Assessing Ex-Ante Socioeconomic Impact of China Pakistan Economic Corridor (CPEC) Across the Zone of Influence

Manzil Pakistan is a Karachi based think tank dedicated to developing and advocating public policy that contributes to the growth and development of Pakistan.

Business Plaza, Suite 501Mumtaz Hassan Road Karachi 74000 Pakistan

Topic: Assessing Ex-Ante Socioeconomic Impact of China Pakistan Economic Corridor (CPEC) Across the Zone of Influence

Authors: Naheed Memon, Farkhanda Jabeen, and Fazal Rabbi

Abstract:
The development of the China Pakistan Economic Corridor (CPEC) can play an important role in the socioeconomic development of Pakistan. The proposed route will reduce travel time and transportation costs across the surrounding districts of the corridor, referred to as the Zone of Influence (ZOI). This study uses the Probit Model to simulate ex-ante socioeconomic impact in terms of access to education (attendance and enrollment) of school students, and health utilization (Lady Health Worker service) of households across the western route of ZOI districts, as a result of reduced travel time after the completion of the corridor. The study finds that a decrease in travel time would significantly increase enrollment and attendance of the school students (primary and middle school) and increase utilization of health services (Lady Health Worker service) across the districts. The study can aid in the formulation of education and health policies, which should focus on building schools and health units in districts with less average travel time, to increase access to education and utilization of health services by households.

Key Words: Socio-economic, Enrollment, Attendance, Health, Zone of influence

1. Introduction

The construction of corridors (a network of roads) helps in improving trade and economic connectivity of a region. It enhances regional economic and trade cooperation which contributes towards regional peace and stability. It also creates a welcoming environment for foreign investment and capital inflow. Therefore, infrastructural development offers a unique opportunity for a vast capital inflow. Road networks are an essential part of infrastructure development. Low travel times and unencumbered mobility complements improves socio-economic indicators in any given area.

In developing economies, road networks improve means of transportation which enhances socio-economic status such as community access to basic facilities like education, health, employment, and economic opportunity. Islam and Adiv (2009)[1] state that the rehabilitation of the Bamyan-Dushi road in Afghanistan has improved socio-economic conditions and benefited the population in the zone of influence (ZOI)[2].

Education and Health are closely related to travel time and mobility. Howard and Masset (2004)[3] argue that reduced time and convenient mobility improved enrolment rates in a developing country such as Ghana. Mattson (2011)[4] says that reduced time and convenient mobility increases access to the community for the utilization of health care and education facilities.

The China Pakistan Economic Corridor (CPEC) is a $46 billion project that will undertake the construction of industrial zones, highways, and railway links running through most of Pakistan starting from Gwadar in Balochistan and culminating in Kashgar in western China. This corridor is expected to be mutually beneficial for both countries (China and Pakistan). China would be able to use the shortest way to access the global market and it also gives a comparative advantage to the Chinese industry by significantly reducing transportation time and cost. On the other hand, Pakistan would gain economic and social uplift by triggering huge economic activity particularly in undeveloped areas like Balochistan. The Pakistan Government has proposed three routes: Eastern, Western, and Central route for the CPEC. In this study, we will only focus only on the western route. It is the shortest feasible route and passes through various districts of Baluchistan, Punjab, and Khyber Pakhtunkhwa (KPK). Bengali (2015)[5] claims that the western route is likely to be the most cost effective in term of dislocation compensation cost, opportunity cost of land, and environmental cost. The Zone of Influence in the Western route comprises of 11

---

[1] Islam, Mafizul, and Roni Adiv.2009. *Bamyan-Dushi Road Socio-Economic Baseline Study Final Report*. United States Agency for International Development.
[2] Zone of influence refers to the districts touched by the road network/highway.
[3] White, Howard, and Edoardo Masset. *Books, buildings, and learning outcomes: An impact evaluation of World Bank support to basic education in Ghana*. Washington, DC: World Bank, 2004.
[4] Mattson, Jeremy. "Transportation, distance, and health care utilization for older adults in rural and small urban areas." *Transportation Research Record: Journal of the Transportation Research Board* 2265 (2011): 192-199.
[5] Bengali, Kaiser, Ishaque Baloch, Badar-ud-din Khan, Mahmood Tareen, Mehnaz Hafeez, and Saeed Yousuf. 2015. *China-Pakistan Economic Corridor? The Route Controversy*. The Times Press.

districts such as Gwadar, Turbat, Panjgur, Khuzdar[6], Kalat, Quetta, Qila Saifullah, Zhob, Dera Ismail Khan, Mianwali, Attock, and onwards.

The government is anticipating a huge uplift in socio-economic conditions in the ZOI of the CPEC. Education and health are two core indicators of socio-economic conditions. CPEC is expected to reduce travel time for households to access education and health services. By simulating the impact through a Probit Model, the study identifies the potential uplift on enrollment, attendance, and access to lady health worker service[7]. It is predicted that travel time in the ZOIs would be the same as in the developed areas of the country.

1.1. Research Question

This research is governed mainly by the proposition that (CPEC) will improve the socio-economic conditions of the ZOI. In addition, we have two driving questions for this broader query. These are:

- What is the impact of reduced travel time and convenient mobility on enrollment and attendance across genders?
- What is the impact of reduced travel time and convenient mobility on utilization of health care facilities?

1.2. Objective of the Study

The study has three objectives. These are the following:

- To identify the impact of CPEC on health and education indicators
- To identify the impact of the western route of CPEC on attendance and enrolment across genders
- To identify community access to social services and basic facilities such as education and health

---

[6] Although Khuzdar lies in the central route but its linkage between central and western routes makes it an important district to study.

[7] Lady health worker is the program in underdeveloped areas where health worker reaches to the households. Given that a very small number of households, especially females, tend to visit health care units in the areas surrounding the ZOI, the main health care service likely to be improved as a result of reduction in travel time is availability of lady health workers to a greater number of households.

2. Literature Review

Research has shown a direct relation between investment in infrastructure and improved education indicators. Phyrum, Sothy, and Horn (2007)[8] argue that road improvements would enhance access to education, health care, markets, and other public service facilities in the surrounding areas of economic corridors. Vuri (2008)[9] writes that travel time has a significant impact on student enrolment in Ghana and Guatemala. Vuri's study claims that in Ghana if middle schools are built nearby, parents are more likely to invest in their children's primary and middle school education. However in Guatemala, parents' decision of their child's primary education relied more on school variables (travel cost and distance etc.) related to primary education. Filmer (2004)[10] estimates the impact of reducing average distance to schools on the enrollment of students in 21 rural areas in low-income countries using the Probit model. The study finds that statistically significant impact of distance to primary and secondary schools on the enrollment of 6-14 year olds, yet the magnitude of the effect is small. Jepsen and Montgomery (2009)[11] also find distance to the nearest college a very significant factor in college enrollment of students in the Greater Baltimore area in the United States, using the Probit model.
King and Lillard (1983)[12] argue that travel distance from schools negatively effects schooling in Philippines. Toor and Parveen (2004)[13] also analyze the determinants of female enrollment at the primary school level in Pakistan using the Probit model. Distance to school is one of the relevant variables affecting the probability of female enrollment.
Mattson (2010)[14] estimates the impact of transportation and distance factors on health care utilization in the rural Upper Great Plains states of North Dakota, South Dakota, Montana, and Wyoming using ordered and binary Probit models. Road networks and convenient mobility give easy access to health care services in case of emergency. Lubetzky et al (2011)[15] write that numbers of patients' visit to specialist-clinics are negatively correlated to the geographical distance to the clinics in Israel. Tanser, Gijsbertsen, and Herbset 2006)[16] argue that health facility usage has been significantly reduced by households with increased travel time in South Africa.

---

[8] Phyrum, Kov, Va Sothy, and Kheang Seang Horn. *Social and economic impacts of GMS Southern Economic Corridor on Cambodia*. Research and Learning Resource Center of the Mekong Institute, 2007.
[9] Vuri, Daniela. "The effect of availability and distance to school on children's time allocation in Ghana and Guatemala." *Understanding Children's Work Programme Working Paper* (2008).
[10] Filmer, Deon. "If you build it, will they come? School availability and school enrolment in 21 poor countries." *Journal of Development Studies* 43, no. 5 (2007): 901-928.
[11] Jepsen, Christopher, and Mark Montgomery. "Miles to go before I learn: The effect of travel distance on the mature person's choice of a community college." Journal of Urban Economics 65, no. 1 (2009): 64-73.
[12] King, Elizabeth M., and Lee A. Lillard. *Determinants of schooling attainment and enrollment rates in the Philippines*. Santa Monica, Calif.: Rand Corporation, 1983.
[13] Toor, Imran Ashraf, and Rizwana Parveen. "Factors influencing girls' primary enrolment in Pakistan." (2004).
[14] Mattson, Jeremy. "Transportation, distance, and health care utilization for older adults in rural and small urban areas." *Transportation Research Record: Journal of the Transportation Research Board* 2265 (2011): 192-199.
[15] Lubetzky, Hasia, Michael Friger, Lora Warshawsky-Livne, and Shifra Shvarts. "Distance and socioeconomic status as a health service predictor on the periphery in the southern region of Israel." *Health policy* 100, no. 2 (2011): 310-316.
[16] Tanser, Frank, Brice Gijsbertsen, and Kobus Herbst. "Modelling and understanding primary health care accessibility and utilization in rural South Africa: an exploration using a geographical information system." *Social Science & Medicine* 63, no. 3 (2006): 691-705.

3. Empirical Framework

3.1. Data

This paper uses household level data from Pakistan Social and Living Standard Measurement (PSLM) 2012-13 for the 11 districts falling under the Zone of Influence (ZOI) of the western route of CPEC. The dependent variables used to analyze the impact of travel time on education include attendance and enrollment of primary and middle school students overall as well as of male and female students, all taken as binary variables. Since data of these variables is collected from individuals of each household, these variables are redefined at household level. The households with half or more children enrolled and attending school, out of the total number of school-age children (4-14 years), are taken as 1 and 0 otherwise for the respective variables. Similarly, the observations for households with half or more of male/ female children enrolled and attending school, out of the total number of male/ female school-age children in each household, are taken as 1 and 0 otherwise for the respective variables. Haq and Shahid (2008) [17] also used a similar procedure to transform individual level data of enrollment and attendance to household level. The variable used to analyze the impact of travel time on health is utilization of Lady Health Worker (LHW) facility by households (dummy variable: 1 if used the facility in last 30 days, 0 otherwise). The study converted travel time into distance in kilometers since travel time varies depending on mode of transportation (on foot, bicycle; car; etc.). By converting into distance, the travel time of a household is standardized regardless of the mode of transport[18]. Thus, the independent variables used as a proxy to travel time are distance from primary schools, middle schools, and health units (in kilometers). The travel time in the PSLM database is a categorical variable, thus the distance is also derived in the categorical form. Other independent variables include gender of household head (male/female), visit to health units by households in last 30 days, and market value of household assets. Table 3.1 describes all the variables used in the model. For simulation, new distance variables are generated as a proxy of the post-CPEC traveling time[19].

[17] Baluch, Mazhar Ul Haq, and Saima Shahid. "Determinants of enrollment in primary education: a case study of district Lahore." *Pakistan Economic and Social Review* (2008): 161-200.

[18] The distances are estimated from Google Maps on the basis of average time taken to travel a certain distance in rural areas using different modes of transportation.

[19] The new distance is estimated from Google Maps on the basis of average time taken to travel a certain distance in urban areas using different modes of transportation.

Table 3.1: Description of Variables used in the Probit Model

Variable	Description	Unit	Obs
D_{PS}	Distance from Primary School	Km	3385
D_{MS}	Distance from Middle School	Km	3385
D_{HU}	Distance from Health Unit	Km	3385
Enroll	Enrollment of school-age children	Yes/No	3385
FemEnroll	Enrollment of female school-age children	Yes/No	2561
MaleEnroll	Enrollment of male school-age children	Yes/No	2895
Att	Attendance of school-age children	Yes/No	3385
FemAtt	Attendance of female school-age children	Yes/No	2561
MaleAtt	Attendance of male school-age children	Yes/No	2895
HVisit	Visit to a health unit by household	Yes/No	3385
LHW	Visit of a Lady Health Worker to the household	Yes/No	3385
Ghh	Gender of Household Head	Male/Female	3385
Assets	Market value of total household assets	PKR	3385

Source: Pakistan Social and Living Standard Measurement 2012-13

3.2. Estimation Model

To estimate the impact of travel time on enrollment and attendance, Probit models are used. The independent variables used distance from primary school, distance from middle school, gender of household head, and market value of assets, where the distance is used as a proxy to travel time. The Probit models for enrollment (Equation 1) and attendance (Equation 2) are used separately for male students, female students, and overall.

$$Enroll = \alpha_0 + \alpha_1 * D_{PS} + \alpha_2 * D_{MS} + \alpha_3 * Ghh + \alpha_4 * Assets + \varepsilon \qquad \text{(Equation 1)}$$

$$Attend = \beta_0 + \beta_1 * D_{PS} + \beta_2 * D_{MS} + \beta_3 * Ghh + \beta_4 * Assets + \varepsilon \qquad \text{(Equation 2)}$$

Similarly, to analyze the impact of travel time on health, the Probit model is used to relate the utilization of Lady Health Workers (LHW) facilities by households to the distance from health units, visits to health clinics by households, and market value of assets (Equation 3).

$$LHW = \gamma_0 + \gamma_1 * D_{HU} + \gamma_2 * HVisit + \gamma_3 * Assets + \varepsilon \qquad \text{(Equation 3)}$$

For each of the dependent variables, the average predicted values of the Probit model are compared to the average predicted values of the model after simulation where new distances are used as a proxy of simulated travel time.

4. Results and Analysis

4.1. Estimation Results

Table 4.2 summarizes the marginal effects of distance (proxy to travel time) from primary and middle schools on enrollment and attendance as well as marginal effects of the distance from health units on utilization of LHW facilities.

Table 4.2: Marginal Effects of Distance

	Marginal Effects of Distance		
	Distance from Health Unit	Distance from Primary School	Distance from Middle School
Visit of LHW to households	-.0086*		
Enrollment (overall)		-0.058*	-0.051*
Enrollment of male children		-0.057*	-0.050*
Enrollment of female children		-0.058*	-0.055*
Attendance (overall)		-0.046*	-0.009*
Attendance of male children		-0.047*	-0.007**
Attendance of female children		-0.033**	-0.014*

*Significant at 5 percent
**Significant at 10 percent

The distance from primary and secondary schools is significant and negatively related to enrollment and attendance for both male and female students as well as overall attendance. The p-value of the coefficient of distance from a health unit also indicates that the travel time from a health unit is significant and negatively related to the probability of a visit of a Lady Health Worker to a household.

4.2. Simulation Results

The estimation results are used to assess the impact of simulating reductions in travel time on education and health at district level. Therefore, the probability values of the models -- pre and post-simulation -- are aggregated for each of the 11 districts.

4.2.1. Impact of Travel Time to Schools on Enrollment

Figure 1-3 (Appendix) illustrates the impact of simulated reduction in travel time to school enrollment. The top left panel of each graph illustrates the simulated impact of reducing the travel time on the respective variable. Points farther from the 45-degree line are points, where reducing the travel time has a significant impact on the respective variable. The results imply that reducing the travel time from primary and middle schools has a significant impact on enrollment (overall, male, and female) for all districts; all the 11 districts lie above the 45-degree line.

Table 4.3 compares the average travel time from schools with the effects of the reduced travel time on enrollment (percentage point increase in enrolment) for each district. On average, districts with greater travel time from schools experience greater increase in school enrollment, after the reduction in travel time, as compared to the districts with smaller travel time.

Table 4.3: Average Travel Time from Schools and Effects of Simulated Reduction in Travel Time on Enrollment

District	Percentage Point Increase in Enrollment			Travel Time from Households (km)	
	(Overall)	(Male)	(Female)	Primary School	Middle School
Attock	4.8	4.7	5.5	4.4	11.6
Mianwali	4.9	5.2	4.8	5.2	11.2
D.I. Khan	4.3	3.8	4.8	4.8	10.8
Quetta	3.3	3.2	3.8	5.2	8.8
Kalat	9.9	10.1	10.9	4.4	19.6
Khuzdar	9.3	8.8	9.4	4.4	18.4
Turbat	17.9	17.6	19	5.6	32.4
Gawadar	14.4	13.6	16.2	7.6	26
Panjgur	27	26.9	31.2	7.2	45.2
Zhob	19.1	19.1	18.4	7.2	34.8
Q.Saifullah	33.7	33.3	35.4	6.8	59.2

Source: Authors' estimation

4.2.2. Impact of Travel Time to Schools on Attendance

Figure 4-6 (Appendix) shows that reducing the travel time from primary and middle schools has a significant impact on overall and female attendance for all districts. However, for male attendance the impact is significant for all the districts except Quetta and D.I. Khan.

Table 4.4 compares the average travel time from schools with the effects of the reduced travel time on attendance (percentage point increase in attendance), for each district. On average, districts with greater travel time from schools experience greater increases in school attendance after the reduction in travel time as compared to the districts with smaller travel time from schools.

Table 4.4. Average Travel Time from Schools and Effects of Simulated Reduction in Travel Time on Attendance

District	Percentage Point Increase in Attendance			Travel Time from Households	
	(Overall)	(Male)	(Female)	Primary School	Middle School
Attock	0.9	0.7	1.4	4.4	11.6
Mianwali	1.3	1.2	1.4	5.2	11.2
D.I. Khan	0.8	0.6	1.2	4.8	10.8
Quetta	0.8	0.7	1.1	5.2	8.8
Kalat	1.8	1.5	2.8	4.4	19.6
Khuzdar	1.8	1.6	2.4	4.4	18.4
Turbat	3.4	2.9	4.8	5.6	32.4
Gawadar	3.5	2.7	4.7	7.6	26
Panjgur	5.3	4.5	8.2	7.2	45.2
Zhob	3.4	2.9	4.6	7.2	34.8
Q.Saifullah	5.8	4.8	8.8	6.8	59.2

Source: Authors' estimation

4.2.3. Impact of Travel Time from Health Units on Utilization of LHW Facilities

Figure 7 (Appendix) shows that reducing travel time from health units has a significant impact on utilization of the Lady Health Worker (LHW) facility by the households for all the districts except Attock, Mianwali, and Khuzdar.

Table 5.5 compares the average travel time from health units with the effects of reduced travel time on utilization of LHW service, for each district. On average, districts with greater travel time from health units experience greater utilization of LHW service after the reduction in travel time, as compared to the districts with smaller travel time from the health units.

Table 4.5: Average Travel Time from Health Units and Effects of Simulated Reduction in Travel Time on LHW Utilization

District	Percentage Point Increase of LHW Utilization	Travel Time from Health Units to Households (km)
Attock	0.6	16
Mianwali	0.8	15.6
D.I. Khan	1	18.8
Quetta	0.6	16
Kalat	1	23.2
Khuzdar	0.5	18.8
Turbat	2.6	35.6
Gawadar	1.8	31.2
Panjgur	3.8	50.4
Zhob	2.4	35.6
Q.Saifullah	5.3	60.4

Source: Authors' estimation

5. Discussion

The economic corridor would play an important role in decreasing travel times to reach schools and health units. As Islam and Wieland (2008)[20] argue that the road network developed from Kabul to Kandahar has significantly improved access to education (enrollment and attendance) and the utilization of health services (visits to health units). Therefore, an assessment between the controlled villages and traditional villages indicates that road improvement projects have had a significant impact on enrollment and attendances in primary education in the districts lying within the corridor.

The western route of CPEC would save travel time from schools and health units. In this study, we have simulated the impact of travel time reduced after the completion of the corridor on enrollment, attendance (overall and across the gender) and utilization of health facilities,

[20] Islam, Mafizul, and Robert Wieland. 2008. *Roads Socio-Economic Impact Assessment*. United States Agency for International Development.

particularly the LHW service. Most of the areas along the western route are the rural areas of Balochistan where the majority of middle schools and health units are located far from households. The results show that road networks will significantly reduce travel time, which will increase enrolment and attendance at the elementary level (primary & middle). Apart from this, simulation results indicate a significant impact on the enrolment and attendance of male and female students separately. The results also show that the percentage increase in enrollment and attendance of female students is greater as compared to that of male students for all the districts. Islam and Wieland (2008) claim that the rate of female attendance almost doubled from 12.6% to 24% decrease travel time. Road networks and convenient mobility significantly impacts the utilization of health facilities such as regular visits of lady health workers to households.

The results also imply that effect of reduced travel time on enrollment and attendance is larger for districts with greater average travel time from school as compared to the districts with lesser average travel time. The average travel time from households to middle schools in Qila Saifullah is 56 minutes by car for an average distance of 14 km. By reducing the time to 30-35 minutes, there is an increase in enrollment by around 33 percent and attendance by 5 percent. However, the average travel time from households to middle schools in Quetta is 12-15 minutes on foot for average distance of 2.17 km. Therefore, it would not be any significant reduction in travel time for distances covered on foot. The results indicate only minor increase in enrollment (3.3 percent) and attendance (1.1 percent) in Quetta.

Similarly, effect of reduced travel time on health care utilization (LHW) is larger for districts with greater average travel time from health units as compared to the districts with lesser average travel time. The average travel time from health units to households for Qila Saifullah is 60 minutes by car for an average distance of 15 km. By reducing the time to 30-35 minutes, the utilization of LHW facility would be increased by 5 percent. On the other hand, the average travel time from health units to households for Quetta is 16 minutes by car (32 minutes by bicycle) for average distance of 4 km. By reducing the time to 8-10 minutes by car (15-20 minutes by bicycle), there is only 0.8 percent increase in LHW utilization. These results imply that time required to reach specific destination plays a vital role in the increase in enrollment, attendance, and health service utilization in the districts mentioned as ZOI.

Reduction in travel time in the ZOI would also effect travel time in other districts along the corridor but the magnitude of impact may vary across districts. Howard and Masset (2004) write that the decrease in travel time from schools resulted in high attendance rates in their respective areas. As Filmer (2007) points out that although distance to the nearest school is weakly associated with enrollment, few countries such as Mali, Chad, and Central African Republic showed increases in enrollment by 8.6, 6.8, and 4.4 percentage points respectively.

6. Conclusion and Policy Implications

The study simulates the impact of reduced travel time after the development of CPEC on education (enrollment and attendance) and health utilization (LHW utilization) for 11 districts that lie within the Zone of Influence. The study finds a significant increase in enrollment (overall, male, and female) and attendance (overall and female) due to reduced travel time for all 11 districts. However, the impact on male attendance is significant for all districts except Quetta and Dera Ismail Khan. The finding also shows significant increases in LHW utilization for all the districts except Attock, Mianwali, and Khuzdar as these districts already have the lowest average distances from health units. The results suggest that the CPEC would play a key role in the socio-economic development of districts that lie along the western route of CPEC.

This study is helpful for policymakers in the education sector who can consider travel time from household to schools in the formulation of education policies. It is also important in the formulation of health policies especially regarding how the utilization of Lady Health Worker (LHW) services can be increased if health units are built closer to households.

The study can be extended further by incorporating education and health variables as non-linear functions of disparity in the travel time. Although enrollment, attendance, and utilization of health services are linear functions of travel time, the impact of travel time on these variables can vary across districts. For example, changing the travel time from one hour to 30 minutes might have a very different and more significant impact than changing it from 10 to 5 minutes. By incorporating the heterogeneity factor in the model, the impact of simulating reduction in travel time would be more accurate, especially for the greater travel times.

Appendix

Note: Each district in Figure 1-7 is labeled with average distance from primary school (PS) and middle school (MS) in kilometers. The simulated distances from primary and middle schools respectively appear in the parenthesis.

Figure 1. Simulated vs. Actual Enrollment (Overall)

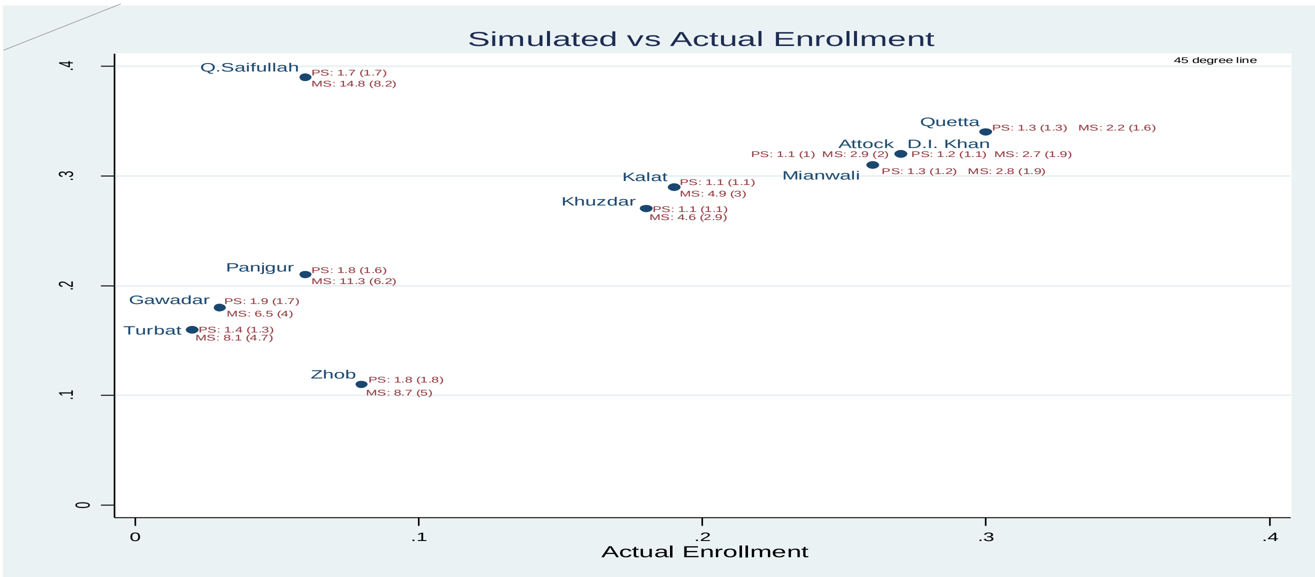

Figure 2. Simulated vs. Actual Enrollment (Male)

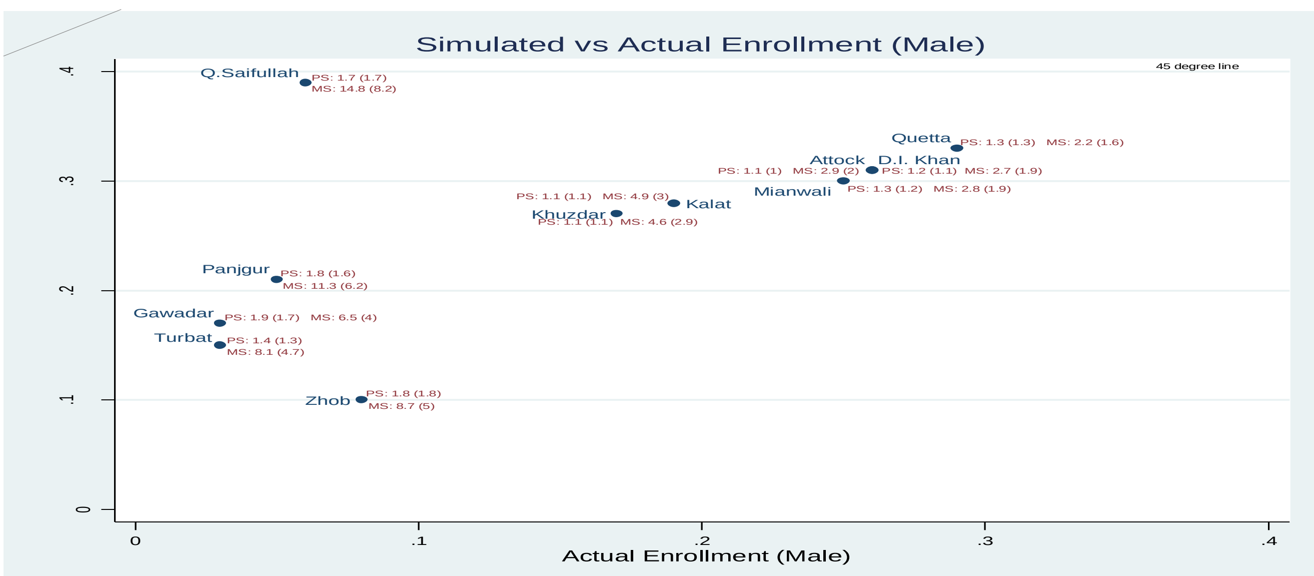

Figure 3. Simulated vs. Actual Enrollment (Female)

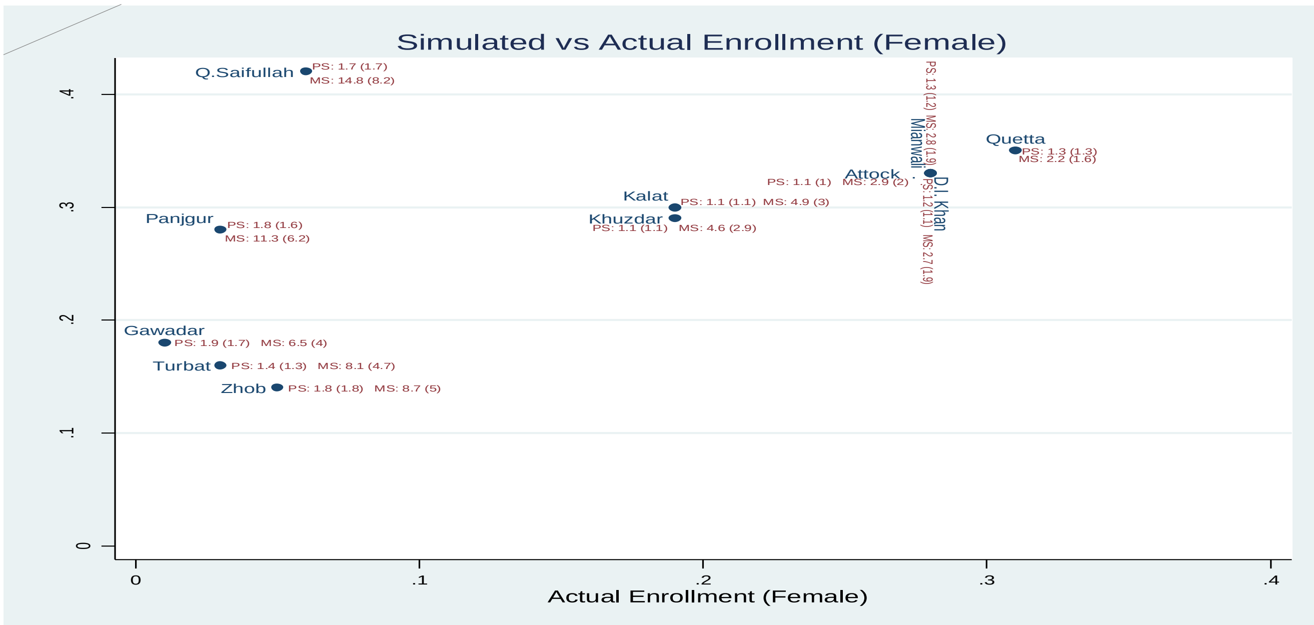

Figure 4. Simulated vs. Actual Attendance (Overall)

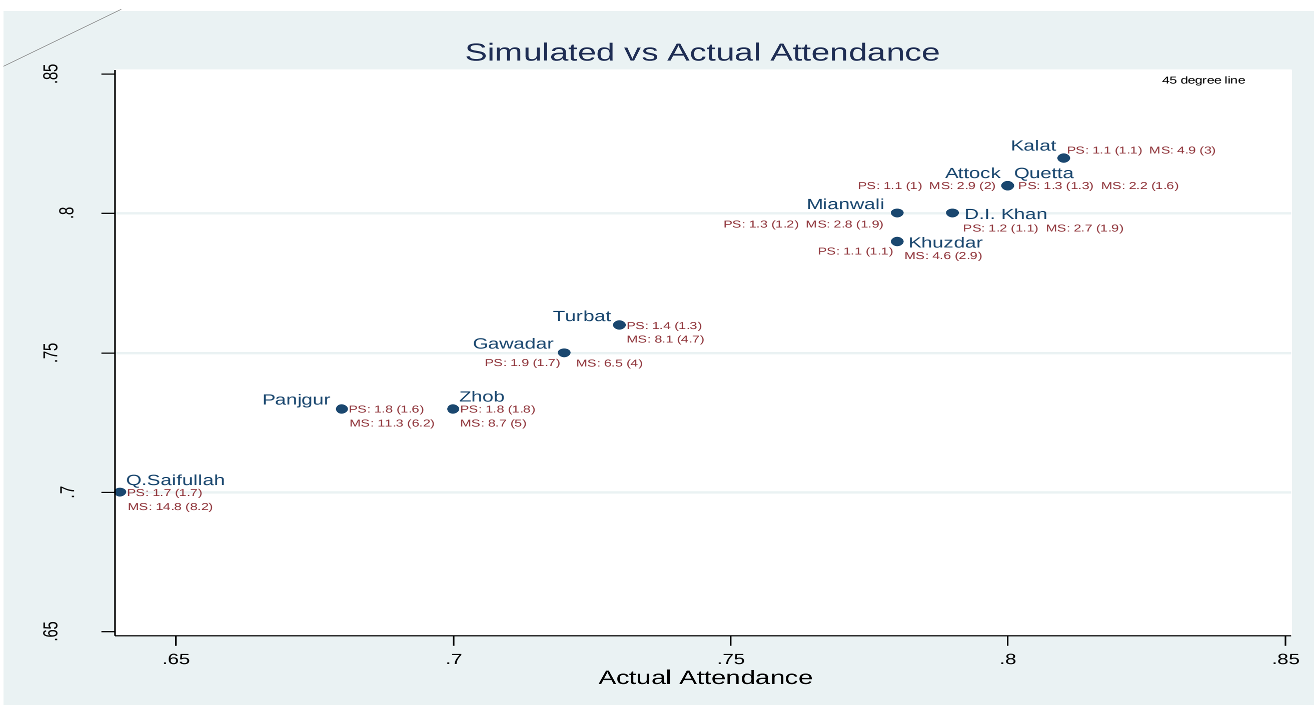

Figure 5. Simulated vs. Actual Attendance (Male)

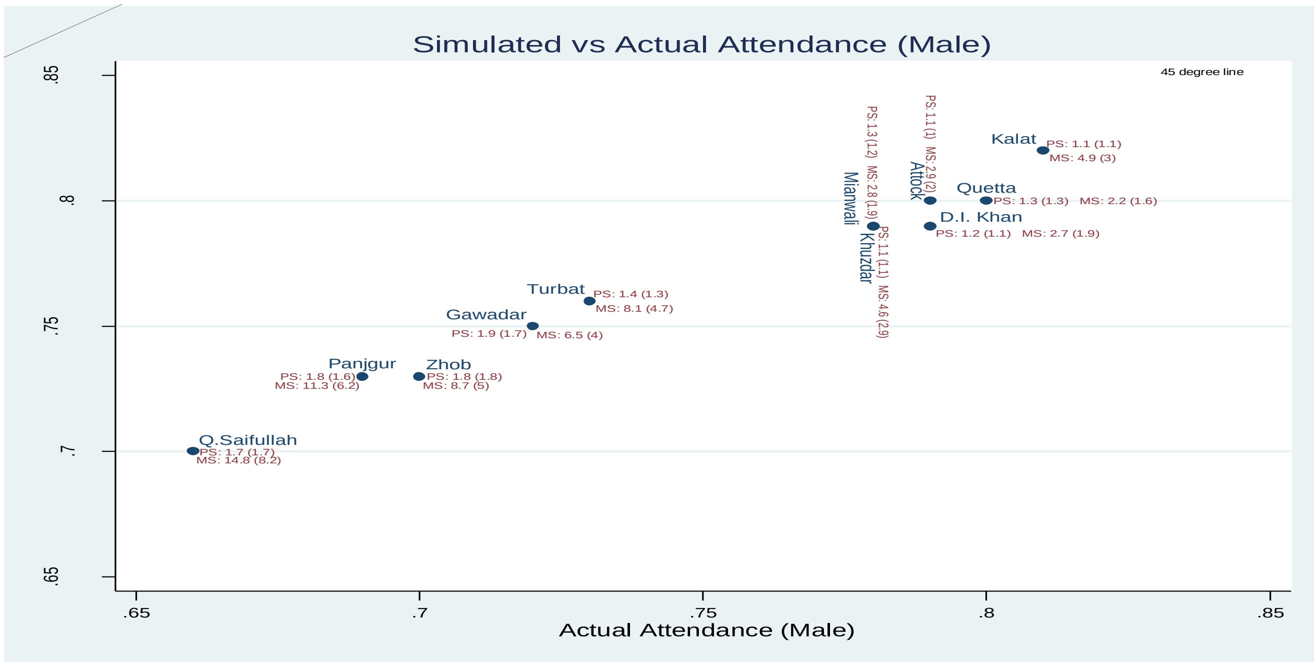

Figure 6. Simulated vs. Actual Attendance (Female)

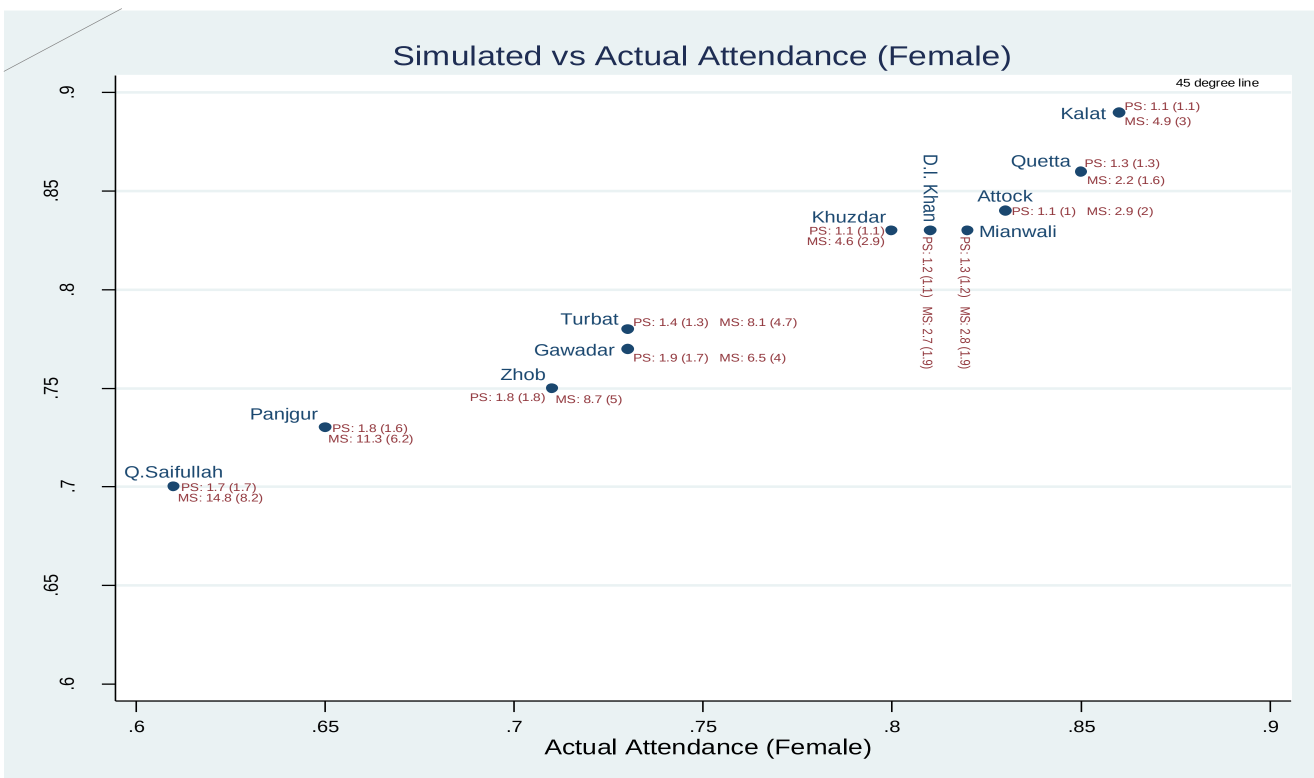

Figure 7. Simulated vs. Actual LHW Utilization