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Does a Rural Road Improvement Project Contribute to Inclusive Growth? – A Case Study from Bangladesh

Yasuo Fujita*

Abstract

The concept of "Inclusive growth," which has increasingly been used in the international arena, is concerned with both the pace and pattern of growth (i.e., the income growth of both poor and non-poor, non-income poverty and inequality). Developing countries and donors have often considered rural roads to have a positive impact on the growth of the rural economy and poverty reduction, through the promotion of better connectivity. This paper analyzes the impact of a rural road improvement project on inclusive growth in Bangladesh using a difference-in-difference method based on panel data from a large household survey. The results show that the project did contribute to the growth of the average income in the project area, and therefore to the inclusive growth at the national level. However this was mainly because of the income growth of households other than the poorest. In particular, the poor households with inferior initial resource endowments in landholding and household occupation did not benefit from the project. Thus, rural road projects are not necessarily inclusive at household level, though project specific factors should carefully be considered. A policy implication is that a rural road project in a poor rural area does not always benefit the poorest; hence complimentary interventions for these poorest households are needed.

Keywords: inclusive growth, impact analysis, rural infrastructure, Bangladesh

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1. Introduction

Since the late 1990s, "inclusive growth" has been increasingly recognized by national policy makers and international organizations as part of development policies and assistance strategies, in addition to the earlier emphasis on "pro-poor growth". The concept is equally applicable for both developed and developing countries. It has become clear that, in many cases, the benefits of economic growth have not been equitably shared, as income inequality has been worsening in many countries. In addition, to reduce and fight poverty in poverty stricken developing countries, development policy is required to deal with the needs of marginal to low income people. Moreover, economically and socially vulnerable groups are usually most affected by economic down-turns, such as the global economic crisis in 2008, and thus require more policy attention. As conventional economic growth has apparently failed to consider these issues, the concept of inclusive growth has been become more popular (ADB 2014; OECD 2015; Ostry et al. 2014).

Unfortunately, still there is no consensus among policy makers and donor agencies on a concrete definition of inclusive growth. Even international organizations, such as the Asian Development Bank (ADB), the Organization for Economic Cooperation and Development (OECD), and the World Bank provide slightly different definitions. Nevertheless, while there may be no agreement on the definition, there is consensus that the main objective of inclusive growth is to pursue broad-based and equitable growth through providing access to increased opportunities, especially jobs, so that all people, including the marginal and poor, can participate in and contribute to economic growth (World Bank 2009). A key difference between this concept and that of pro-poor growth is that while pro-poor growth is concerned with income growth of the poor, inclusive growth is concerned with both the pace and pattern of growth (ADB 2014). Income growth will always be emphasized, but so should non-income poverty and the inequalities in both poor and non-poor populations. While questions also arise as to how to measure inclusiveness, there have been some efforts at the country level, such as setting multiple indicators (ADB 2011), and the creation of a synthetic indicator (Ali and Son 2007; Anand et al. 2013).

Policies to promote inclusive growth include fiscal policy, monetary policy, and structural reforms (Aoyagi and Ganelli 2015). For developing countries particularly, infrastructure investment is one of these. The impact of infrastructure on inclusive growth is an important policy issue because infrastructure provision is one of the pillars of most growth strategies, and because a sizeable portion of government and donor funds is spent on the infrastructure sector. While it is widely recognized that infrastructure can significantly contribute to inclusive growth, the contribution from infrastructure is not automatic: it "depends on the context in which the investment is made and the way in which it is used" (ADB 2012, 17). Transport infrastructure can generally have positive effects on economic growth from expanding economic opportunities by reducing trade, transport and transaction costs, but it can also worsen inequality at regional and household levels (Winters 2014).

Using primary data collected from Bangladesh, this paper investigates the impact of rural roads on inclusive growth. Rural infrastructure development, including roads, has long been considered to have positive impact on poverty reduction, since it is usually implemented in poor rural areas (van de Walle 2008). The study investigates the impact of rural road projects on average income growth, income growth of the poor, and on levels of inequality[1] in the light of the concept of inclusive growth. It uses household survey data to make an impact assessment of a rural infrastructure improvement project in Bangladesh. This is the "Rural Infrastructure Improvement Project" (RIIP) funded by ADB, Kreditanstalt für Wiederaufbau (KfW) and GTZ[2] between 2003 and 2010.[3] Using panel data from more than 3,200 households in two poorer Divisions, Barisal and Khulna, of Bangladesh, this study demonstrates that such projects on

[1] Due to data constraints, this paper does not analyze the impact on non-income poverty.
[2] The household survey data was collected using grant assistance from GIZ (then GTZ) (GTZ No. BMZ PN 2006.2138.3) under this project.
[3] Although the author initially planned to evaluate two JICA-funded rural road projects similar to the RIIP, it was not possible due to insufficient data. LGED, GIZ (then-GTZ) and ADB allowed the author to use the RIIP data.

average lead to income growth, but identifies in turn some negative impacts on the income of marginal and poorer groups.

The rest of this paper is organized as follows: Section 2 reviews existing literature related to rural infrastructure; Section 3 explains the project, data and summary statistics; Section 4 presents the analytical framework; Section 5 presents the study results; and Section 6 presents a discussion and the conclusion.

2. Literature review

Studies of the impact of infrastructure projects on income growth and distribution based on households or community level data are ubiquitous, although the word "inclusive growth" has not been explicitly used in many of them (Ahmed and Hossain 1990; Lokshin and Yemtsov 2005; Khandker et al. 2009, Khandker and Koolwal 2011). While most of the evaluation related literature has identified positive impacts from rural infrastructure on income growth (Khandker et al. 2009), a few studies have reported vague impacts, mainly due to lack of baseline data, limited control group data, and/or smaller sample sizes. Regarding distributional effects, while a number of studies assert that the poor benefit more proportionally from these projects (Lokshin and Yemtsov 2005), a few have pointed out the increasing inequality deriving from rural infrastructural projects (ADB et al. 2005; Hettiage 2006).[4]

Generally, the evaluation literature on rural roads faces serious data constraints. Only a limited number of studies have had the luxury of being able to use a large panel data set at the household and/or community level. In the past, in the absence of baseline data, the propensity score matching (PSM) method was used to generate a good control group (Escobal and Ponce 2004; Ahmed and Hossain 1990), or reliance was placed on retrospective questionnaire surveys to

[4] ADB et al. (2005) and Hettiage (2006) have data constraints. The former had difficulties in finding good control group data in case studies, while Hettiage (2006) used one-time cross sectional data and did not use a robust econometrics method.

create panel data (Lokshin and Yemtsov 2005). Recently, panel data including both the household and community level have been more frequently used to evaluate the impact of rural infrastructure on economic growth (Jalan and Ravallion 2002; Hossain and Byes 2009; Khandker et al. 2009; Khandker and Koolwal 2011).

Regarding theoretical models, some studies employed theoretical models to investigate structures from which project outcomes might be derived. Sawada et al. (2006) extended Paxon's model on changes in seasonal expenditure, to analyze poverty dynamics. Jalan and Ravallion (2002) used the Ramsey model to detect geographical capital. Most of these studies relied on conceptual frameworks, and therefore simply estimated the reduced form equations.

Evaluation of the impacts of rural infrastructure on studies have often applied PSM, the instrumental variable (IV) method, the difference-in-difference (DID) method using panel data, or a combination of two or three of these methods. These methods are applied mainly to eliminate observed and unobserved biases, and address the problem of data constraints. In order to obtain a good control group, PSM is frequently used before IV and DID. When panel data is available for several years, the dynamic panel data method has also been used by a number of studies (Sawada et al 2006; Khandker and Koolwal 2011; Jalan and Ravallion 2002). Jacoby and Minten (2008) measured willingness-to-pay for transport investment using one-time cross sectional data.[5] The comparison of the coefficients of the poor and non-poor group based on their participation in a program is also a widely used method to investigate the distributional impacts of rural infrastructure (Lokshin and Yemtsov 2005; Ahmed and Hossain 1990). Finally, the quantile regression analysis is another popular method to measure the distributional impacts of rural infrastructure development programs (Khandker et al. 2009).

The present study is similar to those carried out by Khandker et al. (2009) and Khandker and Koolwal (2011) in many aspects. Khandker et al. (2009) examined the impacts of two rural

[5] Jacoby and Minten (2008) attempted to develop a new methodology which is less costly because they considered that collection of panel data and experimental methods are generally expensive.

paved-road projects in Bangladesh using a household level panel fixed–effects model, controlling for initial area conditions, and accounting for potential bias in program placement at the village level. They found that rural road investments reduce poverty significantly through enhancing agricultural production, lowering input and transportation costs, and ensuring higher prices for agricultural output at local village markets. The increased income also contributed to higher secondary schooling enrollment for children in the sampled villages. Regarding distributional impacts, using a quantile regression they found that road investments have also benefited the poor, meaning the gains are significant for the poor, and in some cases disproportionately higher than for the non-poor.

Khandker and Koolwal (2011) examined the long-term impact of rural road through a dynamic panel model, using three-year household level panel data in addition to the data used by Khandker et al. (2009). Khandker and Koolwal (2011) confirmed the substantial short-term effects of roads on economic and non-income aspects, but found that some of the effects attenuated over time. Regarding distributional impacts, the latter paper also found opposite results, i.e., that the very poor have failed to sustainably gain from the short-term benefits of roads, and yet those that have accrued to middle-income groups have continued to strengthen over time. They argued that these new results are more reliable because of the larger sample size used.

Although the findings and methodologies of Khandker et al. (2009) and Khandker and Koolwal (2011) are quite comprehensive and sophisticated, it is still worthwhile to further investigate the distributional impact of rural roads by using data from a different project implemented in other parts of Bangladesh.

3. The project, the data, and summary statistics

3.1 The project

This paper analyzes the impact of a rural roads upgrading project in the 16 districts of the Khulna and Barisal Divisions, located in the southern coastal area of Bangladesh. The project area was selected because these two divisions belong to the poorer areas of Bangladesh due to limited connections to the other parts of the country.[6] The project included the construction/upgrading of 1,226km of roads in 98 sub-districts; the construction of 7,624m of bridges and culverts; tree plantation and maintenance on 900km of roads; the improvement of local 68 markets; the improvement of 89 boat landing jetties (*ghats*), and the construction of three small ferry terminals (GITEC 2009).[7] The project also invested in the construction of local 100 administration authority buildings. The project was approved by ADB in December 2002, and implementation started in July 2003. The project was completed in March 2010 (Appendix 1: Map of the project area).

The main component was the construction/upgrading (i.e., asphalting) of rural roads which used to be gravel, or poorly paved in some parts by bricks, thus significantly improving transport conditions. Other investments were complementary to the road pavement, and involved improving accessibility and providing commercial opportunities in local markets. In addition, intervention for poverty reduction occurred, particularly for women, including the employment of destitute women for road maintenance, the provision of shop spaces for female entrepreneurs, and training for income generation.

3.2 The data

The baseline and terminal surveys were conducted from July to September 2004 and from June to October 2008 respectively, meaning that both were conducted in the same season. This study uses data from 14 project roads[8] (4 in Barisal Division and 10 in Khulna Division), and 7 control roads[9] (3 in Barisal Division and 4 in Khulna Division). The physiographic characteristics of the project area

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[6] According to the poverty headcount ratio in 2010, following the poorest Rangpur Division, Barisal Division is the second poorest and Khulna Division the third, among 7 Divisions (BBS 2011, 62-63).

[7] GITEC 2009 is the terminal evaluation report of the RIIP. The evaluation methodology was basically the comparison of mean values of outcome indicators between the project and control groups.

[8] "Project roads" means constructed or upgraded roads. In the evaluation literature, they may be identified as treatment roads or treatment groups.

[9] They were selected because there is no plan for road pavement during the project period. But, one of the roads included in the baseline survey was paved through the Bangladeshi government's own funds. So there is not much difference between the project and control roads.

(highland, medium-highland, and low-lying/coastal-belt) were reflected in the selection of surveyed roads (GITEC 2009). There were two concerns on the selection of control roads: first, a few of the control roads are geographically close or parallel to certain project roads[10], and second, one of the control roads was heavily used for relief operations after Tropical Cyclone Sidr of November 2007 (GITEC 2009). These situations might have affected household behavior and traffic volumes along that control road.[11]

The household surveys covered all of the road length and villages/part-villages along the road, within a strip of 1/2kms on either side of the road. The respondents living on both sides of the selected roads were identified using a systematic sampling method in a way that the entire road length and both sides of a road were covered, and that a sample of 5-6% of the total number of households, with a maximum of around 200 households was obtained (GITEC 2009). Therefore, the structure of the sample households was very close to that of the population size of the sampled areas. One problem was the sample attrition from the baseline survey. About 15% of households of the baseline survey were not included in the terminal survey due to attrition. The rate of attrition was particularly high along the along the control road hit by Cyclone Sidr. By contrast, there was no significant difference in sample attrition rates between the project and control roads, except for the road hit by the cyclone.[12]

After compromising in regard to the attrition problem, the present study obtained information from 3,279 sample households in the baseline and terminal surveys,[13] including the households alongside the control roads hit by the cyclone. There were concerns on the selection of the control

[10] One of the strengths is that control roads share geographical and socio-economic similarities with project roads.

[11] The negative impact of the cyclone on the surveyed households appeared to be very limited and concentrated. The terminal survey included a question as to whether households were affected by Cyclone Sidr: 266 households (8.1%) out of the total 3,279 households answered “affected”. These affected families were concentrated along one road (129 households), and another 5 roads.

[12] Generally, poor households are more mobile than wealthier ones because the poor have fewer fixed assets.

[13] The baseline survey covered 3,895 households, whereas the terminal survey covered 3,894 households including those were not in the baseline survey. The sample attrition rate was approximately 16% from the baseline survey.

roads and the sample attrition of households, so particular attention was given to these problems during our econometric analyses[14] and interpretation.

3.3 Summary statistics

Table 1 gives a range of summary statistics relating to the outcome variables and explanatory variables. First, the average household income per person before the project was 1,065 Taka for the project group and 1,083 Taka for the control group; and it increased to 1,950 Taka and 1,437 Taka after the project, respectively (the net increase by project was 532 Taka, about 50% increase before the project).[15] The difference in mean of average household income per person before and after the project is statistically significant. While the indicators related to income and assets in both the project and control groups changed, the increases were larger in the project group, which suggests a positive impact from the project on the "pace" of economic growth. Second, regarding the income distributional issue, the Gini coefficient changed from 0.313 to 0.377 (+0.064) in the project group, and 0.294 to 0.385 (+0.091) in the control group. The income inequality of the project group was less affected than that of the control group.

[14] In the econometric analysis, although a dummy variable was included for the 266 cyclone-affected families to ensure a robustness check for the impact of Cyclone Sidr, it was not statistically significant.

[15] The data of 2008 are indicated in 2004 prices in consideration of the inflation rate. 532 Taka = (1,950 - 1,065) - (1,436 - 1,083).

Table 1. Summary statistics (1)

Variables	Baseline (2004)				Terminal (2008)			
	Project		Control		Project		Control	
	Mean (2)	SD	Mean	SD	Mean	SD	Mean	SD
Monthly HH income per person (Taka) (3)	1,065.3	736.7	1,083.2	695.1	1,950.0 ***	1,530.6	1,436.5 ***	1,175.9
Non-agriculture HH asset per person (Taka) (3)	4,869.6 **	10,859.1	4,018.5 **	7,139.2	5,920.4 ***	9,176.5	4,453.8 ***	7,979.5
Food self-sufficiency (FSS)								
3 month or less	22.5 %	–	20.8 %	–	13.0 %	–	52.0 %	–
up to 6 months	14.7 %	–	16.0 %	–	4.7 %	–	5.0 %	–
up to 9 months	13.3 %	–	17.4 %	–	12.2 %	–	10.8 %	–
upto one year	25.0 %	–	27.4 %	–	27.3 %	–	17.2 %	–
surplus	24.5 %	–	18.4 %	–	43.0 %	–	15.0 %	–
Age of household (HH) head (years old)	46.19 **	12.63	44.96 **	13.06	49.56 **	12.59	48.55 **	13.32
Percentage of male HH head	98.89 %	–	99.34 %	–	98.73 %	–	99.01 %	–
Number of hh members	5.27 **	1.99	5.45 **	2.10	5.09 ***	1.88	5.36 ***	1.95
Dependency ratio (%)	59.82	54.23	61.00	54.92	51.61 ***	48.79	59.12 ***	53.65
Share of adult in HH (%)	66.37	20.54	65.53	20.52	69.70 ***	19.83	67.27 ***	20.24
Share of male in HH (%)	54.29	15.47	53.98	15.91	54.66 *	14.82	53.69 *	15.05
Land holding size (LHS)								
LHS < 0.5 acre	36.9 %	–	37.0 %	–	28.0 %	–	40.6 %	–
0.5 <= LHS < 1.0 acre	19.5 %	–	18.5 %	–	21.8 %	–	19.7 %	–
1.0 <= LHS < 2.5 acre	25.2 %	–	25.5 %	–	27.6 %	–	21.6 %	–
2.5 <= LHS < 5.0 acre	11.2 %	–	11.7 %	–	14.1 %	–	10.7 %	–
LHS >= 5.0 acre	7.2 %	–	7.3 %	–	8.6 %	–	7.4 %	–
Occupation of HH								
Agriculture only	15.9 %	–	13.8 %	–	14.1 %	–	11.8 %	–
Non-agriculture Only	35.8 %	–	42.4 %	–	28.5 %	–	41.0 %	–
Agriculture plus non-agriculture	48.3 %	–	43.7 %	–	57.5 %	–	47.2 %	–
Education of HH head								
Illiterate	31.3 %	–	27.5 %	–	26.3 %	–	25.3 %	–
Primary school	25.5 %	–	29.8 %	–	26.4 %	–	32.0 %	–
Secondary school	25.4 %	–	28.4 %	–	29.8 %	–	30.0 %	–
Higher secondary school	12.9 %	–	11.2 %	–	12.6 %	–	9.7 %	–
Graduate or post-graduate	4.9 %	–	3.1 %	–	4.9 %	–	3.0 %	–
Gini coefficient	0.313	–	0.294	–	0.377	–	0.385	–
Total household sample	2,371	–	908	–	2,371	–	908	–
Khulna Div.	1,723	–	534	–	1,723	–	534	–
Barisal Div.	638	–	374	–	638	–	374	–

Notes:
(1) *** p<0.01, ** p<0.05, * p<0.1
(2) mean value if not indicated otherwise
(3) Figures of 2008 are in 2004 price.
(4) Peason chi-squared test

Food self-sufficiency in 2004	Peason chi-squared (4) = 16.87***
Food self-sufficiency in 2008	Peason chi-squared (4) = 595.03***
Land holding size in 2004	Peason chi-squared (4) = 0.5773
Land holding size in 2008	Peason chi-squared (4) = 50.75***
Occupation of HH in 2004	Peason chi-squared (4) = 12.27***
Occupation of HH in 2008	Peason chi-squared (4) = 47.11***
Education of HH head in 2004	Peason chi-squared (4) = 12.65**
Education of HH head in 2008	Peason chi-squared (4) = 14.09***

Source: Author's calculation from RIIP household surveys

To check the exogeneity of the project impact on the project group, a balancing test was conducted by examining the statistical significance of difference of mean values of key outcome and independent variables between the project and control groups at the base year 2004. As in Table 1, there are statistically significant differences in the indicators between the project and control groups before the project (2004). These were found in “non-agricultural household assets”, “age of household heads”, “number of household members”, “food self-sufficiency”, “occupation of household”, and “education of household heads”. The mean value of non-agricultural household assets per person in the project group was 4,869 Taka, which is higher by about 20% than that of the control group (4,018 Taka). The number of households sharing a food surplus was 24.5% compared with 18.4% in the control group. The household size of the project group (5.27 persons) was smaller than the project group (5.45 persons). The average age of household heads in the project group was more than one year older than the control group. Regarding household occupation, the share of “agriculture plus non-agriculture” in the project group was 48.3% compared with 43.7% in the control group. The distribution of household head education was also found to be different - the percentage of “illiterate” and “graduate and post-graduate” persons was a little higher in the project group.

In addition, differences were found in traffic volumes between the project and control groups (Table 2). Three indicators of 12-hour traffic counts (motorized, non-motorized and pedestrian) in the baseline survey (2004) were much higher for project roads than for control roads. For example, in 2004, the mean value of the “12-hour traffic count of motorized vehicles” on the project roads was 370 units, while that of the control roads was 73 units. In 2008, the mean values of both roads increased, but 8 percentage points higher on the project roads, suggesting the project’s impact on growth.

The reason for this difference in 2004 may be found because the project roads were selected purposively in consideration of higher expected benefits from the project design, and that control roads were selected due to the high probability that they would not be included under any/or other development project in the near future. While the sample selection in the baseline survey appears to have been carefully done, a difference in household characteristics could not be completely avoided. Therefore, the project impact will be overestimated, unless selection bias in the project and control roads is controlled for.

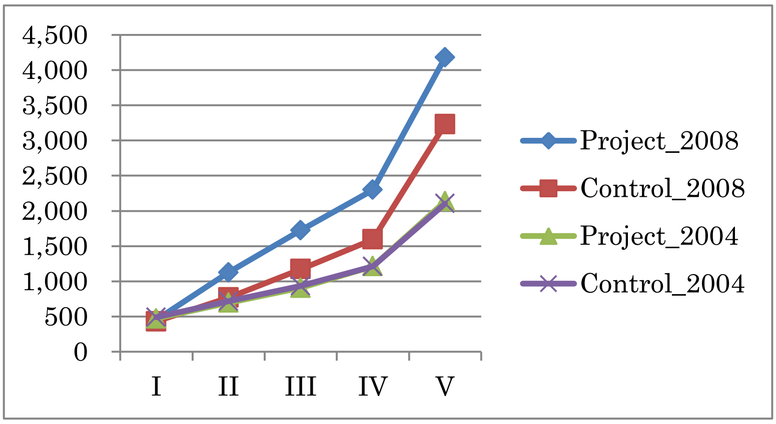
Table 2. Summary statistics (2)

Variable	Baseline (2004)			Terminal (2008)			
	Project	Control		Project		Control	
	Mean	Mean	% of Project (1)	Mean	Increase (%) (2)	Mean	Increase (%)(2)
No of project / control roads (#)	14.00	7.00	N/A	14.00	N/A	7.00	N/A
12 hours traffic count of motorized vehicle (#)	370.36	73.84	20%	749.79	102%	143.12	94%
12 hours traffic count of non-motorized vehicle (#)	1,517.81	435.19	29%	3,004.24	98%	713.57	64%
12 hours traffic count of pedestrians (#)	909.72	226.14	25%	3,159.40	247%	771.27	241%
No of roadside shops per road length (#)	4.95	5.54	112%	18.71	278%	9.77	76%
No of employees (roadside shops) per road length (#/km)	3.73	4.69	126%	28.53	665%	14.55	210%
No of educational institutions per road length (#/km)	0.82	0.93	114%	1.20	47%	1.29	38%
No of student enrollment per road length (#/km)	222.91	262.65	118%	332.11	49%	344.18	31%
No of student attendance per road length (#/km)	188.24	218.16	116%	304.75	62%	314.07	44%
No of students dropped out per road length (#/km)	9.90	11.50	116%	12.29	24%	12.83	12%
No of teachers per road length (#/km)	6.73	7.56	112%	9.98	48%	10.26	36%
No of Industries per road length (#/km)	0.64	0.68	105%	1.37	114%	1.18	74%
No of employees (industries) per road length (#/km)	5.13	2.76	54%	10.45	104%	4.68	70%
No of service center per road length (#/km)	0.15	0.17	118%	1.02	594%	0.70	302%
No of weekly patients per road length (#/km)	55.56	35.88	65%	201.07	262%	95.84	167%
No of depositors per road length (#/km)	69.55	79.51	114%	615.83	786%	569.84	617%
No of borrowers per road length (#/km)	40.03	19.37	48%	390.49	876%	362.34	1770%
No of market per road length (#/km)	0.27	0.24	88%	0.34	27%	0.30	26%
No of permanent shops per road length (#/km)	32.03	47.34	148%	86.74	171%	85.00	80%
No of market employees per road length (#/km)	23.51	19.92	85%	62.03	164%	54.45	173%
No of visitors to markets per road length (#/km)	1,070.95	1,544.10	144%	2,704.79	153%	3,157.56	104%
No of transport operator per road length (#/km)	4.38	5.54	126%	39.77	807%	26.27	374%

Note: (1) Percentage of mean of the project roads;
(2) Percantage increase from the baseline survey
Source: Author's calculation from RIIP traffic and other surveys

Further on the income distribution aspect, Figure 1 shows the change of monthly household income per person in the project and control groups by five income quantiles. Before the project (2004), income in the five quantiles is almost identical between the two groups. In 2008, while income in the lowest quantile of the project and control groups did not change from that of 2004, income in the higher four quantiles increased. In addition, the income of the four quantiles of the project group increased more than that of the control group. The increase of the II, III and IV quantiles was around 44% to 47% more than those of the control group; and the highest quantile was higher by 29% than the control group (Table 3). The percentage change in income shows that middle income groups benefitted more from the project, as found in earlier literature.

Figure 1. Change of Income Distribution (average household monthly income per person)



Source: Made by the Author from RIIP household surveys

Table 3. Household monthly income per person by income quantile

	Project_2008	Control_2008	Project_2004	Control_2004	Project (2004 to 2008)	Control (2004 to 2008)	Projct-Control (2008)
I	456	432	472	491	-3.4%	-11.9%	5.5%
II	1,126	769	697	718	61.6%	7.1%	46.4%
III	1,725	1,173	908	936	89.9%	25.3%	47.0%
IV	2,298	1,595	1,214	1,212	89.3%	31.7%	44.1%
V	4,177	3,230	2,136	2,104	95.6%	53.5%	29.3%
Total	1,950	1,436	1,065	1,083	83.0%	32.6%	35.7%

Source: Author's calculation from RIIP household surveys

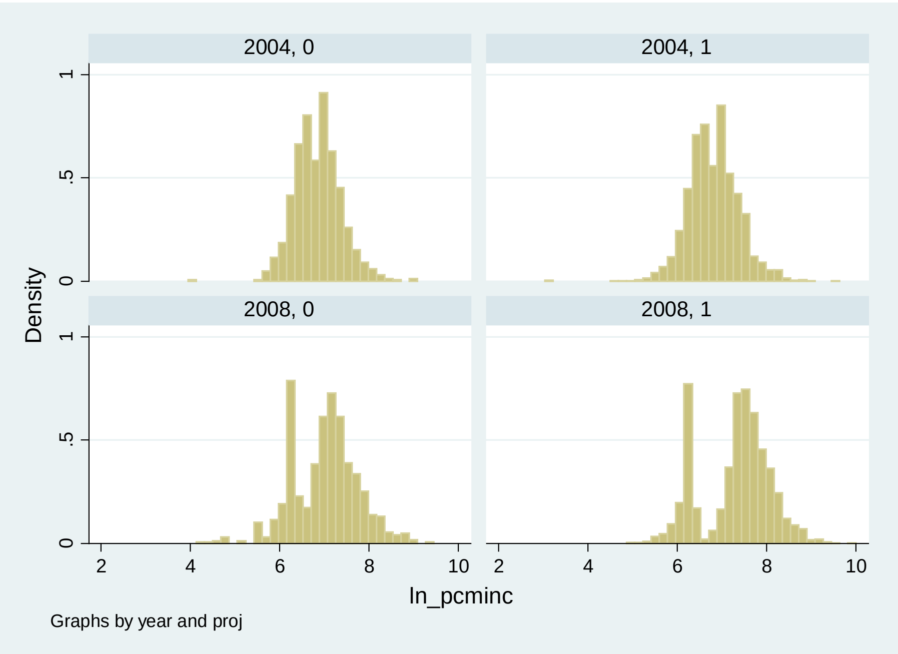
Figure 2 indicates the log-distributions of households by monthly household income per person before/after the project, and with/without projects. We can find the following through a comparison of the four situations:

- A tendency towards a bimodal dispersion of income distribution was observed in both project and control households;
- Rural infrastructure investment appears to have accelerated this dispersion, and the bimodal pattern is more apparent in 2008 (control-2008 vs. project-2008);
- Among the project households, those whose "log (monthly household income per person)"

was more than approximately 6.5 to 7 in 2004 shifted to a higher income level in 2008. Thus, the poorest segment of the project group in 2004 is in almost the same situation in 2008 (project-2004 vs. project-2008).

Using an econometric approach, this paper places emphasis on investigating the observed changes of income distribution patterns between households located in project areas and those households in the control group.

Figure 2. Change of Income Distribution (average household monthly income per person)



Note: 1= project group households; 0= control group households.
Source: Author's calculation from RIIP household surveys.

4. Analytical framework

Taking the opportunity of the availability of a large household panel dataset of the RIIP, the difference-in-difference (DID) method is used to analyze the impact of rural infrastructure projects in Bangladesh. The basic specification of the econometric model is as follows:

$$y_{it} = \alpha_0 + \beta_0 y08_t + \alpha_1 proj_i + \beta_1 y08_t \cdot proj_i \cdot compt_i$$
$$+ (\gamma_1 x_{it1} + \gamma_2 x_{it2} + \cdots + \gamma_k x_{itk})\, y08_t \cdot proj_i \cdot compt_i$$
$$+ (\delta_1 x_{it1} + \delta_2 x_{it2} + \cdots + \delta_m x_{itm}) + u_{it}, \quad t=1,2 \qquad (4.1)$$

Where: y_{it} is an outcome variable of i[th] household in year t; $y08_t$ is a year dummy (0 in 2004 and 1 in 2008); $proj_i$ is a project road dummy (0 for control roads, and 1 for project roads); $compt_i$ is a time factor to allow the consideration of differences in the timing of the completion of individual project roads; $x_{it1}, x_{it2,\ldots} x_{itk,\ldots} x_{itm}$ denote factors controlling for differences in household, road and division characteristics; and u_{it} is an error term.

There are two distinct characteristics in the specification. First, it includes an interaction term β_1 and $y08_t \cdot proj_i \cdot compt_i$, instead of β_1 and $y08_t \cdot proj_i$. The terminal survey was conducted in June to October 2008, the actual completion dates of the 14 project roads ranged from eleven (11) to thirty-seven (37) months before the terminal survey date. Therefore, it is reasonable to include a time factor to adjust for time differences in the completion dates.[17] This is a difference from Khandker et al. (2009), who did not explicitly consider the difference in timing of the completion of individual roads. Since $y08_t = proj_i = 1$ for the project roads after the project completion, and time differences in the completion dates are adjusted, $\hat{\beta}_1$ is interpreted as the average <u>yearly</u> impact of the road improvement project.

Second, it includes the interaction term, $(\gamma_1 x_{it1} + \gamma_2 x_{it2} + \cdots + \gamma_k x_{itk})\, y08_t \cdot proj_i \cdot compt_i$, where $x_{itk \ldots}\, x_{itk}$ indicating household characteristics are applied. This aims to measure differences in project impact according to household characteristics. In general, the randomization method can measure the average treatment effect (ATE), but cannot measure the heterogeneous impact of projects according to household characteristics. In the above specification, by rearranging the equation (4.1), the impact of the road improvement is $\hat{\beta}_1 + \sum \hat{\gamma}_k x_{i2k}$ for i[th] household.

[17] The value of $compt_i$ for the project roads after the project completion ranges from 11/12 (=0.917) to 37/12 (=3.083).

For each outcome variable, we built the following regression models for robustness checks of the project impact:

(A) Pooled OLS models, and panel fixed-effect (FE) models, having control variables;

(B) Pooled OLS models, and panel FE models, having both control variables and interaction terms.

While the former measures the ATE, controlling for household and road characteristics, the latter investigates the differences in project impact due to different household characteristics. In order to control for different initial conditions as in the summary statistics, the variables "No. of 12-hour traffic count of motorized vehicle" and "No. of permanent shops per road length" were included.

For the further estimation of the differences in project impact, the households were separated into two groups, in consideration of the shape of the histogram of the monthly household income per person in 2008 (Figure 1). The "lower income households" are those households whose log of the monthly household income per person in 2008 is less than 6.7; and the "higher income households" are otherwise. From this analysis, the reasons why a significant number of the surveyed households even along the project roads remain as poor can be determined through a comparison of the summary statistics of the two types of households in the project group.

5. Estimation results

5.1 Impact on the monthly household income per person

Table 4 presents estimated functions explaining impacts on monthly household income per person. The outcome variable is the log of monthly household income per person, *log (pcminc)*. The explanatory variables of our primary interest are highlighted. Model (1) is a pooled OLS with control variables but with no interaction terms; and Model (3) is its panel FE version. Model (4) is a panel FE model including two initial area conditions. In these three models, the coefficient $\hat{\beta}_1$ is the ATE of the project. In Models (1), (3) and (4), the coefficient $\hat{\beta}_1$ is positive and statistically significant, showing the positive project impact on per capita monthly income. The coefficient $\hat{\beta}_1$ in Model (3) is 0.146, indicating that the ATE is 14.6% more on monthly household income per person, while that of Model (1) is 0.0876. The monthly household income per person is thus higher by 8.76%. In Model (4), $\hat{\beta}_1$ is 0.179, which is the highest among the three models. In this analysis, it is more appropriate to use a panel fixed model, the ATE is approximately 15%. Overall, the findings in Table 4 confirm that the impact of rural road improvements on per capita monthly income of the household range between 8% at the lowest to 17% at the highest, which is a positive effect.

The sign and statistical significance of the control variables are basically in line with our initial intuitive reactions. The coefficients of explanatory variables, which do not change over time very much (household head's age, and household head's education level), are not statistically significant in panel FE models (3) and (4), though they are statistically significant in the pooled OLS model (1). The coefficient of household size is negative and statistically significant; i.e., the more household members, the less income per capita. The coefficients of dummy variables of household occupation and land holding size are positive and statistically significant. The per capita income of households whose occupation is in non-agriculture only, or in agriculture plus non-agriculture, are higher than those households whose occupation is only in agriculture.[18] Also, land holding size matters in determining household per capita income. Looking at the coefficient of each land holding size dummy, we can see that the larger the land holding size, the higher is household income per person. These observations are similar across the estimated functions in (2), (5) and (6) in Table 4.

Next, we look at the results of Models (2), (5) and (6) which include the interaction terms between households' characteristics and $y08_t \cdot proj_i \cdot compt_i$. Model (6) includes initial area conditions in addition to the variables in Model (5). The coefficient $\hat{\beta}_1$ is not statistically significant in the three

[18] This may need additional explanation. In 2008, the average income per person of all households in "non-agriculture" occupation (1,401 Taka) is lower than that of all households in "agriculture-only" occupation (1,668 Taka). 80% (= 835 out of 1,043 households) of households in "non-agriculture" occupation own marginal land area or landless (land holding size < 0.5 acres), and their average income per person is 1,230 Taka, dragging down the average income per person of all households in "non-agriculture" occupation. It is considered that since land holding size dummy variables are included in estimation, the coefficients of households in "non-agriculture" occupation are positive in the models.

models. However, there are statistically significant coefficients of the interaction terms between $y08_t \cdot proj_i \cdot compt_i$ and the following variables in the panel FE models (5) and (6):

(A) Household population size: the coefficient is negative, i.e., approximately -0.008 in (5) and (6);

(B) Land holding size dummies: the coefficients are positive. The coefficients increase as the land holding size is larger, up to the land holding size in the fourth rank (2.5 acres ≤ land_h_size < 5.0 acres); but the coefficient slightly decreases from the fourth rank to the fifth (land_h_size > 5.0 acres). In Model (6), the coefficients are 0.117 → 0.136 → 0.112, according to the rank of land holding size in comparison to the base case (land holding size < 0.5 acres). The same is found in Model (5);

(C) Household head's age: the coefficient is positive, i.e., approximately 0.002 in both Models (5) and (6).

Finally, we show the net impact of the project on per capita income in the panel FE model with initial area conditions (6), because the computation of the net impact is somehow complicated when interaction terms are included in the equation. First, it is important to note that the coefficient $\hat{\beta}_1$ is not statistically significant in this model; and that only some interaction terms with household characteristics are statistically significant. For example, when the land holding size is in the fourth rank (2.5 acres ≤ land_h_size < 5.0 acres), the net yearly impact for this household is (-0.00849*hhsize* + 0.136*land_holdingize_dum4* + 0.00226*head_age*). More concretely, when *hhsize*=5, *land_holdingize_dum4*=1, *and head_age*=50, the impact is 20.6%. It is important that the net project impact varies by households according to their actual characteristics. This is precisely why the interaction terms are included in the model. This result is consistent with Jacoby's argument that landowners are the main beneficiaries of road improvements (Jacoby 2000).

Table 4. Impact on monthly household income per person (all households)

VARIABLES	(1) OLS log(pcminc)	(2) OLS log(pcminc)	(3) Panel FE log(pcminc)	(4) Panel FE with initial conditions log(pcminc)	(5) Panel FE log(pcminc)	(6) Panel FE with initial conditions log(pcminc)
y08 (Y=1, N=0)	0.192***	0.203***	0.145***	0.246***	0.152***	0.248***
	(0.026)	(0.026)	(0.027)	(0.034)	(0.027)	(0.034)
proj (Y=1, N=0)	-0.0326*	(0.025)				
	(0.020)	(0.020)				
y08_proj_compt	0.0876***	0.013	0.146***	0.179***	0.075	0.081
	(0.013)	(0.084)	(0.012)	(0.013)	(0.079)	(0.079)
hhsize	-0.0933***	-0.0825***	-0.0959***	-0.0961***	-0.0871***	-0.0871***
	(0.005)	(0.005)	(0.009)	(0.009)	(0.010)	(0.010)
hhsize * y08_proj_compt		-0.0135***			-0.00842*	-0.00849*
		(0.004)			(0.004)	(0.004)
hh_occup dum2	0.321***	0.320***	0.213***	0.205***	0.192***	0.185***
(Non-agri only=1, otherwise (OW) =0)	(0.031)	(0.033)	(0.044)	(0.044)	(0.047)	(0.047)
hh_occup dum3	0.382***	0.365***	0.278***	0.286***	0.257***	0.262***
(Agri+ non-agri=1, OW =0)	(0.023)	(0.027)	(0.034)	(0.034)	(0.038)	(0.038)
hh_occup dum2 * y08_proj_compt		-0.007			0.030	0.029
		(0.031)			(0.035)	(0.035)
hh_occup dum3 * y08_proj_compt		0.017			0.022	0.024
		(0.021)			(0.024)	(0.023)
land_h_size dum2	0.142***	0.144***	0.100***	0.0883***	0.0992***	0.0902**
(0.5 to 1.0 acre=1, OW=0)	(0.028)	(0.028)	(0.034)	(0.033)	(0.038)	(0.038)
land_h_size dum3	0.309***	0.259***	0.209***	0.201***	0.135***	0.132***
(1.0 to 2.5 acre=1, OW=0)	(0.027)	(0.028)	(0.044)	(0.043)	(0.046)	(0.045)
land_h_size dum4	0.563***	0.479***	0.397***	0.384***	0.280***	0.272***
(2.5 to 5.0 acre=1, OW=0)	(0.033)	(0.035)	(0.052)	(0.051)	(0.056)	(0.055)
land_h_size dum4	0.917***	0.852***	0.571***	0.563***	0.482***	0.476***
(More than 5.0 acre=1, OW=0)	(0.040)	(0.044)	(0.066)	(0.064)	(0.070)	(0.068)
land_h_size dum2 * y08_proj_compt		0.001			0.045	0.041
		(0.029)			(0.031)	(0.031)
land_h_size dum3 * y08_proj_compt		0.0615**			0.125***	0.117***
		(0.028)			(0.032)	(0.031)
land_h_size dum4 * y08_proj_compt		0.0910***			0.141***	0.136***
		(0.031)			(0.034)	(0.033)
land_h_size dum5 * y08_proj_compt		0.0811**			0.113***	0.112***
		(0.036)			(0.037)	(0.037)
head_sex (male=1, female=0)	-0.144	-0.112	0.086	0.096	0.189	0.181
	(0.089)	(0.104)	(0.179)	(0.173)	(0.197)	(0.188)
head_sex * y08_proj_compt		-0.029			-0.087	-0.066
		(0.073)			(0.067)	(0.067)
head_age (year)	0.00750***	0.00550***	0.001	0.001	0.000	0.000
	(0.001)	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)
head_age * y08_proj_compt		0.00251***			0.00205***	0.00226***
		(0.001)			(0.001)	(0.001)
head_educ dum2	0.0789***	0.0829***	-0.005	-0.005	-0.003	-0.002
(Primary=1, OW=0)	(0.021)	(0.021)	(0.069)	(0.068)	(0.067)	(0.067)
head_educ dum3	0.152***	0.154***	0.020	0.032	0.006	0.019
(Secondary=1, OW=0)	(0.021)	(0.021)	(0.075)	(0.075)	(0.075)	(0.075)
head_educ dum4	0.318***	0.319***	0.086	0.090	0.078	0.084
(Higher secondary=1, OW=0)	(0.028)	(0.028)	(0.093)	(0.092)	(0.093)	(0.092)
head_educ dum5	0.417***	0.423***	0.186	0.193	0.210	0.218
(Graduate/post graduate=1, OW=0)	(0.042)	(0.042)	(0.161)	(0.158)	(0.158)	(0.155)
div (Khulna=1, Barisal=0)	-0.0407**	-0.0365**				
	(0.018)	(0.018)				
No. of 12 hour motorized traffic				-0.00536***		-0.00535***
(in year 2004)				(0.001)		(0.001)
No. of permanent road side shops				-0.00779**		-0.00676**
(in year 2004)				(0.003)		(0.003)
Constant	6.536***	6.564***	6.830***	6.832***	6.782***	6.806***
	(0.101)	(0.116)	(0.236)	(0.232)	(0.252)	(0.245)
Observations	5,195	5,195	5,195	5,195	5,195	5,195
R-squared	0.345	0.354	0.377	0.388	0.394	0.405
Number of hhcode			2,816	2,816	2,816	2,816

Note: Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Source: Author's calculation from RIIP household surveys

5.2 Comparison of the project impact between the higher-income group in 2008 and the lower-income group in 2008

In this analysis the following two groups were set up: the higher income households in 2008 and the lower income households in 2008. The objective was to investigate reasons for the two-peak shape of the histogram of per capita income in 2008 (Figure 2). Table 6 compares the higher and lower income households of the project group, and shows that they are different in the following two aspects: (i) their characteristics before the project, and (ii) their income generation between the baseline and terminal surveys.

Before the project, the lower-income households were inferior to the higher income households in the outcome indicators of monthly income, no-agriculture assets, and food self-sufficiency. The characteristic lower income households were also disadvantaged in many ways when trying to improve their livelihood: a higher dependency ratio (75.7%), a smaller share of males in total household members (50.7%), smaller land holdings (53.3% less than 0.5 acre, or landless), a higher share of the population in non-agriculture occupations (46.6%) whose average income is lower than other occupation categories, and a lower education level of household heads (40.3% of illiterate household heads).

Table 5. Summary statistics of higher and lower income households in the project group

Variables	Baseline (2004)				Terminal (2008)			
	Higher income		Lower income		Higher income		Lower income	
	Mean (2)	SD	Mean	SD	Mean	SD	Mean	SD
Monthly HH income per person (Taka) (3)	1,160.5 ***	790.6	779.3 ***	423.0	2,437.1 ***	1457.7	495.3 ***	98.7
Non-agriculture HH asset per person (Taka) (3)	5,506.9 ***	12,284.9	2,939.2 ***	3,570.2	6,747.8 ***	10074.9	3,392.2 ***	4,812.4
Food self-sufficiency (FSS)								
3 month or less	19.6 %	–	32.9 %	–	9.8 %	–	22.6 %	–
up to 6 months	13.9 %	–	17.5 %	–	2.3 %	–	12.0 %	–
up to 9 months	13.1 %	–	14.1 %	–	9.1 %	–	21.4 %	–
upto one year	25.9 %	–	21.4 %	–	27.4 %	–	27.0 %	–
surplus	27.4 %	–	14.1 %	–	51.5 %	–	17.1 %	–
Age of household (HH) head (years old)	47.48 ***	12.71	42.34 ***	11.50	50.82 ***	12.70	45.75 ***	11.44
Percentage of male HH head (%)	98.77		99.48		98.65		98.98	
Number of hh members	5.30	2.06	5.18	1.75	5.01 ***	1.91	5.34 ***	1.73
Dependency ratio (%)	54.64 ***	52.17	75.75 ***	57.26	44.76 ***	44.45	72.37 ***	55.10
Share of adult in HH (%)	68.28 ***	20.54	60.61 ***	19.46	72.74 ***	19.35	60.55 ***	18.46
Share of male in HH (%)	55.46 ***	15.21	50.70 ***	15.71	55.81 ***	14.24	51.19 ***	15.98
Land holding size (LHS)								
LHS < 0.5 acre	31.5 %	–	53.3 %	–	19.1 %	–	55.0 %	–
0.5 <= LHS < 1.0 acre	19.3 %	–	20.5 %	–	20.8 %	–	24.9 %	–
1.0 <= LHS < 2.5 acre	27.5 %	–	18.0 %	–	32.2 %	–	13.6 %	–
2.5 <= LHS < 5.0 acre	12.9 %	–	6.2 %	–	17.4 %	–	4.3 %	–
LHS >= 5.0 acre	8.9 %	–	2.1 %	–	10.6 %	–	2.2 %	–
Occupation of HH								
Agriculture only	16.2 %	–	15.1 %	–	15.1 %	–	11.0 %	–
Non-agriculture Only	32.2 %	–	46.6 %	–	20.9 %	–	51.6 %	–
Agriculture plus non-agriculture	51.6 %	–	38.3 %	–	64.0 %	–	37.4 %	–
Education of HH head								
Illiterate	28.6 %	–	40.3 %	–	24.4 %	–	32.8 %	–
Primary school	24.6 %	–	28.6 %	–	24.7 %	–	32.1 %	–
Secondary school	26.0 %	–	23.3 %	–	31.1 %	–	25.4 %	–
Higher secondary school	14.7 %	–	6.9 %	–	14.3 %	–	7.0 %	–
Graduate or post-graduate	6.1 %	–	0.9 %	–	5.5 %	–	2.8 %	–
Gini coefficient	–	–	–	–	–	–	–	–
Total household sample	1,777	–	587	–	1,777	–	587	–
Khulna Div.	1,288	–	438	–	1,288	–	438	–
Barisal Div.	489	–	149	–	489	–	149	–

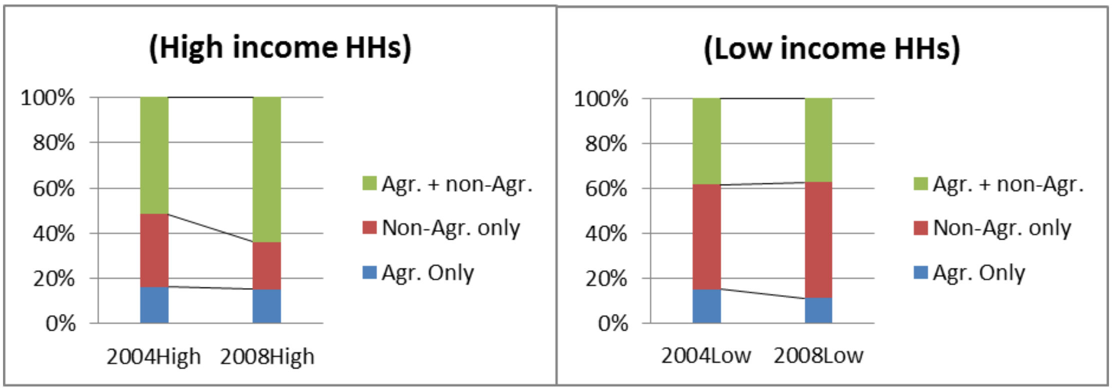
Notes:
(1) *** p<0.01, ** p<0.05, * p<0.1
(2) mean value if not indicated otherwise
(3) Figures of 2008 are in 2004 price.
(4) Peason chi-squared test

Food self-sufficiency in 2004	Peason chi-squared (4) = 53.92***
Food self-sufficiency in 2008	Peason chi-squared (4) = 319.80***
Land holding size in 2004	Peason chi-squared (4) = 118.00***
Land holding size in 2008	Peason chi-squared (4) = 352.30***
Occupation of HH in 2004	Peason chi-squared (4) = 41.42***
Occupation of HH in 2008	Peason chi-squared (4) = 205.30***
Education of HH head in 2004	Peason chi-squared (4) = 51.58***
Education of HH head in 2008	Peason chi-squared (4) = 38.66***

Source: Author's calculation from RIIP household surveys

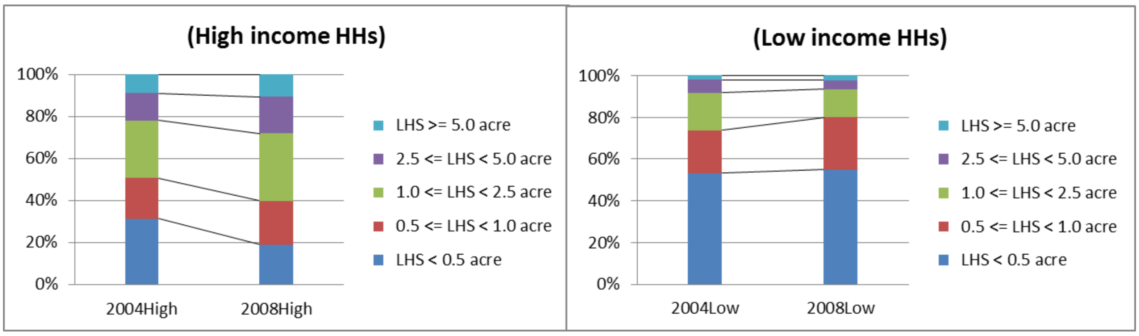
Between 2004 and 2008, the occupation of higher income households shifted from lower income occupations (non-agriculture only) to higher income occupations (agriculture plus non-agriculture), as in Figure 3. Monthly household income per person in 2008 was 2,083 Taka in "agriculture plus non-agriculture," 1,668 Taka in "agriculture only," and 1,401 Taka in "non-agriculture only." In the higher income households, the share of "agriculture plus non-agriculture" occupations increased from 51.6% to 64.0%, together with a reduced share of "non-agriculture only," from 32.2% to 20.9%. By way of contrast, in the lower-income households, the share of "non-agriculture only" occupation increased from 46.6% to 51.6%. This can be supported by data indicating that the higher-income households increased their land holding size, although the land holding size of the lower-income households was almost unchanged (Figure 4). The income of the higher-income group increased by having different occupations and by having more agricultural land, whereas the opposite happened in the lower-income households.

Figure 3. Household (HH) occupation (Higher income households vs. Lower income households)



Source: Author's calculation from RIIP household surveys

Figure 4. Land holding size (Higher income households vs. Lower income households)



Source: Author's calculation from RIIP household surveys

6. Discussion and conclusion

The concept of inclusive growth, which has increasingly been used in the international arena, is concerned with both pace and pattern of growth, based on income growth for both poor and non-poor, and on the reduction of non-income poverty and inequality. Developing countries and donors have often considered rural roads to have positive impact on the growth of the rural economy and poverty reduction through better connectivity. While there is a general consensus that rural infrastructure projects contribute to income growth, there is a mixed view of their impact on the income of marginal and the poorest groups. This study analyzed the impact of a rural road improvement project on inclusive growth in Bangladesh, using a DID method based on panel data from more than 3,200 households.

The results are summarized as follows: first, the road improvement project in Bangladesh had positive impacts on the income of rural households. On average, road improvements increase per capita income. Second, the results show the heterogeneity of project impacts based on household characteristics. In this analysis, wealthier households and/or households that have more land benefitted more from the road improvement project, as reflected in the changes in their monthly income. Third, the project worsened the income inequality of households, even though the increase in inequality was less in the project group than in the control group. The analysis also found that the initial characteristics of a household matters in determining whether they can take advantage of opportunities offered by the project.

Based on these findings, the answer to the research question depends on the population being considered.[19] At the national level, the project is inclusive because the net project impact was as much as approximately 50% of increase of average household income per person according to the summary statistics.[20] However, when the impact on individual households is analyzed, the impact of the rural road project was not inclusive in this case; in other words, it indeed improved the "pace" of economic growth, but not the pattern of growth. The poorest group mostly remained poor and income inequality did not improve (Figure 1). Nevertheless, lower income groups *except* the poorest benefitted from the project to some extent. The higher income households took advantage of opportunities provided by the road improvement, but the poorer households failed to accrue benefits due to their initial constraints. This result supports the findings of Khandker and Koolwal (2011), who stated that rural road projects have generally negative impacts on the poor, rather than those of Khandker et al. (2009).

It is worth noting that, during the project implementation period, the economic situation did not appear favorable to poor people. In rural Bangladesh, the Gini co-efficient of income slightly increased to 0.431 in 2010, from 0.428 in 2005 (BBS 2011, 30). Perhaps, the increase of the Gini coefficient of the project and control groups appears to be in line with the trends in Gini coefficients in the rural area of the country. During the project period, there were disasters which affected economic activities in the project area. One of the major ones was the two successive and severe floods in the same season in 2007 (MoEF 2008), and the other was Cyclone Sidr, one of the worst natural disasters to hit Bangladesh, that affected the project area in November 2007. Also, in Bangladesh food shortages were serious at this time, and the inflation rate was higher at around 10% in 2007-2008,

[19] For example, if rural incomes are much lower than urban incomes on average, then investing in rural areas can lower "national" inequality even if it increases rural inequality. The generalization of the conclusion to the national level therefore requires some caution.

[20] The growth rate of GDP per capita of Bangladesh from 2004 to 2008 was 22.5% (USD572.2 in 2004 to USD 701.2 in 2008).

amid rising international food prices. It may be that these factors affected the livelihood of the people, particularly, those of the vulnerable groups.[21]

In developing countries, rural road development projects are implemented with the expectation of increases in income in poorer areas, and a more equitable distribution of income among residents. Donors consider rural roads as a direct intervention for pro-poor or inclusive growth, because they are implemented in poverty stricken areas (van de Walle 2008). Therefore, donors have been providing support for the improvement of rural roads in Bangladesh. When trunk roads are constructed, rural roads are also constructed to spread their benefits to near-by areas. However, while it is indeed necessary to connect rural roads to the trunk road network, this is not sufficient by itself to boost the income of the poor and marginal groups as is suggested by the findings of this study.

A policy implication from this study is that it is necessary to design and implement complimentary interventions together with rural roads. One of the important findings is that the poor cannot take advantage of the opportunities offered by better access through road improvement due to their initially low physical and human capital endowments. Example of such wider interventions may include the upgrading of their initial conditions (asset, education, social safety nets, etc.), and support for other livelihood activities in order for them to move into the high income group.[22] In fact, it is as important to take time to change the initial conditions of poor communities as it is to provide them with better rural road access.

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[21] In fact, Cyclone Sidr hit one of the control road areas. In this road, many sample households in the baseline survey could not be identified in the terminal survey, perhaps because they had relocated their residence due to the cyclone.

[22] Rural road projects in Bangladesh include complimentary interventions, such as the allocation of small shop spaces for women in local markets, and road maintenance work employment opportunities for destitute women.

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Abstract (in Japanese)

要約

国際社会で近年よく用いられている「包摂的成長（Inclusive growth）」は、（経済）成長のペースとパターンの両方に関する概念である（貧困層・非貧困層両方の所得上昇、非所得貧困、不平等など）。開発途上国やドナーは、農村道路の整備は、交通の円滑化を通じ、農村経済や貧困削減にポジティブな効果を及ぼすと考えている。本論文では、農村道路改良プロジェクトが、バングラデシュの包摂的成長に及ぼすインパクトを分析した。

分析方法は、大規模な家計調査パネルデータに基づく Difference in Difference 手法を用いた。分析の結果、対象としたプロジェクトは、事業地域の平均家計所得(一人当たり)を大きく増加させ、国レベルで見た包摂的成長に寄与したとみられる。しかし、この所得増加は、最貧困層以外の家計の所得増加によるもので、これら家計が交通条件改善によって生ずる機会を所得向上につなげることができたことによると考えられる。他方、特に事業前の資源等賦存状況（土地所有、職業）が相対的に不利な家計は、プロジェクトの恩恵を受けなかった。分析対象プロジェクトの特有事情に留意を要するものの、農村道路改良プロジェクトは家計レベルでみると必ずしも包摂的であるとは言えない。

よって、政策的には、貧困農村地域での農村道路改良プロジェクトでは、道路改良だけでなく、最貧困層に対する資源賦存状況（人材育成、雇用機会等）の改善に資する政策的介入も合わせて実施することが必要である。

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