Urbanization and Health Expenditure: An Empirical Investigation from Households in Vietnam

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Abstract: This study examines the effects of urbanization on household health expenditure. Using a unique bi-annually household-level dataset from 2012 – 2018 from Vietnam, we obtain key findings as follows. First, urbanization significantly reduces Vietnamese households' inpatient and outpatient health expenses. Second, the self-treatment expenses of households increase as the process of urbanization advances. Our results survive several robustness checks. Furthermore, we propose different ways to explain these results, including health insurance expenses and household income.

Keywords: urbanization; health expenditure; health insurance; instrumental variable; ICT; VHLSS

Subject classification codes: D10, I10, I15, I31, O10, O18.

1. INTRODUCTION

Industrialization, along with the rapid development of technology, has fueled the expansion of urban areas globally (see, e.g., Shao et al., 2022; Zheng & Walsh, 2019; Gollin et al., 2016). Urbanization is now considered an inevitable and essential trend for the progress of human society (see, e.g., Wang & Xu, 2023; Zhu et al., 2022). It stimulates economic growth by creating demand and generating opportunities for innovation and development. According to the World Cities Report 2022 of the United Nations Human Settlements Programme (UN-Habitat), the world will continue to urbanize for the next 30 years, with urban areas accounting for all population growth. Additionally, although there has been some temporary migration from urban to rural areas due to the COVID-19 pandemic, this is not expected to change the overall trend toward urbanization. This means that the percentage of the world's population living in urban regions is expected to rise by 12% from 56% in 2021 to 68% in 2050, representing an additional 2.2 billion urban residents, with Africa and Asia experiencing the most remarkable growth. All regions of the world will

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become more urbanized, but developed regions may experience a decline in urban growth rate. Urbanization refers to the process of transformation from rural living to an urban lifestyle that can have significant implications for people's health and well-being. The effects of urbanization on health can be intricate and diverse, including both favorable and unfavorable outcomes (Yang et al., 2013). On the one hand, urbanization can provide access to better healthcare resources and services, potentially leading to improved health outcomes for residents (Dye, 2008). On the other hand, urbanization can also lead to adverse health outcomes, such as increased exposure to environmental pollutants and the adoption of sedentary lifestyles (see, e.g., Li et al., 2012; Van de Poel et al., 2012). Healthcare expenditure is a vital part of residents' daily expenses that encompasses spending on medicines, medical, and health services and is considered a crucial indicator of the quality of life. The impact of urbanization on healthcare expenditure is also a complex issue that varies depending on several factors. As urbanization progresses, residents may face higher healthcare costs due to increased demand for healthcare resources and services and changes in health behavior. On the other hand, urbanization can also lead to enhancements in healthcare infrastructure and better public health outcomes, reducing healthcare costs in the long run (Shen & Sun, 2023; Shao et al., 2022). Therefore, it is imperative to investigate the impact of urbanization on healthcare expenditure to understand its potential effects on residents' quality of life and economic development.

Urbanization in Vietnam has been rapid and profound, with the urban population increasing from around 20% in 1990 to over 38% in 2021, according to the 2018 Revision of World Urbanization Prospects of the United Nations Population Division. This growth has been driven by industrialization, urbanization policies, and migration from rural to urban regions. While larger cities like Ho Chi Minh City and Hanoi have experienced the fastest growth, smaller towns and cities have also witnessed substantial increases in both population and economic activity. One primary driver of urbanization in Vietnam has been industrialization, particularly in the manufacturing and service sectors. As Vietnam has opened up to foreign investment and trade, many multinational corporations have established factories and offices in the country's major cities. This has created job opportunities and driven economic growth but has also led to environmental degradation and social inequality, as low-skilled workers are often concentrated in informal settlements with poor living conditions. Another factor driving urbanization in Vietnam is government policy. The implementation of economic reforms in the 1980s, known as "Doi Moi,"

brought about increased economic stability in Vietnam. This newfound stability resulted in higher levels of urbanization in the following decade as people began to move from rural to urban areas in search of better jobs and living conditions. This trend was particularly noticeable in major cities such as Hanoi and Ho Chi Minh City, which experienced significant growth during this period. In recent decades, the Vietnamese government has instituted various policies to promote urbanization as a strategy to attain economic growth and modernization. This has involved investment in infrastructure, such as roads, bridges, and public transportation systems, to support urban growth. More specifically, in order to facilitate and manage the development of urbanization effectively, the Vietnamese government introduced the 2009 Adjustment of Orientation Master Plan for Urban Development until 2025 with a vision to 2050 (AOMP). Two national programs for urban development supplement the AOMP. First, the 2009 National Urban Upgrading Program (NUUP) was introduced to support the implementation of the AOMP and to target interventions in disadvantaged urban areas. Second, the 2012 National Urban Development Program (NUDP) was implemented to provide better-defined mechanisms for the AOMP and to align it with the Socio-economic Development Strategy further. Additionally, the Socio-economic Development Strategy 2011-2020 (SEDS) and the Vietnam Sustainable Development Strategy 2011-2020 offer overall guidance for development in Vietnam. Given these well-established urban policy frameworks, Vietnam is expected to experience a continued upward trend in urbanization rates. It is essential to recognize that healthcare expenditure among residents has increased significantly in Vietnam over the past few years alongside the process of urbanization. According to the Global Health Expenditure database of the World Health Organization, the per capita health expenditure in 2020 is US$ 180.72, which is equivalent to an increase of US$ 71.78 compared to 2012.

Given the significant impact of urbanization on residents' lifestyles, it is crucial to explore the relationship between urbanization and healthcare expenditure. Such research would be of practical significance for urban management and policy development in Vietnam. As urbanization progresses, residents' healthcare demands and behaviors may change, potentially leading to increased healthcare expenditure. Understanding these potential effects can inform policy decisions related to healthcare infrastructure development and resource allocation. Therefore, research on the relationship between urbanization and healthcare expenditure is crucial for effectively managing the impact of urbanization on residents' quality of life in Vietnam. To the

best of our knowledge, this is the first study examining the impacts of urbanization on household health expenditure in Vietnam. Using unique household-level data collection from 2012 to 2018 in Vietnam, we obtain the following key results. First, urbanization leads to a significant decrease in inpatient and outpatient health costs incurred by Vietnamese households. Second, the self-treatment expenses of households tend to rise as urbanization progresses. Several robustness checks conducted on the key findings confirm their validity.

The remainder of this study is structured as follows. Section 2 presents the related literature. Section 3 describes research data and variable definitions. Section 4 reports the research methodology. Section 5 presents empirical findings, including the main results, several robustness checks, and pathways. Section 6 provides conclusions and discusses the main results.

2. RELATED LITERATURE

2.1. Impacts of urbanization on health and health expenditure

2.1.1. Impacts of urbanization on health

The effects of urbanization on human well-being are dual in nature. On the one hand, urbanization can offer increased accessibility to health services and improved water quality and sanitation infrastructure (see, e.g., Shen & Sun, 2023; Shao et al., 2022; Miao & Wu, 2016). For instance, Shen and Sun (2023) construct panel data from the China Family Panel Study (CFPS) and use the difference-in-difference approach to investigate the impact of the in situ urbanization policy (IUP) on individual health.[2] They demonstrate that in contrast to other forms of urbanization that have been associated with adverse effects on mental health and increased smoking or alcohol consumption, this policy substantially improves self-reported health status among the affected population. They explain that the implementation of IUP can potentially enhance individuals' optimism for the future, contentment with their present circumstances, and enrollment in medical insurance, ultimately leading to better self-reported health status.

On the other hand, several studies demonstrate that urbanization may give rise to stressful lifestyles, higher mortality, nutritionally imbalanced diets, excessive weight, hypertension, and greater

[2] The in-situ urbanization policy is often referred to as the process of converting villages into urban neighborhoods, which is closely connected to the commonly used term "reclassification." This involves changing the nature of settlements from rural to urban areas.

metabolic and cancer risks, all of which can contribute to poor health outcomes (see, e.g., Fu & Land, 2017; Danaei et al., 2013; Attard et al., 2012; Gong et al., 2012; Li et al., 2012; Van de Poel et al., 2012). As an example, Li et al. (2012) employ remote sensing image analysis that is based on night light data to study the impacts of urbanization on human health in China. They find that the transformation of the urban environment and residents' lifestyles as a consequence of urbanization and urban expansion leads to health issues. Furthermore, their analysis shows that areas that experience greater degrees of urbanization tend to have a greater prevalence of chronic diseases.

2.1.2. Impacts of urbanization on health expenditure

There have been few studies that have explored the nexus between urbanization and healthcare expenses. For instance, Thornton and Rice (2008) employ US data in 1998 for 50 states to examine the factors influencing healthcare spending. Their analysis reveals solid empirical evidence that states with lower levels of urbanization have higher healthcare spending. Wang (2009) re-examines the factors that influence health expenditure using 5-year US state-level data from 1999 to 2003 and finds that urbanization reduces health expenditure similarly. He demonstrates that the resulting effect of urbanization is understandable, given that providing healthcare to populations living in rural regions is far more expensive than those in urban areas. Shao et al. (2022), using a fixed-effect framework and annual data from 31 Chinese provinces from 2001 to 2019, examine the effect of urbanization on healthcare expenditure. They find a substantial rise in healthcare spending in Eastern and Central regions, which can be attributed to the process of urbanization. However, the influence of urbanization on healthcare spending in the Western region is negligible, possibly due to the region’s low urbanization rate and underdeveloped economy.

2.2. Underlying pathways of the effects of urbanization on health expenditure

One notable limitation of existing empirical research on the connection between urbanization and health expenditure is that they do not provide a comprehensive explanation of the pathways through which urbanization affects health expenditure. Nonetheless, two possible mechanisms are explored.

The first channel is health insurance. Health insurance has been found to substantially increase household access to and utilization of health services, thereby facilitating healthcare financing. In addition, it functions as a safeguard against excessive healthcare costs, which can lead to financial

hardship. Empirical evidence suggests that enrollment in the health insurance program is closely linked with a reduction in inpatient and outpatient medical expenses across all demographics, with a more pronounced effect observed among individuals with lower socioeconomic status in Vietnam (Thanh et al., 2019; Jowett et al., 2004). The effect of health insurance on health-seeking behavior has yielded inconsistent findings in the literature. While some studies have reported a positive impact (Al-Hanawi et al., 2020; Levine et al., 2016; Waters et al., 2004), others have found no discernible effect (Raza et al., 2016) or adverse effects (Wagstaff & Lindelow, 2008). However, empirical evidence suggests that health insurance can enhance the accessibility of high-quality healthcare services for impoverished or marginalized households (Duc Thanh et al., 2021; Sparrow et al., 2013).

The second pathway is household income, which has been proven to enhance health outcomes significantly (Frijters et al., 2005; Marmot, 2002; Ettner, 1996). Households that experience income growth over time tend to utilize more healthcare services since they are more concerned about the quality of medical care and may be more willing to pay for better healthcare services. Therefore, high-income households usually incur more health-related expenses (Dang, 2018).

3. SAMPLE CONSTRUCTION

3.1. Data source

The primary data source for this research is the Vietnam Household Living Standard Surveys (VHLSS) from 2012, 2014, 2016, and 2018. These surveys were conducted bi-annually by the General Statistics Office of Vietnam (GSO) in collaboration with the World Bank. They provide various information on households and individuals, such as their demographic characteristics, employment status, and health expenditure. Information on the head of household is also provided in this data.

Data on the urbanization of each province are extracted from the Statistical Yearbook of General Statistics Offices of Vietnam. Other data on province characteristics are collected from different sources. The unemployment rate is extracted from the "Report of Labor and Employment" conducted by GSO. Data on government revenue at the provincial level is collected from the Ministry of Finance of Vietnam.

Information about households' adoption of information communication technology (ICT) is obtained from the "Vietnam ICT Index," a report on assessing and ranking the readiness level for IT development and application in different provinces in Vietnam gathered by the Ministry of Information and Communications and the Vietnam Informatics Association. The ICT index, which has existed since 2005, demonstrates the readiness of Vietnamese provinces for ICT and has been published annually since 2005. The purpose of the index is to assist local governments in improving ICT access for households and businesses, thereby reducing income inequality in the region.

3.2. Variable definitions

Our main covariate is urbanization, which is collected at the province level. In this study, we employ a share of the urban population to the total population as the main proxy for urbanization. We also use alternative proxies of urbanization, namely the natural logarithm form of urban population and population density, in our robustness check section.

We consider two different aspects of household health expenditure when investigating the impacts of urbanization, including inpatient and outpatient health expenses (IOHEs), which are computed as a sum of hospitalization costs and outpatient costs; self-treatment expenses (STEs), which consist of household's expenditure on purchasing medicines without prescriptions and household's expenditure on purchasing medical appliances and equipment (e.g., blood pressure monitors, phlegm absorbers, clinical thermometers).

In investigating the effects of urbanization on household health expenditure, we control for three main groups of characteristics. First, we include information on the age, education level, marital status, and male gender of the head of the household. In addition, we gather household data, such as the number of individuals in the household (household size), the proportion of dependents (dependent ratio), the location of residence, the household's total value of assets, and house ownership. Finally, we control province-level characteristics, including the unemployment rate and local government revenue.

To address the potential endogeneity that might occur due to the omitted variable bias, we use the ICT index. The information on ICT is gathered from each province and reflects their level of preparedness for the ICT environment and advancements during 2012, 2014, 2016, and 2018. The computation of the ICT index considers various aspects, such as technical infrastructure, human

resources, applications, manufacturing and business, organization, and the policy environment. Tables 1 and 2 present the variable definition and summary statistics, respectively. On average, nearly 29% of the population lives in urban areas.

Table 1: Variable definitions.

Variables	Type	Description	Source
Inpatient and outpatient health expenses	Continuous	Natural log of a sum of hospitalization and outpatient costs	VHLSS
Self-treatment expenses	Continuous	Natural log of a sum of household's expenditure on medicines without prescription and household's expenditure on medical facilities	VHLSS
Urbanization	Continuous	Average urban population by province	Statistical Yearbook of General Statistics Offices of Vietnam
Relative urban intensity	Continuous	Urban population divided by total population for each province	Statistical Yearbook of General Statistics Offices of Vietnam
Age of the household head	Continuous	Age of the household head	VHLSS
Marital status	Categorical	Marital status of the household head	VHLSS
Level of education	Categorical	Level of education of the household head	VHLSS
Male	Dummy	Gender of the household head	VHLSS
Rural	Dummy	Location of residence: whether rural or urban	VHLSS
Household size	Continuous	Household size	VHLSS
Dependent ratio	Continuous	Ratio of dependent people (less than 6 years old and greater than 60 years old)	VHLSS
Total value of household assets	Continuous	Total value of assets in the household	VHLSS
Home ownership	Categorical	Household owns house or not	VHLSS
Government revenue	Continuous	Government revenue at provincial level	Ministry of Finance
Unemployment rates	Continuous	Unemployment rate at provincial level	Statistical Yearbook of General Statistics Offices of Vietnam
Expenditure on insurance	Continuous	Natural log of household's expenditure on health insurance	VHLSS
Household's total income	Continuous	Household's income in the last 12 months (thousand VND)	VHLSS

Notes: VHLSS stand for Vietnam Household Living Standards Surveys.

Table 2: Descriptive statistics.

Variables	N	Mean	SD	Min	Max
Log of in/outpatient health expenses	16,786	6.781	2.350	0	13.12
Log of self-treatment expenses	16,786	5.676	2.097	0	17.03

Relative urban population	16,786	29.21	18.70	9.718	87.28
ICT Index	16,786	44.99	12.19	9.130	94.07
Head of household's age	16,786	51.33	13.97	13	105
Head of household's age squared	16,786	2,830	1,547	169	11,025
Head of household's male	16,786	0.752	0.432	0	1
Head of household's level of education	16,786	1.533	1.192	0	4
Head of household's marital status	16,786	0.803	0.397	0	1
Household size	16,786	3.833	1.570	1	13
Dependent ratio	16,786	0.239	0.217	0	1
House ownership	16,786	0.964	0.185	0	1
Location of residence	16,786	0.709	0.454	0	1
Log of total asset value	16,786	9.922	1.305	3.401	14.85
Log of province's revenue	16,786	15.60	1.497	11.47	19.75
Provincial unemployment rate	16,786	2.216	3.310	0	19

Notes: SD: standard deviation, N: number of observations.

Source: Authors' own calculations.

4. RESEARCH METHODOLOGY

4.1. Baseline models: fixed-effect regressions

To investigate the effects of urbanization on health expenditure of households, we present the following econometric model:

$$Y_{ipt} = \alpha_0 + \alpha_1 Urb_{pt} + \alpha_2' \boldsymbol{X} + \mu_i + \mu_t + \varepsilon_{ipt} \qquad (1)$$

where Y_{ipt} denotes the health expenditure of household i in province p in year t. In this study, we use two measures to proxy for the health expenditure, namely inpatient and outpatient health expenses (IOHEs) and self-treatment expenses (STEs). Urb_{pt}, defined as a share of urban population to the total population in province p in year t, is the main explanatory variable in our model. $\boldsymbol{X}$ denotes a set of control variables. Specifically, we control for: (1) several characteristics of the head of household, including age, squared term of age, gender, education level, and marital status; (2) various characteristics of the household, including household's total assets, household size, house ownership, the ratio of dependent people in the household, location of residence; (3) province-level characteristics, including the unemployment rate and local government revenue. α_0,

α_1, and α_2 are unknown parameters. μ_i indicates an individual fixed effect, μ_t is the provincial time trend, and ε_{ipt} is an error term.

4.2. Two-stage least square regressions

The abovementioned fixed-effect (FE) regressions might suffer endogeneity issues arising from the omitted variable bias (OVB). Therefore, we employ the two-stage least square regression to address any plausible endogeneity problems. Specifically, we use Internet communication technology (ICT) development at the provincial level as an instrumental variable (IV) for our key explanatory variables. The rationale for utilizing this particular instrument is explained as follows. First, a strong correlation probably exists between ICT deployment and the degree of urbanization in each province. For instance, ICT development enables people to access information more easily and quickly. This can help people make informed decisions about where to live, work, and invest, leading to increased urbanization. In addition, ICT deployment can improve communication between people, businesses, and governments, making it easier to coordinate activities and share resources. This can lead to more efficient and effective urbanization. These justifications are confirmed in our sample as indicated in Appendix A Table A1 when the correlation between ICT development and urbanization is relatively high (approximately 0.59). Second, health expenditure is unlikely to have a direct correlation with the level of ICT adoption. This is confirmed because the correlation between health expenditure and ICT appears relatively low (0.10).

We utilize the two-stage least square framework to estimate the impacts of urbanization on household health expenditure. In the first stage, we extract the exogenous part of urbanization that is not related to the error term by performing a regression of urbanization (Urb_{pt}) on ICT (ICT_{pt}), other control variables ($\boldsymbol{X}$), individual fixed effect (η_i), and time trend (η_t):

$$Urb_{pt} = \delta_0 + \delta_1 ICT_{pt} + \boldsymbol{\delta_2}'\boldsymbol{X} + \eta_i + \eta_t + u_{ipt} \quad (2a)$$

where ICT_{pt} denotes the ICT in province p in year t. δ_0, δ_1, and $\boldsymbol{\delta_2}'$ are parameters and u_{ipt} is an error term. The predicted value of urbanization $\widehat{Urb}_{pt}$ obtained from this regression is then employed as the main covariate in the following second stage:

$$Y_{ipt} = \beta_0 + \beta_1 \widehat{Urb}_{pt} + \boldsymbol{\beta_2}'\boldsymbol{X} + \zeta_i + \zeta_t + \vartheta_{ipt} \quad (2b)$$

We assume that ICT_{pt} is uncorrelated with the household's IOHEs and STEs. Now β_1 can be referred to as the causal effect of urbanization on IOHEs and STEs of households. Note that this method is often referred to as a fixed-effect instrumental variable (FEIV) framework.

4.3. Plausibly exogenous IV

Generally, the instrumental variable method may be used to handle endogenous problems, including missing variables, sample selection, spurious relationships, and measurement error, which contradict the standard linear regression assumption to some extent. According to Conley et al. (2012), the classic IV assumption corresponds to exclusion restriction if the instrumental variable ICT_{pt} can only influence the dependent variable Y_{ipt} via the independent variable Urb_{pt}, which means $\gamma = 0$ in the equations below:

$$Urb_{pt} = \delta_0 + \delta_1 ICT_{pt} + \boldsymbol{\delta_2}'\boldsymbol{X} + \eta_i + \eta_t + u_{ipt} \quad (3a)$$

$$Y_{ipt} = \beta_0 + \beta_1 Urb_{pt} + \gamma ICT_{pt} + \boldsymbol{\beta_2}'\boldsymbol{X} + \zeta_i + \zeta_t + \vartheta_{ipt} \quad (3b)$$

However, when the instrument is plausibly exogenous, $\gamma \approx 0$, suggesting that the instrumental variable ICT_{pt} may be slightly associated with Y_{ipt}. In other words, we allow ICT index to affect IOHEs and STEs directly. If γ is known, consistent estimates of the effect of interest, the urbanization, can be obtained via approaches proposed by Conley et al. (2012). We specifically employ the Union of Confidence Intervals (UCI). This framework postulates that $\gamma \in \Gamma$ where Γ is the bounded support of γ and this support $\Gamma = [-\delta,\ \delta]$ for different values of δ. The magnitude of this δ in our case is based on prior information about the reduced form estimates of the household's health expenditure on ICT Index (Meierrieks & Renner, 2023; Guo, 2020). We then can consistently estimate β through 2SLS and compute a union of the resulting confidence interval which consists of β for all values γ within the support Γ. Provided that $\gamma \in \Gamma$, the union will encompass the true parameter value of β.

5. EMPIRICAL FINDINGS

This section presents the estimated results for the impacts of urbanization on households' IOHEs and STEs. To be more specific, we perform a number of exercises as follows. First, we examine the effects of urbanization using the fixed-effect models. Second, to address the endogeneity

problem associated with the fixed-effect regressions, we perform the instrumental variable regressions with fixed effects. We then conduct a series of robustness checks to confirm the sensitivity of our main results. Additionally, we relax the condition of IV of exclusion restriction and conduct a test based on Conley et al. (2012). Finally, we provide potential mechanisms.

5.1. Main results

Table 3 presents estimated results for the FE and FEIV models. A log transformation is performed on all expense variables. Panel A1 in Table 3 implies a statistically insignificant reduction of 11 percentage point IOHEs for every one percent growth in the urban population. Our A2 model employs the instrument in 2SLS to demonstrate that an additional one percent in urban population results in a 36.4 percentage point decrease in IOHEs. Findings from both the FE and FEIV models indicate, in general, a negative nexus exists between the relative urban population and the amount of money households spend on inpatient and outpatient treatment. The endogeneity of the urban population further collaborates with our hypothesis that FE biases the estimates downward, which is supported by the results from our preferred FEIV model.

Panel B in Table 3 displays the findings for self-treatment expenses. According to the FE results, model B1 predicts this spending will rise by approximately 5.8 percentage points for an additional one percent of the urban population. The FEIV results in model B2 demonstrate that STEs rises by about 34.4 percentage point for every extra one percent increase in urbanization. Again, FE bias the estimates of the effects of urbanization.

Furthermore, our first-stage findings in Table 3 show that a 10 percent rise in the ICT Index translates into a 0.21 percentage point increase in the urban population. The finding is statistically significant. The reliability of the instrument has been confirmed by a Kleibergen-Paap rk Wald F statistic being over 10. In general, Table 3 shows that FEIV findings point to lower expenditure on inpatient and outpatient treatment and greater spending on self-treatment expenses as a consequence of the increasing urban population. We also re-estimate these findings with different clusters for the standard errors and summarize the results in Appendix A Table A2.

Table 3: Effects of urbanization on household's health expenditure.

	FE	**FEIV**
Panel A: Inpatient and outpatient health expenses (IOHEs)	**(A1)**	**(A2)**
Relative urban population	-0.011	-0.364**

	(0.015)	(0.180)
Number of observations	16,786	16,786
R-squared	0.008	-0.043
Number of households	6,582	6,582
Kleibergen-Paap rk LM statistic (Underidentification test)		80.2
Kleibergen-Paap rk Wald F statistic (Weak identification test)		78.565
First-stage results		
ICT Index		0.021***
		(0.002)
Panel B: Self-treatment expenses (STEs)	**(B1)**	**(B2)**
Relative urban population	0.058***	0.344**
	(0.013)	(0.154)
Number of observations	16,786	16,786
R-squared	0.025	-0.024
Number of households	6,582	6,582
Kleibergen-Paap rk LM statistic (Underidentification test)		80.2
Kleibergen-Paap rk Wald F statistic (Weak identification test)		78.565
First-stage results		
ICT Index		0.021***
		(0.002)

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

Source: Authors' own calculations.

We conduct an array of robustness tests on the key findings. First, instead of employing the relative urban population, we use the natural log of urban population and the natural log of population density as the instrumented variables. This is to ensure that the obtained outcomes remain unaffected by the definition of variables, or the functional structure of the model being estimated. The estimated results are presented in Table 4. These results further collaborate with our main findings in Table 3.

Table 4: Robustness checks: Different proxies for urbanization.

	In/outpatient health expenses	Self-treatment expenses	In/outpatient health expenses	Self-treatment expenses
Log of urban population	-5.549**	5.240**		
	(2.712)	(2.321)		
Log of population density			-11.160**	10.539**

			(5.575)	(4.809)
Numeber of observations	16,786	16,786	16,786	16,786
R-squared	-0.023	0.014	-0.123	-0.123
Number of households	6,582	6,582	6,582	6,582
Under. Id.	174.424	174.424	67.768	67.768
Weak id.	172.159	172.159	67.463	67.463
First-stage results				
ICT Index	0.001***	0.001***	0.001***	0.001***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Under. Id. refers to Kleibergen-Paap rk LM statistic. Weak id. refers to Kleibergen-Paap rk Wald F statistic.

Source: Authors' own calculations.

We further investigate our main findings by employing the lag of relative urban as an additional IV. Table 5 presents the estimated results. On the whole, our key findings from this exercise are unaltered. Although the estimates of urbanization on IOHEs and STEs under this model are lower (in absolute values) than those under our FEIV, the signs remain unchanged. Specifically, a 1% rise in the relative urban population leads to a 4.4% reduction in IOHEs. Meanwhile, STEs rise by 7.7% when the relative urban population increases by 1%. Our key findings survive this robustness check. Note also that the Kleibergen-Paap rk Wald F statistic illustrates that our IVs are not weak. Furthermore, our models do not suffer an overidentification test as the Hansen J statistics cannot reject the null hypothesis at a 5% level.

Table 5: Robustness checks: Additional IV.

	Inpatient and outpatient health expenses	Self-treatment expenses
Relative urban population	-0.044*	0.077***
	(0.025)	(0.020)
Numeber of observations	16,786	16,786
R-squared	0.007	0.025
Number of households	6,582	6,582
Kleibergen-Paap rk LM statistic (Underidentification test)	926.43	926.43

Kleibergen-Paap rk Wald F statistic (Weak identification test)	450.797	450.797
Hansen J statistics (Overidentification test)	3.375	3.114
Hansen J statistics (p-value)	0.066	0.078
First-stage results		
ICT Index	0.014***	0.014***
	(0.002)	(0.002)
Lag of relative urban population	0.517***	0.517***
	(0.017)	(0.017)

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

Source: Authors' own calculations

5.2. Plausible exogeneous IV

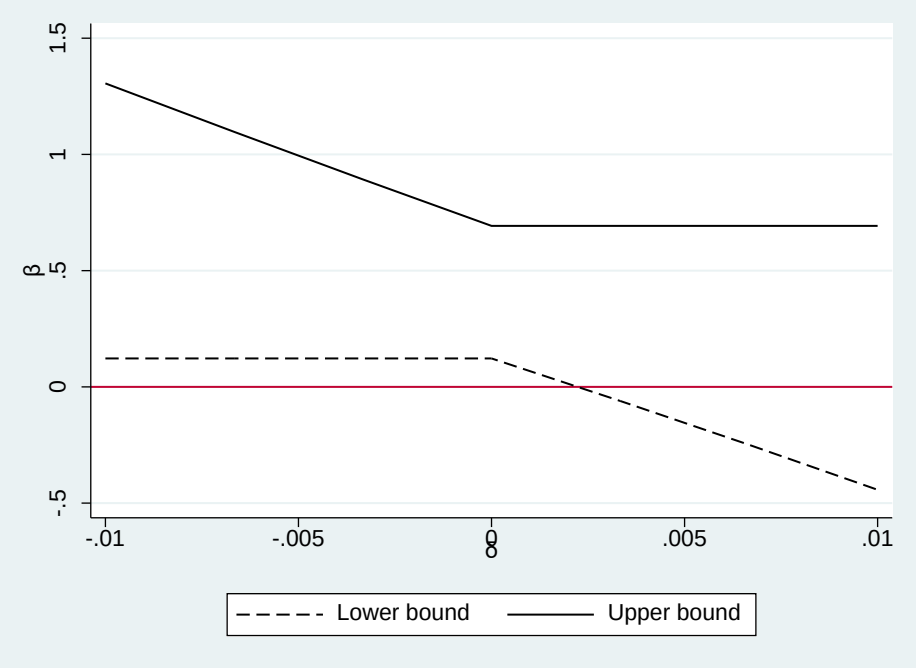
Although our chosen instrumental variables are evidently linked with the key variables, it is impossible to test the exclusion restriction due to the unobservable nature of the error term. As a result, we follow Conley et al. (2012) and utilize the union of all confidence intervals (UCI) approach to check our key findings when relaxing the exclusion restriction. This approach has been employed in previous studies (see, e.g., Zheng et al., 2023; Clarke & Matta, 2018). By permitting the direct effect of instrument variables on the dependent variable to vary within a certain range rather than assuming it to be zero, this approach can help to identify a plausible range of values for the effect of the endogenous variable on the outcome of interest, even in the presence of imperfect instrumental variables.

Figure 2 presents the estimated impacts of urbanization on our two main outcomes of interest (IOHEs and STEs) when the instrumental variable – ICT is plausibly exogenous. The dashed and solid lines illustrate the lower and upper bounds of the 95% confidence interval of urbanization, respectively. Overall, our FEIV estimates of the impacts of urbanization on IOHEs and STEs fall within the 95% confidence intervals computed for distinct values of δ. It is worth mentioning that δ here represents the coefficient of ICT after both the endogenous variable (urbanization) and the instrumental variable (ICT) are incorporated in the second-stage regressions. Accordingly, δ demonstrates the direct effect of ICT on IOHEs and STEs through channels other than urbanization.

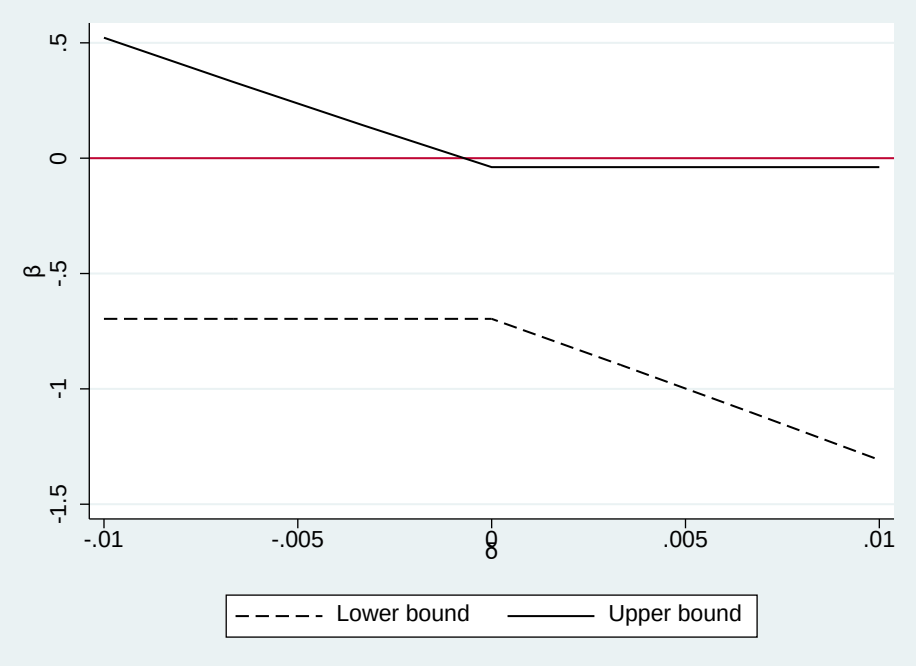
Figure 2a presents the estimated impacts of urbanization on STEs. When δ is negative, the bounds on the coefficient of urbanization (β) are comparatively further from 0 than the FEIV estimate of β, demonstrating that the conventional FEIV estimate underestimates the true impact of urbanization on STEs when a higher ICT index lowers STEs. Furthermore, we find that the 95% confidence interval for β includes 0 only when δ is larger than 0.002. It is worth mentioning that although we do not report the result here, our reduced form estimates of the impact of ICT on STEs is roughly 0.007. Accordingly, our bound of 0.002, which accounts for nearly 30% of the overall direct impact of ICT on STEs, is appropriate. Guo (2020) allows for significantly smaller deviations (25% of reduced-form coefficient) from perfect exogeneity. Thus, our findings still support the presence of a positive and significant impact of urbanization on STEs, even though we allow for a sizable departure from the assumption of perfect exogeneity.

The FEIV estimate of urbanization on IOHEs when the ICT index is plausibly exogenous is shown in Figure 2b. Clearly, the constraints on the estimated value of urbanization are significantly further away from 0 than the FEIV estimate of urbanization when δ is positive. This indicates that the conventional FEIV approach underestimates the negative impact of urbanization on IOHEs when a higher ICT increases IOHEs. Additionally, we still obtain significantly negative impacts of urbanization provided that δ is larger than -0.001. This limit is acceptable as it is equivalent to 14% of the overall direct effect of ICT on IOHEs from the reduced-form estimation (-0.007). In brief, we confirm our main result of a negative and significant impact of urbanization on IOHEs even though we allow for a reasonable distortion from the perfect exogeneity.

Similar results are obtained when we employ different proxies for urbanization. The results are presented in Figures B1 and B2 of Appendix B. Furthermore, we provide the additional robustness test using local-to-zero methods of Conley et al. (2012). Overall, our key results are unaltered (see Table B1 of Appendix B).



a. Self-treatment expenses (STEs)



b. Inpatient and outpatient health expenses (IOHEs)

Figure 1. Plausible exogeneity for our IV – ICT: The 95% confidence intervals using Conley's UCI approach for the impacts of urbanization on Inpatient and outpatient health expenses (IOHEs) and Self-treatment expenses (STEs)

5.3. Mechanisms

The key results indicate that urbanization lowers household spending on inpatient and outpatient treatment but raises expenditures on self-treatment. Thus, these findings suggest the plausibility of urbanization affecting health expenditure through two different pathways.

First, evidence suggests that urbanization leads to an expansion of health insurance. Results based on health insurance spending are shown in Table 6 model A1. The findings imply that an additional one percent of urbanization increases 118 percentage points in the amount of money households spend on insurance. The second is the household's total income. The results in Table 6 model A2 indicate that an extra percent of the urban population improves household earnings in the last 12 months by 9,443 thousand VND (approximately 400USD).

Our main findings shed light on the impacts of urbanization on two aspects of health expenditure. It may seem surprising that urbanization leads to a decrease in hospitalization and outpatient health expenses. An increase in health insurance coverage partially explains this unexpected result. Expanding health insurance coverage can help defray the costs of hospitalization and outpatient care, thereby reducing the financial burden on households. This growth in health insurance coverage is in line with the efforts of the Vietnamese government to expand health insurance coverage across the whole country, primarily through the national health insurance program.

Table 6: Possible pathways.

	(A1)	(A2)
	Insurance expense	Household's total income
Relative urban population	0.780***	9,422.991***
	(0.213)	(3,189.222)
Number of observations	16,786	12,704
R-squared	-0.141	-0.065
Number of households	6,582	5,046
Kleibergen-Paap rk LM statistic (Underidentification test)	80.2	56.812
Kleibergen-Paap rk Wald F statistic (Weak identification test)	78.565	55.614
First-stage results		
ICT Index	0.021***	0.02***
	(0.002)	(0.003)

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

Source: Authors' own calculations

6. CONCLUSIONS AND POLICY RECOMMENDATIONS

The study investigates the relationship between urbanization and household health expenditure using a unique household-level dataset from Vietnam between 2012 and 2018. The study demonstrates that urbanization has a statistically significant influence on healthcare expenses, causing a decrease in inpatient and outpatient costs but an increase in self-treatment expenses. The results are robust across various sensitivity analyses. We also propose two different paths to explain these results. The presence of health insurance attenuates the effect of urbanization on hospitalization and outpatient costs, whereas the impact of urbanization on self-treatment expenses is strengthened in the presence of household income.

This study is not without limitations. Since health expenditure is only available at the household level, this study cannot capture the effect of urbanization on an individual's health behavior. Further research can conduct surveys and research at the individual level, thus, providing a more comprehensive insight into the linkage between urbanization and health expenditure.

The findings of this research have potential policy implications. First, it is imperative to note that urbanization has been correlated with a decrease in hospitalization and outpatient expenses. Therefore, policymakers must prioritize the provision of accessible and cost-effective healthcare services. The study also revealed that the presence of health insurance mitigates the impact of urbanization on inpatient and outpatient healthcare expenses. Consequently, the government must encourage households to obtain health insurance. Third, policymakers can promote the regularity of health check-ups among households as a preventive measure against the development of chronic diseases, thus, potentially reducing hospitalization and outpatient expenses. Finally, in order to guarantee equitable access to healthcare services regardless of income, policymakers must tackle the issue of income inequality.

Conflict of interest statement

No potential conflict of interest was reported by the author(s)

Sources of funding

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Availability of data

The authors have no permission to share the data.

APPENDICES

Appendix A: Supporting results.

Table A1: Correlation matrix.

	In/outpatient health expenses	Self-treatment expenses	Relative urban population	ICTIndex
In/outpatient health expenses	1			
Self-treatment expenses	0.1918	1		
Relative urban population	0.0418	0.1012	1	
ICTIndex	0.0939	0.1451	0.5863	1
Observations	16,786	16,786	16,786	16,786

Source: Authors' own calculations.

Table A2: Additional specifications.

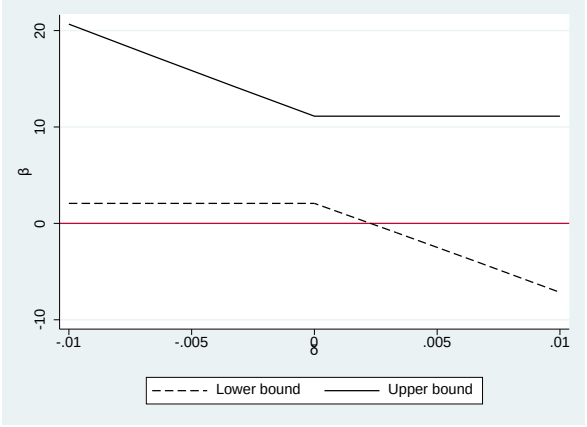
	In/outpatient health expenses	Self-treatment expenses
Panel A: Standard errors are clustered at household level		
Relative urban population	-0.364**	0.344**
	(0.179)	(0.157)
Number of observations	16,786	16,786
R-squared	-0.043	-0.024
Number of households	6,582	6,582
Under. Id.	72.948	72.948
Weak id.	71.349	71.349
Panel B: Standard errors are clustered at commune level		
Relative urban population	-0.364**	0.344**
	(0.169)	(0.165)
Number of observations	16,786	16,786
R-squared	-0.043	-0.024
Number of households	6,582	6,582
Under. Id.	16.037	16.037
Weak id.	30.468	30.468
Panel C: Standard errors are clustered at district level		
Relative urban population	-0.364*	0.344*
	(0.169)	(0.165)

Number of observations	16,786	16,786
R-squared	-0.043	-0.024
Number of households	6,582	6,582
Under. Id.	27.321	27.321
Weak id.	26.611	26.611

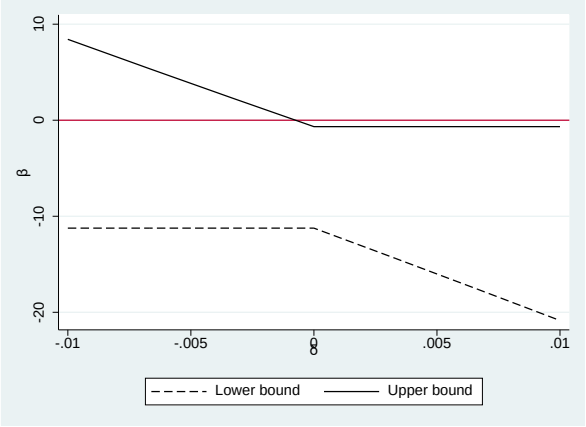
Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Under. Id. refers to Kleibergen-Paap rk LM statistic. Weak id. refers to Kleibergen-Paap rk Wald F statistic.

Source: Authors' own calculations.

Appendix B: Additional results for Conley's methods.

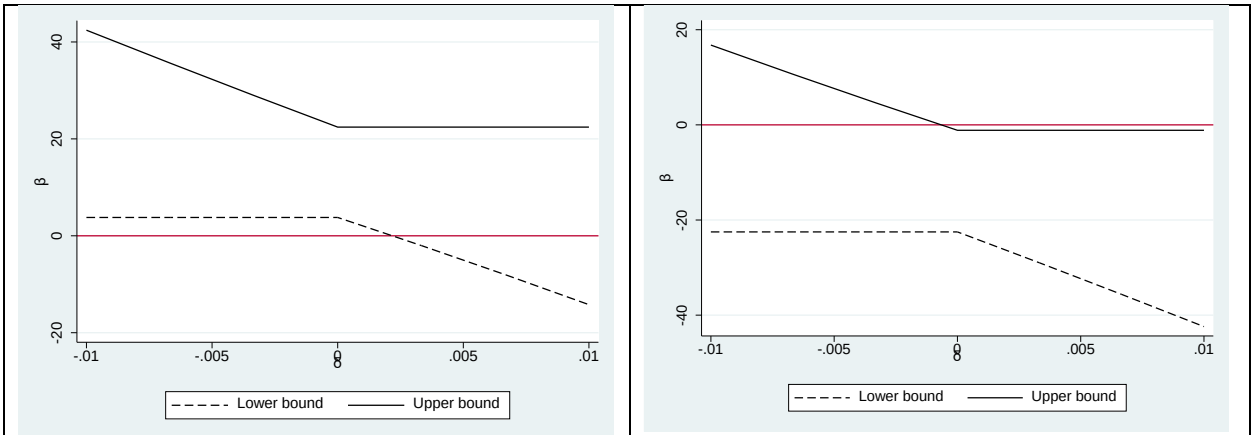


a. Self-treatment expenses (STEs)



b. Inpatient and outpatient health expenses (IOHEs)

Figure B1. Plausible exogeneity for our IV – ICT: The 95% confidence intervals using Conley's UCI approach for the impacts of urbanization on Inpatient and outpatient health expenses (IOHEs) and Self-treatment expenses (STEs) (log of urban population).



a. Self-treatment expenses (STEs)

b. Inpatient and outpatient health expenses (IOHEs)

Figure B2. Plausible exogeneity for our IV – ICT: The 95% confidence intervals using Conley's UCI approach for the impacts of urbanization on Inpatient and outpatient health expenses (IOHEs) and Self-treatment expenses (STEs) (log of population density).

Table B1: Conley's LTZ method estimation for instrumental variable.

Variables	IOHEs			STEs		
	Coef	Ro_std	95% CI	Coef	Ro_std	95% CI
Panel A. Effect of relative urban population on IOHEs and STEs						
Relative urban population	-0.368**	0.177	[-0.715; -0.020]	0.408***	0.156	[0.101; 0.714]
Control variables	Yes			Yes		
Province × Year	Yes			Yes		
Observations	16,786			16,786		
Panel B. Effect of log of urban population on IOHEs and STEs						
Log of urban population	-5.951**	2.848	[-11.533; -0.369]	6.598***	2.484	[1.730; 11.466]
Control variables	Yes			Yes		
Province × Year	Yes			Yes		
Observations	16,786			16,786		

Panel C. Effect of log of population density on IOHEs and STEs

Log of population density	-11.822**	5.747	[-23.085; -0.559]	13.108**	5.094	[3.124; 23.091]
Control variables	Yes			Yes		
Province × Year	Yes			Yes		
Observations	16,786			16,786		

Notes: Coef = Coefficient, Ro_std = Robust standard errors, CI = Confidence interval. Control variables include age, education level, marital status, gender of the head of the household, household size, dependent ratio, location of residence, household's total assets, house ownership, unemployment rate, local government's revenue. *** p<0.01, ** p<0.05, * p<0.1.

Source: Authors' own calculations.

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