomes, will utilize more inpatient services while using fewer outpatient services.

Conclusion

This study provides an empirical investigation into the causal effect of schooling on health care utilization in Vietnam by exploiting a compulsory schooling reform to plausibly instrument for exogenous changes in education. The paper robustly finds the significant impacts of education on health care utilization in Vietnam. However, the sign of the impacts depends on the specific type of health care services. While education increases the use of inpatient health care services, it reduces the use of outpatient services. Furthermore, the favorable impact of schooling on inpatient service utilization is larger for the private health sector than the public health sector. Meanwhile, the reverse effect of education on outpatient service utilization is roughly similar for both public and private health providers. These findings suggest that education is an important determinant in Vietnamese people's choices of health care service type.

Furthermore, the paper suggests that health insurance and income are key mediators of the link between schooling and health care utilization. Health insurance is important for health care utilization because health insurance has been a major channel of the health care payment in Vietnam (Wagstaff et al. 2016; World Bank 2007). In addition, income may affect the use of health care services. In low-income countries such, the poor have a low likelihood of accessing high-quality health care services. Therefore, the poor likely select outpatient health services that are affordable than inpatient health care services (O'Donnell et al. 2008; Thoa et al. 2013). Because education increases income, the more educated tend to choose inpatient health services rather than outpatient utilization, as found in this study.

The various findings of the impact of schooling on the utilization of inpatient and outpatient health care services in this study are interesting because they provide a more insightful understanding of socio-economic determinants of the demand for health care services in a developing country like Vietnam. However, the result that education increases the use of inpatient services might suggest the possibility that the more educated people may overuse inpatient health care services.

Acknowledgements The author would like to thank the editor, two anonymous reviewers and Thomas Cornelissen for helpful comments and suggestions.

Appendices

Appendix 1: Definition of variables

Health care utilization outcomes

Public health care services

Probability of an inpatient visit Probability of an inpatient visit to public health care services during the last 12 months (= 1 if yes, = 0 otherwise).
Probability of an outpatient visit Probability of an outpatient visit to public health care services during the last 12 months (= 1 if yes, = 0 otherwise).
Frequency of inpatient visits The number of inpatient visits to public health care services over the last 12 months (times).
Frequency of outpatient visits The number of outpatient visits to public health care services over the last 12 months (times).

Private health care services

Probability of an inpatient visit Probability of an inpatient visit to private health care services during the last 12 months (= 1 if yes, = 0 otherwise).
Probability of an outpatient visit Probability of an outpatient visit to private health care services during the last 12 months (= 1 if yes, = 0 otherwise).
Frequency of inpatient visits The number of inpatient visits to private health care services over the last 12 months (times).
Frequency of outpatient visits The number of outpatient visits to private health care services over the last 12 months (times).

Table 8 The impact of the 1991 compulsory schooling reform on the probability of a doctor visit: reduced-form (intent-to-treat) regressions

Dependent variable	Panel A: Public health sector		Panel B: Private health sector	
	(1)	(2)	(1)	(2)
Probability of an inpatient visit	0.018***	0.018***	0.0001	0.0002
	(0.004)	(0.004)	(0.0009)	(0.0009)
Probability of an outpatient visit	−0.037***	−0.036***	−0.029***	−0.030***
	(0.008)	(0.007)	(0.007)	(0.006)
Controls	No	Yes	No	Yes
Survey year fixed effects	Yes	Yes	Yes	Yes
Quadratic function of age	Yes	Yes	Yes	Yes
Observations	27,271	27,271	27,271	27,271

Robust standard errors are clustered at the provincial level and reported in parenthesis. IV-Probit regressions are used. Reported coefficients are marginal effects. Controls consist of male, urban, majority, and dummies for six geographical regions
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

Table 9 The impact of the 1991 compulsory schooling reform on the frequency of doctor visits: reduced-form (intent-to-treat) regressions

Dependent variable	Panel A: Public health sector		Panel B: Private health sector	
	(1)	(2)	(1)	(2)
Frequency of inpatient visits	0.015**	0.018***	0.004	0.004
	(0.006)	(0.006)	(0.002)	(0.002)
Frequency of outpatient visits	−0.135***	−0.132***	−0.147***	−0.151***
	(0.029)	(0.028)	(0.032)	(0.025)
Controls	No	Yes	No	Yes
Survey year fixed effects	Yes	Yes	Yes	Yes
Quadratic function of age	Yes	Yes	Yes	Yes
Observations	27,271	27,271	27,271	27,271

Robust standard errors are clustered at the provincial level and reported in parenthesis. IV-Poisson regressions are used. Reported coefficients are marginal effects. Controls consist of male, urban, majority, and dummies for six geographical regions
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

Main control variables

Male Respondent's gender is male (= 1 if yes, = 0 otherwise).
Urban Respondent's household is in an urban area (= 1 if yes, = 0 otherwise).
Majority Respondent's ethnicity is the majorities, Kinh or Hoa (= 1 if yes, = 0 otherwise).
Red River delta The geographical region is Red River delta (= 1 if yes, = 0 otherwise).
Midlands and northern mountainous areas The geographical region is Midlands and northern mountainous areas (= 1 if yes, = 0 otherwise).
Northern and coastal central region The geographical region is Northern and coastal central region (= 1 if yes, = 0 otherwise).
Central Highlands. The geographical region is Central Highlands (= 1 if yes, = 0 otherwise).
Southeastern area. The geographical region is the Southeastern area (= 1 if yes, = 0 otherwise).
Mekong river delta. The geographical region is Mekong River delta (= 1 if yes, = 0 otherwise).
Survey 2010 The survey year is 2010 (= 1 if yes, = 0 otherwise).
Survey 2012 The survey year is 2012 (= 1 if yes, = 0 otherwise).
Survey 2014 The survey year is 2014 (= 1 if yes, = 0 otherwise).

Potential mechanisms

Health insurance The probability of being insured with public or private health insurance (= 1 if yes, = 0 otherwise).
Income Respondent's monthly income (1000 VND, 2010 price).

Schooling variables

Reform exposure Respondent's probability of being exposed to the 1991 schooling reform that her or his age equals 14 or less than 14 in 1991 (= 1 if yes, = 0 otherwise).
Schooling years Respondent's full schooling years at the year of survey (years).

Table 10 The impact of the 1991 compulsory schooling reform on schooling years: robustness, various windows, first-stage

	Dependent variable: schooling year							
	Age in 1991: 7–22		Age in 1991: 8–21		Age in 1991: 9–20		Age in 1991: 10–19	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Reform exposure	1.592***	1.491***	1.503***	1.417***	1.321***	1.244***	1.222***	1.134***
	(0.136)	(0.102)	(0.135)	(0.102)	(0.135)	(0.099)	(0.140)	(0.105)
Male		0.478***		0.490***		0.494***		0.537***
		(0.060)		(0.061)		(0.064)		(0.069)
Urban		2.315***		2.328***		2.428***		2.513***
		(0.170)		(0.176)		(0.192)		(0.190)
Majority		2.736***		2.796***		2.780***		2.744***
		(0.258)		(0.267)		(0.263)		(0.259)
Red River delta		2.756***		2.759***		2.742***		2.734***
		(0.358)		(0.369)		(0.389)		(0.379)
Midlands and northern mountainous areas		1.918***		1.938***		1.882***		1.795***
		(0.248)		(0.252)		(0.265)		(0.267)
Northern and coastal central region		1.489***		1.455***		1.390***		1.354***
		(0.310)		(0.308)		(0.328)		(0.318)
Central Highlands		1.294***		1.255***		1.232***		1.114***
		(0.241)		(0.232)		(0.214)		(0.224)
Southeastern area		1.039***		1.025***		1.040***		1.048***
		(0.321)		(0.304)		(0.299)		(0.265)

Table 10 continued

	Dependent variable: schooling year							
	Age in 1991: 7–22		Age in 1991: 8–21		Age in 1991: 9–20		Age in 1991: 10–19	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Mekong River delta		Omitted		Omitted		Omitted		Omitted
Survey year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quadratic function of age	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	7.613***	3.021***	7.598***	2.944***	7.658***	2.989***	7.622***	2.998***
	(0.235)	(0.324)	(0.243)	(0.327)	(0.246)	(0.327)	(0.251)	(0.327)
F-stat	48.05	50.53	43.52	51.53	33.57	44.59	26.81	43.71
R-squared	0.041	0.249	0.036	0.248	0.028	0.246	0.024	0.248
Observations	24,131	24,131	21,107	21,107	17,798	17,798	14,598	14,598

Ordinary least squares are used. Robust standard errors are clustered at the provincial level and reported in parenthesis. Controls consist of male, urban, majority, and dummies for six geographical regions

***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

Table 11 The impact of the 1991 compulsory schooling reform on the probability of health insurance and monthly income: Reduce form (intent-to-treat) mechanisms

	Panel A: Health insurance		Panel B: Income	
	(1)	(2)	(1)	(2)
Reform exposure	0.048***	0.052***	440.187***	384.632***
	(0.011)	(0.009)	(76.642)	(56.268)
Model	IV-Probit	IV-Probit	IV	IV
Controls	No	Yes	No	Yes
Survey year fixed effects	Yes	Yes	Yes	Yes
Quadratic function of age	Yes	Yes	Yes	Yes
Observations	27,271	27,271	27,271	27,271

Robust standard errors are clustered at the provincial level and reported in parenthesis. Reported coefficients are marginal effects. Controls consist of male, urban, majority, and dummies for six geographical regions
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

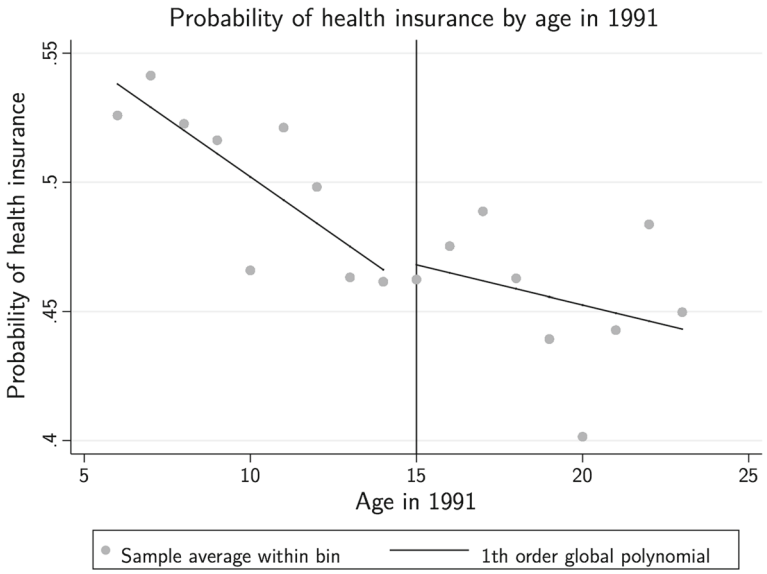

Fig. 2 The impact of the 1991 compulsory schooling reform on probability of health insurance

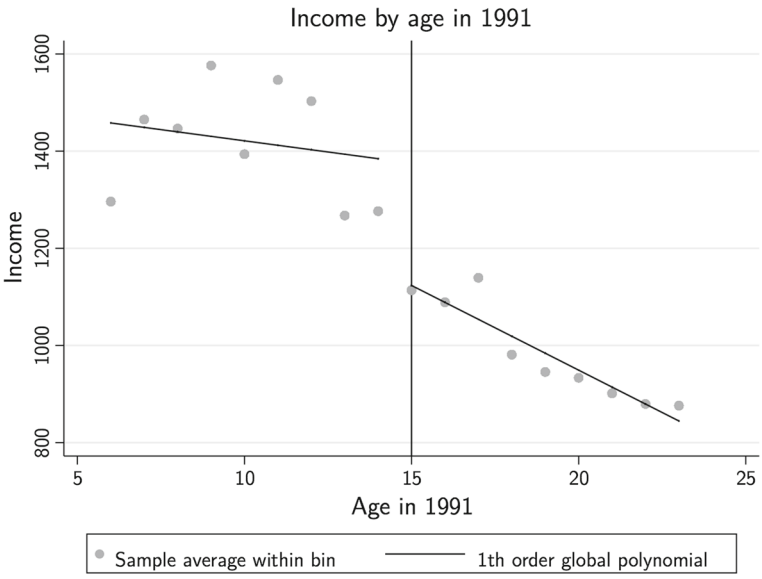

Fig. 3 The impact of the 1991 compulsory schooling reform on income

References

Albouy, V., & Lequien, L. (2009). Does compulsory education lower mortality? *Journal of Health Economics*, *28*(1), 155–168.

Altindag, D., Cannonier, C., & Mocan, N. (2011). The impact of education on health knowledge. *Economics of Education Review*, *30*(5), 792–812.

Angrist, J. D., & Pischke, J.-S. (2009). *Mostly harmless econometrics: An empiricist's companion*. Princeton, NJ: Princeton University Press.

Card, D., Dobkin, C., & Maestas, N. (2008). The impact of nearly universal insurance coverage on health care utilization: Evidence from medicare. *American Economic Review*, *98*(5), 2242–2258.

Coxhead, I., & Phan, D. (2013). Princelings and paupers? State employment and the distribution of human capital investments among households in Viet Nam. *Asian Development Review*, *30*(2), 26–48.

Cutler, D., & Lleras-Muney, A. (2008). Education and health: Evaluating theories and evidence. In J. House, R. Schoeni, G. Kaplan, & H. Pollack (Eds.), *Making Americans healthier: Social and economic policy as health policy*. New York: Russell Sage Foundation.

Dang, T. (2017a). Quasi-experimental evidence on the political impacts of education in Vietnam. MPRA Paper 77641, University Library of Munich, Germany.

Dang, T. (2017b). Education as protection? The effect of schooling on non-wage compensation in a developing country. MPRA Paper 79223, University Library of Munich, Germany.

Dang, T. (2017c). The multiple effects of child health insurance in Vietnam. MPRA Paper 78614, University Library of Munich, Germany.

Dickson, M., Gregg, P., & Robinson, H. (2016). Early, late or never? When does parental education impact child outcomes? *The Economic Journal*, *126*, F184–F231.

Eide, E. R., & Showalter, M. H. (2011). Estimating the relation between health and education: What do we know and what do we need to know? *Economics of Education Review*, *30*(5), 778–791.

Ettner, S. L. (1996). New evidence on the relationship between income and health. *Journal of Health Economics*, *15*(1), 67–85.

Frijters, P., Haisken-DeNew, J. P., & Shields, M. A. (2005). The causal effect of income on health: Evidence from German reunification. *Journal Health Economics*, *24*(5), 997–1017.

Gathmann, C., Jürges, H., & Reinhold, S. (2015). Compulsory schooling reforms, education and mortality in twentieth century Europe. *Social Science & Medicine*, *127*, 74–82.

Grépina, K. A., & Bharadwaj, P. (2015). Maternal education and child mortality in Zimbabwe. *Journal of Health Economics*, *44*, 97–117.

Grossman, M. (1972). On the concept of health capital and the demand for health. *Journal of Political Economy*, *80*(2), 223–255.
Grossman, M. (1976). The correlation between Health and schooling. In *Household production and consumption*. National Bureau of Economic Research, pp. 147–224.
Grossman, M. (2000). The human capital model. In A. J. Culyer & J. P. Newhouse (Eds.), *Handbook of health economics*. Amsterdam: Elsevier.
Grossman, M. (2006). Education and nonmarket outcomes. In E. Hanushek & F. Welch (Eds.), *Handbook of the economics of education*. Amsterdam: North-Holland.
Grossman, M. (2008). The relationship between health and schooling. *Eastern Economic Journal*, *34*(3), 281–292.
Hoai, N. T., & Dang, T. (2017). The determinants of self-medication: Evidence from urban Vietnam. *Social Work in Health Care*, *56*(4), 260–282.
Imbens, G. W., & Lemieux, T. (2008). Regression discontinuity designs: A guide to practice. *Journal of Econometrics*, *142*, 615–635.
Kondo, A., & Shigeoka, H. (2013). Effects of universal health insurance on health care utilization, and supply-side responses: Evidence from Japan. *Journal of Public Economics*, *99*, 1–23.
Kruk, M. E., & Freedman, L. P. (2008). Assessing health system performance in developing countries: A review of the literature. *Health Policy*, *85*, 263–276.
Ladinsky, J. L., & Levine, R. E. (1985). The organization of health services in Vietnam. *Journal of Public Health Policy*, *6*(2), 255–268.
Ladinsky, J. L., Nguyen, H. T., & Volk, N. D. (2000). Changes in the health care system of Vietnam in response to the emerging market economy. *Journal of Public Health Policy*, *21*(1), 82–98.
Lee, D. S., & Lemieux, T. (2010). Regression discontinuity designs in economics. *Journal of Economic Literature*, *48*, 281–355.
Leuven, E., Plug, E., & Rønning, M. (2016). Education and cancer risk. *Labour Economics*, *43*, 106–121.
Li, J., & Powdthavee, N. (2015). Does more education lead to better health habits? Evidence from the school reforms in Australia. *Social Science & Medicine*, *127*, 83–91.
Lönnroth, K., Thuong, L. M., Linh, P. D., & Diwan, V. (1998). Risks and benefits of private health care: exploring physicians' views on private health care in Ho Chi Minh City, Vietnam. *Health Policy*, *45*(2), 81–97.
Marmot, M. (2002). The influence of income on health: Views of an epidemiologist. *Health Affairs*, *21*(2), 31–46.
Matsuda, S. (1997). An introduction to the health system in Vietnam. *Environmental Health and Preventive Medicine*, *2*(3), 99–104.
Ministry of Health of Vietnam. (2007). *Vietnam health care report 2006: Equity, efficiency, and development in new situation.* Retrieved December 23, 2016 from: http://jahr.org.vn/downloads/Nghien%20cuu/Khac/Vietnam%20National%20Health%20Report%202006.pdf.
Ministry of Health of Vietnam and Health Partnership Group. (2008). *Joint annual health review 2008*. Health financing in Vietnam. Retrieved December 23, 2016 from: http://jahr.org.vn/index.php?option=com_content&view=frontpage&lang=en.
Murray, C. J., & Frenk, J. A. (2000). Framework for assessing the performance of health systems. *Bulletin of the World Health Organization*, *78*, 717–731.
Nguyen, C. (2016). The impact of health insurance programs for children: Evidence from Vietnam. *Health Economics Review*, *6*(1), 6–34.
Nguyen, C. V. (2012). The impact of voluntary health insurance on health care utilization and out-of-pocket payments: new evidence for Vietnam. *Health Economics*, *21*, 946–966.
O'Donnell, O., van Doorslaer, E., Rannan-Eliya, R. P., Somanathan, A., Adhikari, S. R., Akkazieva, B., et al. (2008). Who pays for health care in Asia? *Journal of Health Economics*, *27*, 460–475.
Palmer, M., Mitra, S., Mont, D., & Groce, N. (2015). The impact of health insurance for children under age 6 in Vietnam: A regression discontinuity approach. *Social Science & Medicine*, *145*, 217–226.
Sepehri, A., Simpson, W., & Sarma, S. (2006). The influence of health insurance on hospital admission and length of stay: The case of Vietnam. *Social Science & Medicine*, *63*, 1757–1770.
Silles, M. A. (2009). The causal effect of education on health: Evidence from the United Kingdom. *Economics of Education Review*, *28*(1), 122–128.
Stock, J. H., Wright, J. H., & Yogo, M. (2002). A survey of weak instruments and weak identification in generalized method of moments. *Journal of Business and Economic Statistics*, *20*(4), 518–529.
Tat, S., & Barr, D. (2006). Healthcare in the New Vietnam: Comparing patients' satisfaction with outpatient care in a traditional neighborhood clinic and a new, western-style clinic in Ho Chi Minh City. *Social Science & Medicine*, *62*, 1229–1236.

Thanh, N. X., Tran, B. X., Waye, A., Harstall, C., & Lindholm, L. (2014). Socialization of health care in Vietnam: What is it and what are its pros and cons? *Value in Health Regional*, *3C*, 24–26.
Thoa, N. T., Thanh, N. X., Chuc, N. T., & Lindholm, L. (2013). The impact of economic growth on health care utilization: A longitudinal study in rural Vietnam. *International Journal for Equity in Health*, *12*(19), 1–6.
United Nations. (2015). *Millennium development goals and beyond 2015*. Retrieved December 23, 2016 from: http://www.un.org/millenniumgoals/.
Uplekar, M. W. (2000). Private health care. *Social Science & Medicine*, *51*(6), 897–904.
Webbink, D., Martin, N. G., & Visscher, P. M. (2010). Does education reduce the probability of being overweight? *Journal of Health Economics*, *29*(1), 29–38.
Wolffers, I. (1995). The role of pharmaceuticals in the privatization process in Vietnam's health-care system. *Social Science & Medicine*, *41*(9), 1325–1332.
World Bank. (2007). *Vietnam development report 2008: Social protection, joint donor report to the Vietnam consultative group meeting*. Hanoi: World Bank.
World Bank. (2017). *The statistics for Vietnam*.
World Health Organization. (2011). *Investing in health for Africa: The case for strengthening systems for better health outcomes*.
World Health Organization. (2017). Global health observatory: Vietnam. Retrieved November 21, 2017 from: http://www.who.int/gho/countries/vnm/country_profiles/en/.