



Infrastructure investment and household income in Vietnam Mekong Delta region

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Abstract

This paper applied a difference-in-differences estimator to measure the impact of infrastructure investment on household income in the Mekong Delta region, Southern Vietnam, using the data from the Vietnam Household Living Standard Survey (VHLSS) for 2016 and 2018. The results indicate that reinforcing canals has a positive effect on improving household income, whereas the evidence regarding the effectiveness of bridge and road projects remains inconclusive. The study also points out that infrastructure investment requires the coordinated planning of projects to achieve the best results for the people in the Mekong Delta region.

Keywords: infrastructure investment, household income, impact evaluation, Mekong Delta.

JEL classification: H54, O18, O54, R11.

1. Introduction

Since “Doi Moi”, Vietnam’s economy has changed dramatically, with high and stable economic growth elevating the country to low-middle-income status after 2000. However, the economic development in Vietnam is uneven across regions (Hoang and Doan, 2018). Certain regions, such as the Southeastern region and the Hong River Delta, have emerged as economic hubs. In contrast, others, including the Northwestern, Central Highlands, and Southwestern or Mekong Delta region, lag significantly behind, often described as underdeveloped or backward compared to neighboring regions.

As the largest rice-producing region in Vietnam, the Mekong Delta produces 23 million tons of rice each year, along with various special products, fruits, and aquaculture products. However, the economic picture of the Mekong Delta is incomplete, fragmented, and lacking in cohesion. Multiple factors contribute to the region’s isolation, constraining its provinces’ economic development. The complex river system in the Mekong Delta, which seems to provide advantageous conditions for agriculture production, has become a significant barrier to inter-provincial connectivity. It can be asserted that the My Thuan and Can Tho bridges play a vital role in this riverine region. They reduce travel time to Ho Chi Minh City, lower the cost of exporting aquaculture products, and stimulate the development of logistics activities. Despite these developments, National Road 1A has long been the only route connecting the Mekong Delta and the Southeastern, creating a persistent bottleneck without any comprehensive solution. The poor infrastructure connectivity within the region’s provinces also turns each locality into a separate market and production unit, leading to ongoing concerns about agricultural prices for many farmers.

Infrastructure investment, increasing connectivity between economic centers and remote regions, has been empirically studied in countries like India (Asher and Novosad, 2020), China (Banerjee et al., 2020), Indonesia (Gibson and Olivia, 2010), and the Philippines (Olsson, 2009). Most studies have shown that infrastructure investment significantly benefits development in remote areas and enhances connectivity between regions within the economy. Nguyen et al. (2017) argue that infrastructure investment, such as roads and irrigation systems, is crucial for rural development in Vietnam; however, no studies specifically focus on the Mekong Delta.

Infrastructure investment is the most critical factor for revitalizing the Mekong Delta's economy. Enhancing infrastructure will improve regional connectivity, facilitate better labor division, and foster economic growth in the future. This paper aims to examine infrastructure investment activities at the commune level in the Mekong Delta and investigate their impact on household income in the surveyed communes.

2. Literature review

Rural infrastructure, particularly from the perspective of roads, plays a crucial role in driving local economic development. It stimulates economic structural transformation and labor mobility in developing countries (Asher and Novosad, 2020; Banerjee et al., 2020), enhances income in impoverished regions (Escobal and Ponce, 2002; Olsson, 2009; Koomen et al., 2016; Spey et al., 2019), and improves the quality of non-agricultural enterprises (Gibson and Olivia, 2010).

Economic development in underdeveloped or developing countries often involves the application of various economic models, including the dual-sector model proposed by Lewis (1954). The policies aimed at improving the quality of life and increasing the welfare of rural populations are enacted through various projects, including upgrading existing roads and constructing new ones in rural or remote areas. These projects might not fully achieve the goal of enhancing income for people, but they have fostered labor structure transformation, particularly by encouraging a shift away from the agricultural sector (Asher and Novosad, 2020). Access to infrastructure (such as roads) in rural areas, in the context of prolonged high economic growth like that of China, revealed similar results, potentially even reducing income growth for rural populations (Banerjee et al., 2020).

People living near road renewal or upgrading projects have greater opportunities to improve their economic situation compared to those in other areas (Escobal and Ponce, 2002). Furthermore, Escobal and Ponce (2002) argued that households near these projects could earn higher non-agricultural income and have more opportunities to participate in waged employment or self-employment (Spey et al., 2019). Olsson (2009) also indicated that improving access to better-quality roads helped fishers achieve a better quality of life. Moreover, upgrading the quality of roads indirectly impacts productivity, as it makes it easier for firms to renovate their facilities and for the market to develop further.

Empirical research indicates that improved road access in rural areas accelerated the transition of the populations away from agricultural activities, leading them to seek and join more stable and higher-income opportunities. Gibson and Olivia (2010) explored that households not only gained access to roads, but local enterprises also increased their profits as they gained easier access to electricity. Moreover, agricultural products would gain easier access to markets due to the improved quality of roads, which facilitated the formation of agricultural specialization activities (Quin and Zhang, 2016).

It can be summarized that although households in rural areas with access to improved roads may not necessarily experience a significant increase in income, they tend to alter their behavior. Specifically, they were more likely to move away from agricultural activities, pursue self-employment, or seek salaried jobs to achieve sustainable earnings in the future.

Little research assesses the impact of regional connectivity from an infrastructure perspective on household income in Vietnam. Instead, existing research has primarily focused on the effects of rural roads on income, welfare (Nguyen, 2011), agricultural activities (Nguyen et al., 2017), and the development of traditional markets (Mu and Walle, 2011). Regarding income and household welfare, Nguyen (2011) indicated that households residing in communes with improved infrastructure tend to have higher incomes than others. However, the increase was insignificant regarding living expenditures, non-agricultural income, and the ratio of children attending school. Nguyen et al. (2017) also argued that rural roads positively impacted households' wealth index despite harming agricultural activities.

3. Data and research methodology

Infrastructure projects in provinces are not randomly assigned, leading to bias in regression estimation due to unobserved heterogeneity confounders. Therefore, this paper applied a difference-in-differences approach using two-way fixed effects estimation to eliminate unobserved heterogeneity in the model. The estimated regression is outlined as follows:

$$Y_{it} = \beta_0 + \beta_1 T_t + \beta_2 Treat_{it} + \beta_3 T_t Treat_{it} + \beta_4 X_{it} + u_i + \epsilon_{it} \quad (1)$$

Where Y represents the average income in logarithmic form of household i at time t ; T is the time variable (with 2018 = 1); $Treat$ is the policy variable indicating that the commune receives projects at time t , including roads to district/province, commune roads, bridges, and

canal reinforcement; X denotes the covariate control variables; u represents the unobserved characteristics of household; and ε is the error term. The coefficient β_3 in the difference-in-differences estimation represents the impact of infrastructure projects on household income. The difference-in-differences approach enhances the reliability of the results by comparing the treatment and control groups overtime, rather than just between the two groups at a single point in time.

The paper utilizes the Vietnam Household Living Standard Survey (VHLSS) data from 2016 and 2018 to analyze income and household characteristics in the Mekong Delta (repeated). Moreover, the commune survey data from 2016 is used to identify the infrastructure projects implemented between 2014 and 2016, including roads to the district/province, commune roads, bridges, and canal reinforcement. The data in this paper have been merged from two separate datasets, as previously mentioned. Consequently, the merged dataset includes only rural households, with 1,429 households and 2,857 observations (one observation is missing income data). The VHLSS data are collected biennially by the General Statistics Organization using a stratified random sampling method. The survey was conducted across 63 provinces and cities in Vietnam, which enhanced the reliability of the dataset.

Table 1 presents the descriptive statistics for the variables used in the model to estimate the impact of infrastructure investment on household income in the Vietnam Mekong Delta region. Average household income increased by approximately VND 900,000 per month per member in 2018 compared to 2016. However, the standard deviation of income in 2018 was also higher, reflecting a significant variability in income over the two-year period. Household characteristics did not change significantly over the two-year period due to the use of repeated cross-section. Any observed changes are attributable solely to differences in the household head.

The Mekong Delta is ethnically diverse, but the Kinh and Chinese ethnic groups are predominant, constituting over 95 percent of the population. Additionally, household sizes typically range from three to four members. The average age of the household head is approximately 51 years. The marriage rate exceeds 80 percent, but only five percent of household heads are party members. On average, the education level is limited to primary school.

TABLE 1: Household characteristics in two periods (n = 1,429)

	2016				2018			
	Mean	Standard deviation	Skewness	Kurtosis	Mean	Standard deviation	Skewness	Kurtosis
Income per capita (thousand Dong/month)	2,598.585	4,442.449	0.320	5.037	3,492.455	5,410.830	0.462	5.693
Ethnic (Kinh, Chinese = 1)	0.957	0.202			0.956	0.205		
Household size	3.691	1.505	0.436	3.220	3.600	1.527	0.396	3.058
Gender (Male = 1)	0.791	0.407			0.782	0.413		
Age (Years)	51.794	12.598	0.492	2.955	53.624	12.628	0.376	2.971
Marital status (Marriage = 1)	0.818	0.386			0.806	0.395		
Vietnam Communist Party member (Yes = 1)	0.052	0.222			0.048	0.214		
Education (Years)	5.458	3.411	0.193	2.240	5.585	3.450	0.178	2.186
Salaried job (Yes = 1)	0.381	0.486			0.366	0.482		
Self-employment (Yes = 1)	0.654	0.476			0.624	0.485		
Self-production (Yes = 1)	0.185	0.388			0.180	0.384		
Agricultural production (Yes = 1)	0.604	0.489			0.554	0.497		
Individual business (Yes = 1)	0.181	0.385			0.219	0.414		

Source: VHLSS - 2016 and 2018 datasets.

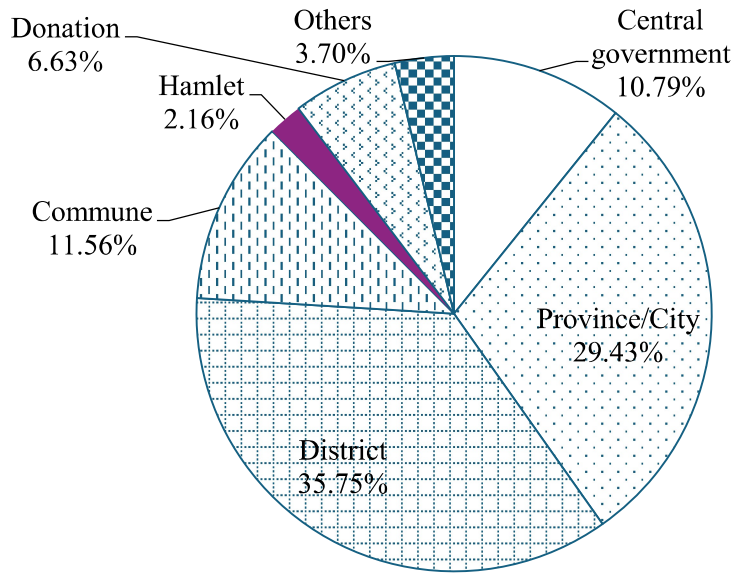
Focusing on household economic characteristics in the surveyed region, most households work in the agricultural sector, accounting for 60%, although this share decreased in 2018. In contrast, self-production and individual businesses increased in 2018 compared to 2016, reaching 21.9 percent and 18.1 percent, respectively. The findings indicate a gradual shift in household economic structure in the Mekong Delta following infrastructure improvements. Despite a decline in 2018, agricultural activities still represent the highest proportion of household economic types. Income from employment accounted for 36 percent, a decrease compared to 2016, while income from self-production and agricultural businesses accounted for 18 percent.

4. Empirical results

4.1. Infrastructure investment activities

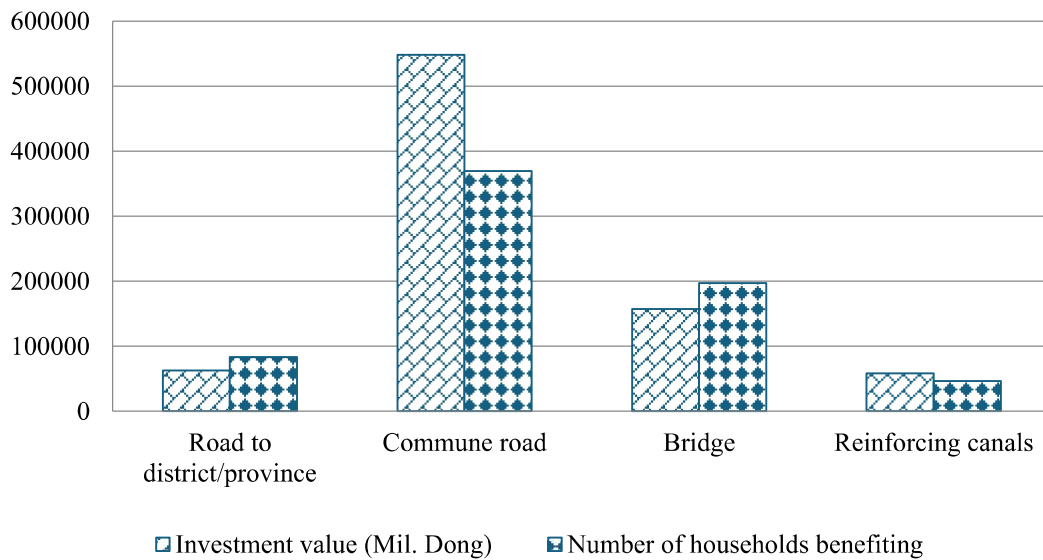
Data from 2016 revealed that, on average, each commune in the Mekong Delta received approximately three infrastructural projects during the 2014-2016 period. Specifically, most of these projects focused on improving or renovating commune roads, followed by bridge construction, provincial road development, and canal reinforcement, which constituted a smaller proportion. Considering the funding sources for infrastructure projects in the Mekong Delta, Figure 1 shows that most projects are funded at the district level, accounting for 35.75 percent. Projects funded by the central government account for slightly more than ten percent, less than those funded at the hamlet level. Meanwhile, projects funded by provincial or municipality governments constitute approximately 30% of the total. To clarify, the projects mentioned are not only conducted within individual hamlets but also include all projects at the hamlet, provincial, or city levels. It can be concluded that infrastructure projects in the Mekong Delta have not received adequate investment attention commensurate with the region's development needs. Most projects are primarily focused on maintenance, improvement, and repairs to preserve the functionality of existing infrastructure rather than on expansion to enhance exploitation and capacity.

FIGURE 1: Funding for local projects



Source: VHLSS - 2016 dataset (Commune).

FIGURE 2: Total investment values from 2014 to 2016 and the number of households benefiting



Source: VHLSS - 2016 dataset (Commune).

A piece of additional evidence highlights the inadequate infrastructure investment in the total investment value recorded in the Mekong Delta during the 2014-2016 period, as observed in the sample survey (Figure 2). The investment amount allocated for constructing roads within hamlets is significantly higher than that for district or provincial roads, bridges, or canals. Despite this, the total investment in the surveyed hamlets over the three-year period was approximately 550 billion dong, compared to only about 60 billion dong allocated for district and provincial roads. However, although the investment amounts remain relatively small, the scope of these projects is substantial. District and provincial roads benefit up to 80 thousand households, while roads within hamlets benefit approximately 360 thousand households. Additionally, bridges serve around 200 thousand households.

4.2. Impact of infrastructure investment on household income

Collinearity is a crucial issue that must be tested before estimating the regression model. Table 2 presents the Variance Inflation Factor (VIF) values, which indicate the presence and extent of collinearity among the variables. The results show that the VIF values are all below 6, with an average of approximately 1.8, indicating that the regression model does not suffer significant collinearity issues.

To estimate the impact of infrastructure investment on household income in the Mekong Delta, the paper sequentially estimated the proposed model across different types of projects in the surveyed hamlets. These projects include district and provincial roads, roads within hamlets, bridges, and the reinforcement of canals. Table 3 presents the results of five estimations organized by the types of projects mentioned. Model (5) specifically represents the coordinated projects within the hamlets.

TABLE 2: Collinearity diagnosis

Variables	VIF	Square root of VIF	Tolerance	R-squared
T	2.57	1.60	0.3889	0.6111
TxTreat1	1.52	1.23	0.6596	0.3404
TxTreat2	3.51	1.87	0.2849	0.7151
TxTreat3	2.46	1.57	0.4072	0.5928
TxTreat4	1.66	1.29	0.6017	0.3983
TxTreat5	1.59	1.26	0.6289	0.3711
Ethnics	1.04	1.02	0.9608	0.0392
Household size	1.15	1.07	0.8711	0.1289

Gender	1.54	1.24	0.6488	0.3512
Age	1.42	1.19	0.7050	0.2950
Marital status	1.70	1.30	0.5879	0.4121
Party member	1.11	1.05	0.9007	0.0993
Education	1.14	1.07	0.8771	0.1229
Salaried job	1.46	1.21	0.6839	0.3161
Farming	1.90	1.38	0.5254	0.4746
Non-agricultural work	1.65	1.29	0.6052	0.3948
Agricultural production	2.73	1.65	0.3664	0.6336
Individual business	2.23	1.49	0.4488	0.5512
Mean VIF	1.80			

Source: Authors' calculations from VHLSS - 2016 and 2018 datasets.

TABLE 3: Result of the estimation of the impact of infrastructure investment on household income

Variables	Household income (Log)				
	(1)	(2)	(3)	(4)	(5)
T	0.291***	0.282***	0.295***	0.274***	0.291***
	(0.021)	(0.033)	(0.026)	(0.020)	(0.018)
TxTreat1	0.034				
	(0.037)				
TxTreat2		0.027			
		(0.039)			
TxTreat3			0.011		
			(0.034)		
TxTreat4				0.100**	
				(0.041)	
TxTreat5					0.141**
					(0.071)
Ethnics	0.049	0.047	0.046	0.042	0.040
	(0.293)	(0.292)	(0.296)	(0.288)	(0.292)
Household size	-0.060***	-0.059***	-0.059***	-0.058***	-0.060***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)

Gender	0.122	0.121	0.120	0.121	0.126
	(0.087)	(0.087)	(0.087)	(0.087)	(0.088)
Age	0.0036	0.004	0.004	0.004	0.004
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Marital status	-0.028	-0.029	-0.028	-0.034	-0.031
	(0.077)	(0.077)	(0.077)	(0.077)	(0.078)
Party member	-0.015	-0.016	-0.017	-0.014	-0.009
	(0.067)	(0.067)	(0.067)	(0.065)	(0.067)
Education	0.010	0.010	0.010	0.010	0.010
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Salaried job	0.141***	0.141***	0.140***	0.144***	0.142***
	(0.040)	(0.040)	(0.040)	(0.040)	(0.040)
Farming	0.095**	0.097**	0.097**	0.094**	0.095**
	(0.043)	(0.043)	(0.043)	(0.042)	(0.043)
Non-agricultural work	0.209***	0.213***	0.210***	0.211***	0.215***
	(0.059)	(0.059)	(0.059)	(0.059)	(0.059)
Agricultural production	-0.104**	-0.103*	-0.105**	-0.105**	-0.104**
	(0.053)	(0.053)	(0.053)	(0.052)	(0.053)
Individual business	-0.045	-0.043	-0.045	-0.048	-0.051
	(0.056)	(0.056)	(0.056)	(0.056)	(0.056)
Constant	7.342***	7.341***	7.348***	7.338***	7.353***
	(0.360)	(0.358)	(0.361)	(0.356)	(0.359)
Number of observations	2.857	2.857	2.857	2.857	2.857
R- squared	0.227	0.227	0.226	0.230	0.229
Number of households	1.429	1.429	1.429	1.429	1.429

Note: White standard errors are reported in parentheses, *** p<0,01; ** p<0,05; * p<0,1;

Treat1: road to province/city; Treat2: commune road; Treat3: bridge;

Treat4: canal reinforcement; Treat5: coordinated projects.

Source: Authors' calculations from VHLSS - 2016 and 2018 datasets.

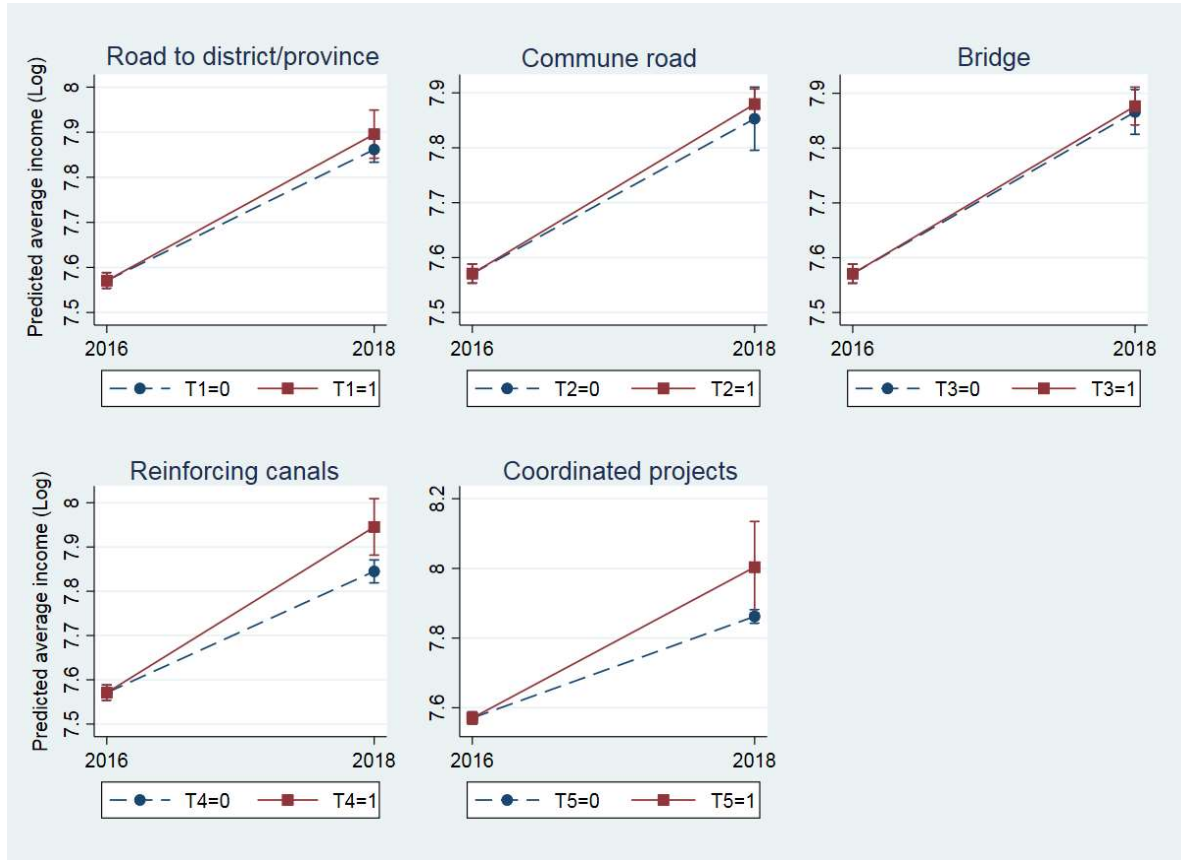
The results presented in Table 3 indicate that the control variables are statistically significant and that their coefficients remain stable across the models. These findings suggest that the assessment model is robust. One of the main results from the five models is that household income increased by approximately 27-29 percent on average. Notably, the project variable was omitted due to using the fixed effects estimator. Regarding the policy variable, the five models indicate that infrastructure investment policy positively impacts improving household income in the Mekong Delta. However, models (1), (2), and (3) do not show statistical significance, whereas models (4) and (5) demonstrate high significance.

For hamlets with only a single project, whether it involves roads or bridges, there is no statistical evidence to conclude that constructing these infrastructures improves household income. Nevertheless, canal reinforcement projects have shown a clear and significant improvement in household income. Moreover, it is particularly noteworthy that hamlets with coordinated projects - comprising roads, bridges, and canal reinforcement - demonstrate the most substantial impact on household income over the two-year analysis period, accounting for a 14.1 percent increase, *ceteris paribus*.

In the Mekong Delta region of Vietnam, irrigation-related issues significantly affect residents' lives, particularly impacting agricultural and aquaculture activities. Consequently, canal reinforcement projects have a positive effect on improving residents' livelihoods. Moreover, in hamlets, where infrastructure was already well-established prior to the research period, no new projects emerged, leading to a lack of statistically significant evidence to assess the impact of such projects. However, for hamlets that received new projects during the research period, there is evidence that these areas are starting to receive increased attention and will benefit more from infrastructure policies. Introducing new projects, as opposed to those completed in the past, has led to significant changes in household income.

Figure 3 replicates the results presented in Table 3 for a more intuitive understanding. Under the assumption that there is no difference in income between households in hamlets that received projects and those that did not in 2016, the year in which benefits from infrastructure policies began to materialize. Following this, Figure 3 indicates that, after two years, hamlets with infrastructure projects experienced higher benefits compared to those without. However, the income gap for road and bridge projects is insignificant. In contrast, canal reinforcement projects show a more pronounced gap and coordinated projects within hamlets have produced the largest effect compared to other types of projects.

FIGURE 3: The impact of infrastructure policies on household income during the period 2016-2018



Source: Authors' calculations from VHLSS - 2016 and 2018 datasets.

5. Conclusions

By applying the difference-in-differences estimator to the Vietnam Household Living Standard Survey data from 2016 and 2018 (covering household and hamlet samples), this paper reveals the estimated impact of infrastructure investment on household income in the Mekong Delta region of Vietnam. Specifically, projects involving district or provincial roads, bridges, and canal reinforcement positively impact household income. However, the evidence of impact is statistically insignificant for hamlets with only a single project, such as roads or bridges. Based on these findings, several policy implications can be drawn.

Firstly, infrastructure projects, such as roads and bridges, must be appropriately scaled to match the province's or region's development needs. Additionally, the timeline and construction progress should be clearly defined and strictly adhered to. The research results

indicate that single projects, such as those within hamlets or district/provincial roads and bridges, do not have a significant impact on benefiting households in the targeted hamlets. Indeed, infrastructure projects such as roads or bridges within hamlets often require more time to construct and may not significantly scale up to provide substantial benefits to households beyond facilitating easier commuting compared to the past.

Secondly, given the complex canal network in the Mekong Delta, it is essential to continue reinforcing the canals to create more opportunities for households. This is particularly beneficial for households engaged in aquaculture, who experience the greatest advantages from such infrastructure improvements. Moreover, reinforcing canals helps mitigate landslide problems, providing stability for households living near rivers. This stability allows these households to focus on production activities and potentially increase their earnings.

Thirdly, coordinating infrastructure projects to ensure cohesive progress is essential for achieving the highest effectiveness. Single or isolated projects may not fully realize their potential in the Mekong Delta, partly due to the region's terrain characteristics. Therefore, it is essential to conduct careful research and ensure that investments are coordinated. This approach will enhance the effectiveness of infrastructure policies.

The development strategy for the Mekong Delta should not only focus on creating connections but also on ensuring that these connections are well-coordinated, with reasonable scaling and construction timelines. Only then can we fully promote the positive benefits of infrastructure investment projects.

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Article history

Received on January 18, 2024

Revised on January 25, 2024

Accepted on January 25, 2024