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Analyzing the Impact of Road Infrastructure Spending on Rural Household Welfare (Food Security) in Laos: A Comparison of DID and PSM-DID Approaches

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Abstract

To investigate the effects of road infrastructure investments on rural household welfare, this study combines DID analysis with Propensity Score Matching (PSM) and Difference-in-Differences (DID). Initial DID results point to a non-significant impact of road infrastructure investment on household well-being; however, PSM-DID analysis yields different conclusions. The non-significant DID results show a possible mismatch between theoretical predictions and actual results, challenging preconceived notions and contradicting empirical data. Nonetheless, the next PSM-DID analysis shows that investments in road infrastructure have a notable and beneficial effect on household welfare, especially when it comes to real food spending per capita. These findings highlight the need to use reliable approaches to precisely evaluate the effects of infrastructure investments. Furthermore, well-being is favorably influenced by control variables including household business, education, and urbanization. Welfare, however, is adversely affected by the size of the home and the number of individuals residing there. These results underline the complexity of rural development and the need for more study to fully comprehend the intricate relationships between these factors.

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Introduction

Investment in road infrastructure is instrumental in elevating the well-being of rural households, serving as a cornerstone for development in these areas (World Bank, 2020). Well-designed and maintained roads not only streamline transportation but also exert diverse influences across rural life, spanning economic opportunities, social connectivity, and access to vital services (Gwilliam & Rajan, 2018). With global recognition of the importance of rural advancement, road infrastructure investment emerges as a pivotal factor in fostering sustainable growth and enhancing the living standards of rural communities (UNDP, 2019). The significance of investing in road infrastructure for rural household welfare is underscored by its multifaceted impact. Firstly, improved road connectivity slashes transportation expenses and time, empowering rural dwellers to access markets, employment prospects, and essential services like healthcare and education more efficiently (Asian Development Bank, 2017). Consequently, this spurs economic activity within rural locales, driving up income levels and overall prosperity (World Bank, 2020). Secondly, upgraded road networks play a pivotal role in bolstering agricultural development by facilitating swift and cost-effective transportation of farm produce to markets (IFAD, 2016). This not only enhances agricultural productivity but also nurtures rural entrepreneurship and promotes market integration, thereby aiding in poverty alleviation and ensuring food security (FAO, 2018). Moreover, enhanced road infrastructure contributes significantly to social cohesion by linking remote communities with urban centers and fostering interaction among diverse populations (ADB, 2019). Enhanced access to education, healthcare, and social amenities reinforces the social fabric of rural societies, fostering inclusivity and equality (UNDP, 2019). Furthermore, investments in road infrastructure yield long-term environmental benefits by curbing carbon emissions through optimized transportation routes and the promotion of sustainable modes of transport (World Bank, 2020).

In recent decades, the global community has increasingly recognized the pivotal role of infrastructure development in fostering economic growth and improving living standards, particularly in rural areas (World Bank, 2020). Among various types of infrastructure, roads stand out as fundamental connectors, facilitating access to markets, healthcare, education, and other essential services (UNDP, 2019). In the context of Laos, a Southeast Asian nation characterized by its predominantly rural landscape, the impact of road infrastructure investment on household welfare is of paramount importance.

Despite significant progress in recent years, Laos still grapples with infrastructural challenges, particularly in rural regions where access to basic amenities remains limited (World Bank, 2020). Recognizing this, policymakers have increasingly turned their attention to investing in road networks as a means to stimulate economic activity and uplift rural communities (Asian Development Bank, 2017). However, the empirical evidence regarding the direct impact of road infrastructure investment on rural household welfare in Laos remains relatively scarce.
The significance of investigating the relationship between road infrastructure investment and rural household welfare in Laos cannot be overstated. Firstly, such research endeavors contribute to a deeper understanding of the dynamics between infrastructure development and socio-economic outcomes in rural settings, offering valuable insights for policymakers not only in Laos but also in other developing countries facing similar challenges (Gwilliam & Rajan, 2018). Secondly, by examining empirical evidence, this study can inform a more targeted and effective allocation of resources towards infrastructure projects, maximizing their potential to improve the well-being of rural populations (ADB, 2019). Moreover, as Laos continues to undergo rapid economic transformation and urbanization, insights gleaned from this research can help mitigate disparities between urban and rural areas, fostering more inclusive

development (FAO, 2018). Lastly, this study holds implications beyond Laos, offering lessons and frameworks applicable to other developing nations striving to leverage infrastructure investment for poverty reduction and rural development (IFAD, 2016). By shedding light on the nexus between road infrastructure and household welfare, this research contributes to the broader discourse on sustainable development and poverty alleviation strategies (World Bank, 2020).

In the following sections, we will explore the theoretical foundations of the PSM-DID model, delineate the methodology, present the data sources, and scrutinize the empirical results, ultimately providing a nuanced understanding of the intricate relationship between road infrastructure investment and rural household welfare in Laos.

Research Question.

This research aims to address several key questions: Does the amount of investment in road infrastructure that increases access have a substantial impact on the welfare of rural households? more specifically, real household food expenditure per capita?

2. Literature review

Several studies have emphasized how important transportation infrastructure is for rural development, especially roads. For example, research by Banerjee and Duflo (2012) highlights that better road connection can result in more opportunities and marketplaces being accessible, which can boost rural economies. In a similar vein, Haider and Patunru (2017) contend that improvements to road infrastructure greatly improve the general wellbeing of rural households and aid in the fight against poverty. Numerous studies have been conducted in the literature regarding the financial effects of investing in road infrastructure in rural areas. Improved road connectivity allows rural communities to participate in non-agricultural activities, diversifying sources of income and boosting livelihoods, as studies like those conducted by Fan and Gao (2016) show. Furthermore, research by Deichmann et al. (2016) emphasizes the significance that road infrastructure development plays in bolstering rural economies by highlighting the favorable association between it and agricultural productivity. In addition to facilitating economic activity, improved road networks also improve social connectedness and rural populations' access to basic amenities. Improved road infrastructure is thought to facilitate better access to healthcare and education, which in turn promotes the development of human capital and general welfare (Ghosh and Mandal, 2019). In a similar vein, research by Hassen and Hossain (2018) highlights the contribution that roads make to social participation and the reduction of differences between rural and urban areas.

Investment in road infrastructure is especially important for the development of agriculture in rural areas. According to research by Ali et al. (2018), farmers can move their goods to markets more effectively and with lower post-harvest losses when there are well-maintained roadways in place. Furthermore, research like that conducted by Rao and Singh (2019) highlights the significance of roadways. Investment in road infrastructure benefits rural communities in many ways, but it also presents environmental issues. The effects of road development on the environment, such as deforestation, habitat fragmentation, and increased carbon emissions, are covered in research by Khandker et al. (2017). Scholars like Liu et al. (2020) have suggested ways to lessen these effects, such as encouraging sustainable forms of transportation and implementing eco-friendly design components. Overall, the literature suggests that road infrastructure investment holds significant potential for enhancing rural household welfare by promoting economic growth, improving access to services, and fostering social inclusion. However, careful planning and consideration of environmental factors are essential to

maximize the benefits of such investments while minimizing adverse consequences.

3. Materials and Methods

3.1. Sample Size

Representative household surveys from 1 capital, 17 provinces, 3 cities, and 145 towns in the Lao PDR are used in this study. Over a year, data were gathered about seasonal consumption patterns, regional (North, Central, and South) features, and the differences between urban and rural areas. Utilizing panel data from two waves of the Laos Expenditure and Consumption Survey: LECS (2013 and 2019), annual observations were conducted. Following the matching of 3,396 total observer households, the sample sizes for the DID model were as follows: 1,698 homeowners in LECS 5 and 1,698 homeowners in LECS 6. There were 3,188 households in the treatment group villages, which included road infrastructure plans, and 208 houses in the control group.

3.2 Research Hypotheses and Definition of Variables:

Let's repeat the specific research hypotheses that my technique addresses to help illustrate how my methods relate to the goals of the research.

Real Food Expenditure per Capita in Households (Kips/month): According to the Lao Statistics Bureau (2019), this indicator assesses the percentage of household spending that is devoted to food, which is essential for evaluating food security and nutritional well-being.

Supposition investments in road infrastructure can raise the real food expenditure per capita of rural communities, hence improving their welfare level. The road infrastructure investment village variable ($Treated_{it}$), the time dummy variable ($After_{it}$), and their interaction term ($Treated_{it} \times After_{it}$) were selected as explanatory variables in this study. In addition, the amount spent on household expenses in each village home served as a measure of the welfare of rural households. Based on earlier studies, the control variables identified in this work are listed in Table 1 along with their definitions and hypotheses.

Table1: Definition and Hypothesis of Variables for using on DID Model

ID	Variables	Definition of Variables	Hypothesis Sign
I. Dependent variables (Welfare)			
1	Lnrfepc	Natural Logarithm of Household Real Food Expenditure Per Capita (Kip/month)	Positive
II. Key Impact variables			
2	Road_acc	Road access to Village Year-round (1 Yes, 0 Otherwise)	Positive
III. Control variables			
3	Age	Head of the household's age (year)	Positive
4	Sex	Head of household's gender (one male, zero female)	Positive
5	Educ	The head of the household's education in the year	Positive
6	Hsize	Household size (Person)	Positive
7	Adults	Number Adults in Household using as Labor (Person)	Positive
8	Business	Business Household have owned Business (1 Owned, 0 Otherwise)	Positive
9	H_urban	Urban (1 Yes, 0 Otherwise)	Positive

Source: Authors' computations (2024).

3.3. The variables descriptive.

Each variable's mean, median, maximum and minimum values, standard deviations, and the total number of data observations are all broken down in depth in Table 2. Following the utilization of econometric methods to tackle problems like skewness, kurtosis, missing data, and outliers, the descriptive statistics for both dependent and independent variables exhibit a normal distribution. The findings, displayed in Table 2, will be used in the research's further phases. The information has been compiled, and some variables have been converted into various estimating units, such as logarithms or the model's percentage of Rfepc.

Table 2: Data descriptive statistics.

Variable	Mean	Std.Dev.	Min	Max
Time	0.50	0.50	0	1
Treated	0.94	0.24	0	1
DID	0.49	0.50	0	1
Lnfepc	12.65	0.59	10	16
Age	47.57	13.55	15	98
Sex	0.89	0.32	0	1
Edu	5.86	5.24	0	21
Hsize	4.97	2.09	1	17
Adult	1.75	1.48	0	10
H_urban	0.43	0.50	0	1
Business	0.21	0.41	0	1
Number of obs.	3,396			

Source: Authors' computations (2024).

All of the samples were divided into two groups in the paper: the treated group and the control group. communities that had previously benefited from investments in road infrastructure were classified as the treatment group, whereas communities that had not benefited from such investments were placed in the control group.

3.4 DID and propensity score matching Model.

3.4.1. Empirical Model

This study will use a mix of Propensity Score Matching (PSM) and Difference-in-Differences (DID) to examine the effects of a "road scheme" in Laos. For a single DID analysis, equation (1) is used to estimate projected values by linear regression. The same rules apply for the introduction of control variables or kernel propensity score matching weights.

Difference-in-Differences (DID):

The goal of the DID analysis is to evaluate the causal link over time between road plans and outcomes at the village level. This study aims to evaluate the impact of road infrastructure investments on rural households' welfare. Road investments create a "policy-treated effect" and a "time effect," which cause variations in welfare over time. Differentiating these effects is where the difficulty lies. To successfully handle this difficulty, the DID model is utilized. The net effect of road investment is estimated by comparing the treated (road infrastructure investment) and control (non-road infrastructure investment) groups. It is anticipated that both groups will follow the same trend prior to the investment because of the "time effect." The "road infrastructure investment operation" is the reason for the post-investment difference between the groupings.

Outcome Variable: Define the outcome variable that represents the Logarithm Household Real food expenditure per capita (Kip/month) and measures we want to assess. Let's call this variable Y (Rural Household Welfare).

Time Indicator: Create a time indicator variable (After) that equals 1 for LECS 6(2019) (post-treatment) and 0 for LECS 5(2019) (pre-treatment).

Treatment Indicator: Create a treatment indicator variable (Treated) that equals 1 for villages with the road scheme and 0 for villages without it.

Regression Model: Specify a DID regression model refer to Inthakesone & Kim (2016); Wang et al. (2019), and Xu et al. (2016) as follows:

$$Y_{it}=\beta_0+\beta_1(Treated_{it}\times After) + X_{it} + \epsilon_{it} \quad (1)$$

Where:

Y_{it}: Outcome variable for village *i* at time t.

$Treated_{it}$: Treatment indicator for village *i*.
After: Time indicator (1 for LECS 6(2019)) means after, 0 for LECS 5(2013)) means before.
X_{it}: Covariates that may affect the outcome (e.g., village characteristics: Household Head Age(Age), Household Head Sex (Sex), Household Head Education (Edu), Household size (H_size), Number Adult in Household (Adult), Business Household (Business) and Urban Household (H_urban)) refer to Wang et al.（2019) and Inthakesone & Kim (2016).
ϵ_{it}: Error term.

In this model, the coefficient β_3 represents the treatment effect of the road scheme.
The estimated coefficients' interaction yields the expected values in equation (1). The following is the explanation of the estimated coefficients:
β_0: the mean outcome of the constant.
β_1: the DID (*Treated×After*) estimate.

Propensity Score Matching (PSM):
Propensity Score Matching (PSM) is a technique that matches treated and control groups according to their propensity scores (PS) in order to reduce sample selection bias. In order to calculate PS, this study uses a logit regression model (Baier et al., 2009). In order to minimize variances and improve comparability, control villages are chosen to be similar to treated ones (Heckman, 1976; Rosenbaum & Rubin, 1983). $Treated_{it}$ = 0 indicates control villages, and $Treated_{it}$ = 1 indicates treated villages. According to Wang et al. (2019), PS indicates the possibility that a community will be chosen to receive funding for road infrastructure. PSM makes it easier to estimate the impact of treatments by generating a balanced sample, which is essential when village heterogeneity makes it difficult to validate common trend hypotheses. Through the use of multiple indicators, including village features, PSM guarantees the consistency of the treatment and control groups before conducting Difference-in-Differences analysis.

$$P_i(X) = \Pr(Treated_{it} = 1 \, X_{it}) = F[h(X_{it})], \quad (2)$$

If a community receives investment in road infrastructure, the variable Treatedit is set to 1, otherwise to 0. X_{it} represents the village traits that influenced this decision. A logistic function is denoted by F (·), whereas a linear function is indicated by H (·). Propensity ratings are used to match villages with and without road investment. By maintaining parity, the scores of the treatment and control villages are comparable. Propensity Score Matching (PSM) corrects sample selection bias, and Difference-in-Differences (DID) deals with endogeneity. DID, however, does not address sample deviation. Therefore, as Equation (3) demonstrates, a PSM-DID model is developed to estimate how road investments affect the well-being of rural households. Using logistic regression, propensity scores—which indicate the likelihood of investing in roads—are calculated. The parameters come from Wang et al. (2019).

$$Probit\ (Y_{it}) = \beta_0 + \beta_1(Treated_{it} \times After) + \gamma X_{it} + \eta Z_i + \epsilon_{it} \quad (3)$$

Where:
$Treated_{it}$: Treatment indicator for village *i*.
X_{it}: Covariates related to village characteristics: Household Head Age (Age), Household Head Sex (Sex), Household Head Education (Edu), Household size (H_size), Number Adult in Household (Adult), Business Household (Business) and Urban Household (H_urban) refer to Wang et al. (2019) and Inthakesone & Kim (2016).
Z_i: Other covariates that may affect treatment assignment.
ϵ_{it}: Error term.

4. Results and Discussion

4.1 The impact of Road on Household Real Non-Food Expenditure per Capita: DID method.

DID without and with covariates

As the DID approach is used, Table 3's results demonstrate that the DID with no covariate treatment-effects estimate forecasts a marginal increase in household real food expenditure per capita of 0.074. Notwithstanding the positive indication, this shift is not statistically significant. This DID estimate indicates that there is no statistically significant relationship between road infrastructure investments and rural households' well-being. This outcome contradicts the empirical data and validates the hypothesis. According to Table 3's findings, a non-significant result is suggested by the DID with variables treatment-effects estimate. This is in line with the hypothesis because the DID result does not corroborate the empirical conclusion, which is consistent with the previous findings.

Table 3: Road and Household Real Food Expenditure per Capita: DID with and without covariates

Outcome var.	DID without covariates		DID with covariates	
	Lnrfepc	S.Err.	Lnrfepc	S.Err.
Before				
Control	12.204		12.553	
Treated	12.442		12.576	
DID(T-C)	0.238***	0.034	0.023	0.039
After				
Control	12.571		12.893	
Treated	12.882		12.969	
DID(T-C)	0.312***	0.088	0.076	0.085
Difference in-Differences	0.074	0.096	0.053	0.092
	R-square: 0.16		R-squared= 0.36	
Number of obs.	3,396			

*Notes: *, **, and *** denote statistical confidence levels at 90%, 95%, and 99%, respectively.*

The Table 4 Hypothesis maintains its strength even when controlling variables are added. The wellbeing of rural households is further enhanced by a number of control variables, including age, education, household business, and household urbanization, all of which have a positive and statistically significant impact. Conversely, control variables like the size of the home and the number of adults living there have a statistically significant negative impact on rural household welfare. The impact of these variables should be further investigated in light of prior empirical findings.

Table 4: Covariates and coefficients

Variable(s)	Coeff.	Std. Err.	t	P>t
Age	0.00	0.00	4.19	0.000***
Sex	0.01	0.03	0.20	0.85
Edu	0.02	0.00	10.34	0.00***
Adult	-0.04	0.01	-4.44	0.00***
Hsize	-0.07	0.01	-12.42	0.00***
H_urban	0.11	0.02	5.10	0.00**
Business	0.05	0.02	1.97	0.05**

*Notes: *, **, and *** denote statistical confidence levels at 90%, 95%, and 99%, respectively.*

Test for Robustness Based on the PSM-DID Model

In order to mitigate the systematic divergence in the patterns of road infrastructure investment between villages with and without such investments, as well as to reduce the inherent selection bias of the DID method, the PSM-DID approach was employed for a robustness evaluation in this work. First, the Heckman et al. (1998) kernel technique for

specific estimating was used to generate the propensity score, yielding the following estimates:

It is necessary to assess the common support hypothesis before executing the PSM-DID computation. To do this, it is required to determine whether the mean values of the variables for the experimental and control groups differ in a way that is statistically significant after matching. The test results, which are shown in Table 5, show a significant difference following matching across all control variables, indicating the viability of the the PSM-DID technique.

Table 5: Propensity score matching-based difference-in-difference (PSM-DID) common support hypothesis.

Variable(s)	Mean Control	Mean Treated	Diff.	t	Pr(T>t)
Lnrfepc	12.20	12.44	0.24	5.95	0.0000***
Age	41.47	47.82	6.36	6.03	0.0000***
Sex	0.98	0.90	-0.08	3.55	0.0004***
Edu	2.14	6.03	3.89	10.49	0.0000***
Adult	2.57	1.85	-0.72	5.82	0.0000***
Hsize	5.73	5.18	-0.56	3.28	0.0011***
H_urban	0.00	0.42	0.42	11.31	0.0000***
Business	0.05	0.35	0.30	8.28	0.0000***

*Notes: *, **, and *** denote statistical confidence levels at 90%, 95%, and 99%, respectively.*

As previously mentioned, control covariates can be easily used to match treatment and control units with the "diff" tool's "kernel" option. Moreover, the kernel propensity-scoring matching DID can be determined within the propensity score's common support range. To examine the propensity score estimation:

Table 6: Road and household real food expenditure per capita: PSM-DID robustness test

Outcome var.	Lnrfepc	S. Err.	t	P>t
Before				
Control	12.239			
Treated	12.442			
DID (T-C)	0.203	0.024	8.39	0.000***
After				
Control	12.56			
Treated	12.882			
DID (T-C)	0.322	0.054	5.99	0.000***
Difference-in-Differences	0.119	0.059	2.02	0.043**
Number of Obs.	3,396			
	R-squared= 0.20			

*Notes: *, **, and *** denote statistical confidence levels at 90%, 95%, and 99%, respectively.*

The results presented in Table 6 illustrate how employing the PSM-DID approach results in an impact coefficient of household actual food spending per capita at 0.119 according to the PSM-DID treatment-effects estimate. This means that compared to communities without roads, households in villages with roads might pay 11.9% more per person. At the 5% level, this result is statistically significant. As a result, investments in road infrastructure continue to significantly increase rural family welfare levels. More evidence for the empirical conclusion comes from the PSM-DID estimation results, which demonstrate a considerable divergence from the earlier DID result. The theory states that road infrastructure improves the welfare of rural households and has a major effect on household actual food expenditure per capita, especially when it comes to nutritional well-being and food security.

5. Discussion

The empirical findings presented using the Difference-in-Differences (DID) approach initially suggest a non-significant impact of road infrastructure investment on rural household welfare, indicated by a marginal rise in household real food expenditure per capita that lacks statistical significance (World Bank, 2020). This finding challenges the theoretical expectations and contradicts empirical evidence, as it does not support the notion that road infrastructure investment significantly affects rural household welfare (Gwilliam & Rajan, 2018). However, incorporating covariates into the DID estimation does not alter this non-significant outcome (World Bank, 2020). This consistency reinforces the argument that road infrastructure investment may not exert a significant influence on rural household welfare, contrary to prevailing expectations and prior empirical evidence (UNDP, 2019).

In contrast, the Propensity Score Matching (PSM) combined with DID analysis reveals a significant and positive impact of road infrastructure investment on rural household welfare (World Bank, 2020). The estimated impact coefficient indicates a substantial increase in household real food expenditure per capita associated with road infrastructure, supporting the empirical conclusion that road infrastructure investment significantly enhances rural household welfare (IFAD, 2016). This departure from the previous DID results underscores the importance of employing robust methodologies, such as PSM-DID, to accurately assess the impact of road infrastructure investment on rural household welfare (ADB, 2019). The statistically significant findings from the PSM-DID estimation align with the hypothesis that road infrastructure investment positively affects rural household welfare, particularly in terms of food security and nutritional well-being (FAO, 2018).

Moreover, the inclusion of control variables in the analysis reveals additional insights into factors influencing rural household welfare (World Bank, 2020). Variables such as household urbanization, education, and household business positively impact welfare, whereas household size and the number of adults living in the household have a negative influence (World Bank, 2020). Further investigation is warranted to elucidate the complex interactions among these variables and their implications for rural development strategies (ADB, 2019).

6. Conclusion

The examination of the impact of road infrastructure investment on rural household welfare yields nuanced findings, shedding light on the complex relationship between infrastructure development and socio-economic outcomes in rural areas. While initial analyses using the Difference-in-Differences (DID) approach suggest a non-significant effect of road infrastructure investment on household welfare, further investigation reveals contrasting results when employing Propensity Score Matching (PSM) combined with DID analysis. The non-significant findings from the DID approach challenge theoretical expectations and contradict prior empirical evidence, indicating that road infrastructure investment may not exert a significant influence on rural household welfare as initially hypothesized. However, the subsequent PSM-DID analysis reveals a significant and positive impact of road infrastructure investment on household welfare, particularly in terms of real food expenditure per capita. These findings underscore the importance of employing robust methodologies, such as PSM-DID, to accurately assess the impact of infrastructure investments. Furthermore, the inclusion of control variables in the analysis provides additional insights into factors influencing rural household welfare. Variables such as household urbanization, education, and household business positively impact welfare, while household size and the number of adults living in the household have a negative influence. These findings highlight the multifaceted nature of rural development and underscore the

need for further investigation to elucidate the complex interactions among these variables.

7. Policy recommendation

Policy makers should recognize the importance of employing robust methodologies, such as Propensity Score Matching combined with Difference-in-Differences analysis, to accurately assess the impact of road infrastructure investment on rural household welfare. This approach can provide more reliable insights into the complex relationship between infrastructure development and socio-economic outcomes in rural areas. When planning and implementing road infrastructure projects, policy makers should consider contextual factors that may influence the effectiveness of such investments. Variables such as household urbanization, education, and household business have been identified as significant determinants of rural household welfare. Therefore, integrating these factors into project planning and evaluation processes can enhance the effectiveness and sustainability of infrastructure interventions. The findings underscore the multifaceted nature of rural development and highlight the need for inclusive strategies that address the diverse needs and challenges faced by rural populations. Policy makers should prioritize investments that not only improve physical infrastructure but also foster social inclusion, enhance access to education and healthcare, and promote economic opportunities for all segments of rural communities. Informed by empirical evidence, policy makers should allocate resources towards infrastructure projects that have the greatest potential to enhance rural household welfare. By prioritizing investments in road infrastructure based on rigorous analysis of their expected impact, governments can maximize the benefits for rural populations and contribute to more equitable and sustainable development outcomes. Given the complexity of the relationship between road infrastructure investment and rural household welfare, policy makers should support further research to explore the intricate interactions among various socio-economic factors. Continued investigation can provide valuable insights into the drivers of rural development and inform the design of more effective policies and interventions aimed at improving the well-being of rural populations.

Declaration of Conflict of Interest:

Regarding the publication of this work, the study's authors declare that they have no conflicts of interest.

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