# Can Technology Overcome Social Disadvantage of School Children's Learning Outcomes? 

Evidence from a Large-Scale Experiment in India

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- $63 \%$ found it difficult to simple divisions
- Issues - Teacher absenteeism; Lack of adequate teacher training; Lack of physical infrastructure
- Socio-economic disadvantage along caste lines is also reflected in low education performance of children

Use of Technology

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- Technology and change in pedagogy has to go together
- Can technology mitigate problems of discriminatory treatment in classrooms?


## Questions ...

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- Does teaching input delivered by use of technology improve student performance?
- Is the impact neutral across various social and gender groups?

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- Randomized control trial design


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- Improvement in performance at SSLC exams
- Improvement in performance among the socially disadvantaged sections
- Among the socially disadvantaged sections, improvement in performance of girls
- At school level - schools around the median performance get maximum benefit.


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## School Education in Karnataka

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- Karnataka one of the better performing states in the country
$\square$ Per Capita income 14\% higher than national average
- Literacy rate $75.4 \%$ against national average of $73 \%$
$\square$ Enrollment rates of $98.3 \%$ as against all India rate of $96.7 \%$


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$\square$ Enrollment rates of $98.3 \%$ as against all India rate of $96.7 \%$
- 75,000+ schools out of which $14000+$ have secondary section.
- 10.1 million students in 2014-15
- However, poor performance on quality of education compared
to national standards


## Learning Levels of Children in Class VIII

Table: Learning Levels of Children in Class VIII

| Reading Levels |  |  |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Not even letter | Letter | Word | Std I text | Std II text | Total |
| India | 1.8 | 4.5 | 6.2 | 12.8 | 74.6 | 100 |
| Karnataka | 2.7 | 3.7 | 6.5 | 16.6 | 70.6 | 100 |
| Arithmetic |  |  |  |  |  |  |
|  | Recognize | Numbers | Can Subtract | Can Divide | Total |  |
|  | None | $1-9$ | $10-99$ |  |  |  |
| India | 1.3 | 5.4 | 26.1 | 23.2 | 44.1 | 100 |
| Karnataka | 1.1 | 2.3 | 31.2 | 28.4 | 37.0 | 100 |

## Caste and Gender Divide in Schools in Karnataka

## Caste Composition of Grade - 1

| $8.11 \%$ | $11.53 \%$ |  |
| :---: | :---: | :---: |
| $19.15 \%$ | $25.73 \%$ |  |
|  |  |  |

## Caste and Gender Divide in Schools in Karnataka

## Caste-wise School Choice



## Caste and Gender Divide in Schools in Karnataka

Gender-wise School Choice


## Caste and Gender Divide in Schools in Karnataka

Total Marks - 625

## Average Total Score in SSLC Exam



## Experiment Design

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- Live satellite transmission of lectures to 1000 government and government aided schools in Karnataka
- Lectures delivered by trained and experienced teachers using multi-media content


## Experiment Design

Figure: Intervention Design


## Experiment Design



Figure: SAMIE Class

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- Covers syllabus for grades V to X


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- Covers syllabus for grades V to X
- 40 minutes of lecture followed by 5 minutes for interactive session


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## Experiment Design

- Complete hardware kit provided with dual power back-ups
- Minimal technical operations required at school level
- Automated + manual confirmation of class-run status
- Hence high rate of compliance


## Sampling and Randomization

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- Stratification at district level and randomization at taluk level


## Sampling and Randomization

- Stratification at district level and randomization at taluk level
- Measure of outcomes at school and student level

Karnataka


## Selected Districts



## Intervention and Comparison Taluks



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- Covers 72 taluks in 18 least developed districts


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- Covers all government and government aided schools in selected taluk that have -
$\square$ Closed classroom in good condition
$\square$ Working electricity connection
$\square$ Minimum average of 20 students in each class


## Sampling and Randomization

- Covers 72 taluks in 18 least developed districts
- Covers all government and government aided schools in selected taluk that have -
$\square$ Closed classroom in good condition
$\square$ Working electricity connection
$\square$ Minimum average of 20 students in each class
- 1000 schools in intervention group; 823 schools in comparison group


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- Evaluation of performance of two cohorts in Grade 10-(AY 2013-14 and AY 2014-15)


## Interim Evaluation

- Intervention started in November, 2014
- Interim evaluation after 3 months of intervention in AY 2014-15
- Evaluation of performance of two cohorts in Grade 10 - (AY 2013-14 and AY 2014-15)
- Schools covered in present study - 659 from Intervention group and 587 from Control group


## Schools Covered

|  | Intervention | Comparison |
| :--- | ---: | ---: |
| Schools in Experiment Group | 1000 | 823 |
| Students in Experiment Group |  |  |
| Schools with Secondary Sections |  |  |
| Schools in Experiment Group | 659 | 587 |
| Students in Experiment Group in 2014 | 41240 | 36804 |
| Students in Experiment Group in 2015 | 42958 | 38127 |

## Comparison of Schools with Secondary Section

Table: School Characteristics

Control Mean Treatment Mean t-statistic p-value

| Total Enrolment | 211.10 | 204.78 | 0.83 | 0.40 |
| :--- | ---: | ---: | ---: | ---: |
| Total Classrooms | 5.27 | 5.45 | -1.06 | 0.29 |
| Working Teachers | 8.36 | 8.32 | 0.27 | 0.79 |
| Pupil-Teacher-Ratio | 26.30 | 25.16 | 1.24 | 0.22 |
| Pupil-Classroom-Ratio | 44.72 | 40.79 | 3.31 | 0.00 |
| Infrastructure Score | 7.24 | 7.32 | -1.27 | 0.20 |

## Comparison of Schools with Secondary Section

## Table: Teachers in Secondary Section

|  | Control Mean | Treatment Mean | t-statistic | p-value |
| :--- | ---: | ---: | ---: | ---: |
| Number of Teachers | 8.78 | 8.76 | 0.08 | 0.94 |
| Number of Female Teachers | 2.43 | 2.42 | 0.06 | 0.95 |
| Academic Qualification Score | 13.47 | 13.64 | -1.25 | 0.21 |
| Professional Qualification Score | 1.89 | 1.91 | -1.05 | 0.29 |
| Proportion of Female Teachers | 0.26 | 0.26 | 0.27 | 0.78 |
| Proportion of OBC Teachers | 0.48 | 0.50 | -1.16 | 0.25 |
| Proportion of SC Teachers | 0.17 | 0.17 | 0.26 | 0.79 |
| Proportion of ST Teachers | 0.07 | 0.07 | -0.80 | 0.43 |

## Comparison of Schools with Secondary Section

## Control Mean Treatment Mean t-statistic p-value

Student Demographics in AY 2013-14 - Grade 10

| Proportion of Girls | 0.47 | 0.47 | -0.09 | 0.93 |
| :--- | :---: | :---: | :---: | :---: |
| Proportion of OBC | 0.44 | 0.47 | -1.42 | 0.16 |
| Proportion of SC | 0.23 | 0.23 | -0.20 | 0.84 |
| Proportion of ST | 0.11 | 0.13 | -3.88 | 0.00 |
|  | Student Demographics in AY 2014-15- Grade 10 |  |  |  |
|  |  | 0.47 | 0.48 | -1.29 |
| Proportion of Girls | 0.48 | 0.49 | -0.33 | 0.20 |
| Proportion of OBC | 0.24 | 0.24 | -0.10 | 0.92 |
| Proportion of SC | 0.11 | 0.14 | -4.02 | 0.00 |
| Proportion of ST |  |  |  |  |

## Comparison of Schools with Secondary Section

## Table: SSLC Exam Performance in April 2014

|  | Control Mean | Treatment Mean | t-statistic | p-value |
| :--- | ---: | ---: | ---: | ---: |
|  |  | 62.70 | 62.58 | 0.05 |
| No. of students in grade 10 | 54.12 | 54.56 | -0.22 | 0.83 |
| No. of students who passed the exam | 47.39 | 47.65 | -0.50 | 0.62 |
| English | 45.38 | 46.13 | -1.54 | 0.12 |
| Maths | 49.50 | 49.59 | -0.19 | 0.85 |
| Science | 60.42 | 61.06 | -1.05 | 0.29 |
| Social Science | 334.04 | 338.16 | -1.42 | 0.16 |
| Total Score |  |  |  |  |

1) No. of Students measures average class size in each school in grade 10
2) No. of students who passed the exam is the average no. of students from each school
3) The other variables are the average scores by students of a school in respective subjects.

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## Student Level - Overall

|  | Dependent variable: |  |  |
| :--- | :---: | :---: | :---: |
|  | English | Maths | Science |
|  | $(1)$ | $(2)$ | $(3)$ |
| Treatment | -0.044 | 0.707 | 0.082 |
|  | $(1.020)$ | $(0.984)$ | $(0.954)$ |
| Year(2015) | $-7.050^{* * *}$ | $-1.790^{* *}$ | $-5.850^{* * *}$ |
|  | $(0.920)$ | $(0.871)$ | $(0.863)$ |
| Treatment:Year(2015) | 0.439 | -0.201 | 0.617 |
|  | $(1.280)$ | $(1.340)$ | $(1.320)$ |
| Constant | $48.400^{* * *}$ | $47.300^{* * *}$ | $50.000^{* * *}$ |
|  | $(2.120)$ | $(0.917)$ | $(1.020)$ |
| Observations | 159,129 | 159,129 | 159,129 |
| $\mathrm{R}^{2}$ | 0.062 | 0.025 | 0.062 |
| Note: | $\mathrm{p}<0.1 ;{ }^{* *} \mathrm{p}<0.05 ;{ }^{* * *} \mathrm{p}<0.01$ |  |  |

All regressions include district dummies. Figures in brackets are standard errors and are clustered at taluk level

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|  | Dependent variable: |  |  |
| :---: | :---: | :---: | :---: |
|  | English <br> (1) | Maths <br> (2) | Science <br> (3) |
| Treatment | -0.094 | -0.024 | -0.016 |
|  | (0.235) | (0.183) | (0.162) |
| Year(2015) | $-0.717^{* *}$ | -0.189 | $-0.923^{* * *}$ |
|  | (0.142) | (0.121) | (0.122) |
| Girls | 2.590*** | 2.210*** | $2.400^{* * *}$ |
|  | (0.343) | (0.263) | (0.254) |
| Treatment:Year(2015) | 0.166 | 0.203 | 0.253 |
|  | (0.226) | (0.189) | (0.169) |
| Treatment:Girls | 0.130 | 0.097 | -0.015 |
|  | (0.470) | (0.359) | (0.333) |
| Year(2015):Girls | 0.256 | 0.130 | 1.050*** |
|  | (0.261) | (0.242) | (0.302) |
| Treatment:Year(2015):Girls | -0.319 | -0.495 | -0.490 |
|  | (0.386) | (0.329) | (0.367) |
| Constant | $1.410^{* * *}$ | 0.992*** | $1.270^{* * *}$ |
|  | (0.266) | (0.216) | (0.242) |
| Observations | 159,129 | 159,129 | 159,129 |
| $\mathrm{R}^{2}$ | 0.248 | 0.257 | 0.283 |
| Note: | * $\mathrm{p}<0.1$ | ${ }^{* *} \mathrm{p}<0.05$ | ${ }^{* * *} \mathrm{p}<0.01$ |

All regressions include district dummies and controls school characteristics. Figures in brackets are standard errors and are clustered at taluk level.

|  | Dependent variable: |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | English <br> (1) | Maths <br> (2) | Science (3) |  |
| Treatment | $\begin{aligned} & -0.094 \\ & (0.235) \end{aligned}$ | $\begin{aligned} & -0.024 \\ & (0.183) \end{aligned}$ | $\begin{aligned} & -0.016 \\ & (0.162) \end{aligned}$ | Intervention improves the gap |
| Year(2015) | $\begin{gathered} -0.717^{* * *} \\ (0.142) \end{gathered}$ | $\begin{aligned} & -0.189 \\ & (0.121) \end{aligned}$ | $\begin{gathered} -0.923^{* * *} \\ (0.122) \end{gathered}$ | in learning outcomes in favor |
| Girls |  | $\begin{gathered} 2.210^{* * *} \\ (0.263) \end{gathered}$ | $\begin{gathered} 2.400^{* * *} \\ (0.254) \end{gathered}$ | of Boys |
| Treatment:Year(2015) | $\begin{gathered} 0.166 \\ (0.226) \end{gathered}$ | $\begin{gathered} 0.203 \\ (0.189) \end{gathered}$ | $\begin{gathered} 0.253 \\ (0.169) \end{gathered}$ |  |
| Treatment:Girls | $\begin{gathered} 0.130 \\ (0.470) \end{gathered}$ | $\begin{gathered} 0.097 \\ (0.359) \end{gathered}$ | $\begin{aligned} & -0.015 \\ & (0.333) \end{aligned}$ |  |
| Year(2015):Girls | $\begin{gathered} 0.256 \\ (0.261) \end{gathered}$ | $\begin{gathered} 0.130 \\ (0.242) \end{gathered}$ | $\begin{aligned} & 1.050^{* * *} \\ & (0.302) \end{aligned}$ |  |
| Treatment:Year(2015):Girls |  |  | $\begin{array}{r} -0.490 \\ (0.367) \\ \hline \end{array}$ |  |
| Constant |  | $\begin{gathered} 0.992^{* * *} \\ (0.216) \\ \hline \end{gathered}$ | $\begin{aligned} & 1.270^{* * *} \\ & (0.242) \\ & \hline \end{aligned}$ | All regressions include district dummies and controls school characteristics. Figures in brackets |
| Observations | 159,129 | 159,129 | 159,129 | are standard errors and are clustered at taluk level. |
| $\mathrm{R}^{2}$ | 0.248 | 0.257 | 0.283 |  |
| Note: | * $\mathrm{p}<0$ | ** $\mathrm{p}<0.05$ | ${ }^{* *} \mathrm{p}<0.01$ |  |

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## Social Disadvantage

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- Does belonging to socially disadvantaged group lead to a learning disadvantage (at baseline)?


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- Does Intervention help in narrowing the social divide in terms of learning outcomes?


## Social Disadvantage

- Does belonging to socially disadvantaged group lead to a learning disadvantage (at baseline)?
- Does Intervention help in narrowing the social divide in terms of learning outcomes?
- Does Intervention improve the learning outcomes of socially disadvantaged groups?


## Social Disadvantage and Learning Outcomes (I)

|  | Dependent variable: |  |  |
| :--- | :---: | :---: | :---: |
|  | English | Maths | Science |
|  | $(1)$ | $(2)$ | $(3)$ |
| Treatment | 0.144 | 0.310 | 0.146 |
|  | $(0.376)$ | $(0.307)$ | $(0.268)$ |
| OBC | $-0.982^{* * *}$ | $-0.613^{* * *}$ | $-0.598^{* * *}$ |
|  | $(0.242)$ | $(0.186)$ | $(0.148)$ |
| SC | $-3.340^{* * *}$ | $-3.630^{* * *}$ | $-3.180^{* * *}$ |
|  | $(0.381)$ | $(0.346)$ | $(0.261)$ |
| ST | $-3.740^{* * *}$ | $-3.450^{* * *}$ | $-3.310^{* * *}$ |
| Treatment:OBC | $(0.419)$ | $(0.370)$ | $(0.275)$ |
|  | 0.005 | -0.243 | -0.257 |
| Treatment:SC | $(0.476)$ | $(0.392)$ | $(0.353)$ |
|  | -0.325 | -0.345 | -0.154 |
| Treatment:ST | $(0.571)$ | $(0.511)$ | $(0.430)$ |
|  | -0.539 | -0.542 | 0.088 |
|  | $(0.567)$ | $(0.506)$ | $(0.431)$ |
| Note: | ${ }^{*} \mathrm{p}<0.1 ;$ | ${ }^{* *} \mathrm{p}<0.05 ;{ }^{* * *} \mathrm{p}<0.01$ |  |

## Social Disadvantage and Learning Outcomes (I)

|  | Dependent variable: |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | English <br> (1) | Maths (2) | Science <br> (3) |  |
| Treatment | $\begin{gathered} 0.144 \\ (0.376) \end{gathered}$ | $\begin{gathered} 0.310 \\ (0.307) \end{gathered}$ | $\begin{gathered} 0.146 \\ (0.268) \end{gathered}$ | Does belonging to socially |
| OBC | $\begin{gathered} -0.982^{* * *} \\ (0.242) \end{gathered}$ | $\begin{gathered} -0.613^{* * *} \\ (0.186) \end{gathered}$ | $\begin{gathered} -0.598^{* * *} \\ (0.148) \end{gathered}$ | disadvantaged group lead to |
| SC | $\begin{gathered} -3.340^{* * *} \\ (0.381) \end{gathered}$ | $\begin{gathered} -3.630^{* * *} \\ (0.346) \end{gathered}$ | $\begin{gathered} -3.180^{* * *} \\ (0.261) \end{gathered}$ | a learning disadvantage (at baseline)? |
| ST | $\begin{gathered} -3.740^{* * *} \\ (0.419) \end{gathered}$ | $\begin{gathered} -3.450^{* * *} \\ (0.370) \end{gathered}$ | $\begin{gathered} -3.310^{* * *} \\ (0.275) \end{gathered}$ |  |
| Treatment:OBC | $\begin{gathered} 0.005 \\ (0.476) \end{gathered}$ | $\begin{aligned} & -0.243 \\ & (0.392) \end{aligned}$ | $\begin{aligned} & -0.257 \\ & (0.353) \end{aligned}$ |  |
| Treatment:SC | $\begin{aligned} & -0.325 \\ & (0.571) \end{aligned}$ | $\begin{aligned} & -0.345 \\ & (0.511) \end{aligned}$ | $\begin{aligned} & -0.154 \\ & (0.430) \end{aligned}$ |  |
| Treatment:ST | $\begin{aligned} & -0.539 \\ & (0.567) \end{aligned}$ | $\begin{aligned} & -0.542 \\ & (0.506) \end{aligned}$ | $\begin{gathered} 0.088 \\ (0.431) \end{gathered}$ |  |

## Social Disadvantage and Learning Outcomes (I)

|  | Dependent variable: |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | English <br> (1) | Maths <br> (2) | Science <br> (3) |  |
| Treatment | $\begin{gathered} 0.144 \\ (0.376) \end{gathered}$ | $\begin{gathered} 0.310 \\ (0.307) \end{gathered}$ | $\begin{gathered} 0.146 \\ (0.268) \end{gathered}$ | Does belonging to socially |
| OBC | $\begin{gathered} -0.982^{* * *} \\ (0.242) \end{gathered}$ | $\begin{gathered} -0.613^{* * *} \\ (0.186) \end{gathered}$ | $\begin{gathered} -0.598^{* * *} \\ (0.148) \end{gathered}$ | disadvantaged group lead to |
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| ST | $\begin{gathered} -3.740^{* * *} \\ (0.419) \end{gathered}$ | $\begin{gathered} -3.450^{* * *} \\ (0.370) \end{gathered}$ | $\begin{gathered} -3.310^{* * *} \\ (0.275) \end{gathered}$ | Yes |
| Treatment:OBC | $\begin{gathered} 0.005 \\ (0.476) \end{gathered}$ | $\begin{aligned} & -0.243 \\ & (0.392) \end{aligned}$ | $\begin{aligned} & -0.257 \\ & (0.353) \end{aligned}$ |  |
| Treatment:SC | $\begin{aligned} & -0.325 \\ & (0.571) \end{aligned}$ | $\begin{aligned} & -0.345 \\ & (0.511) \end{aligned}$ | $\begin{aligned} & -0.154 \\ & (0.430) \end{aligned}$ |  |
| Treatment:ST | $\begin{aligned} & -0.539 \\ & (0.567) \end{aligned}$ | $\begin{aligned} & -0.542 \\ & (0.506) \end{aligned}$ | $\begin{gathered} 0.088 \\ (0.431) \end{gathered}$ |  |
| Note: | * $\mathrm{p}<0$ | ; ${ }^{*} \mathrm{p}<0.05$ | *** $\mathrm{p}<0.01$ |  |

## Social Disadvantage and Learning Outcomes (II)

|  | Dependent variable: |  |  |
| :---: | :---: | :---: | :---: |
|  | English <br> (1) | Maths <br> (2) | Science (3) |
| Year(2015) | $\begin{gathered} -1.010^{* * *} \\ (0.189) \end{gathered}$ | $\begin{gathered} -0.552^{* * *} \\ (0.125) \end{gathered}$ | $\begin{gathered} -0.646^{* * *} \\ (0.157) \end{gathered}$ |
| Treatment:Year(2015) | $\begin{gathered} 0.152 \\ (0.283) \end{gathered}$ | $\begin{gathered} 0.180 \\ (0.223) \end{gathered}$ | $\begin{gathered} 0.146 \\ (0.224) \end{gathered}$ |
| Year(2015): OBC | $\begin{aligned} & 0.435^{* *} \\ & (0.219) \end{aligned}$ | $\begin{aligned} & 0.425^{* *} \\ & (0.193) \end{aligned}$ | $\begin{aligned} & 0.299^{*} \\ & (0.158) \end{aligned}$ |
| Year(2015):SC | $\begin{aligned} & 0.682^{* *} \\ & (0.300) \end{aligned}$ | $\begin{aligned} & 0.646^{* *} \\ & (0.275) \end{aligned}$ | $\begin{gathered} 0.167 \\ (0.289) \end{gathered}$ |
| Year(2015):ST | $1.240^{* * *}$ <br> (0.442) | $\begin{gathered} 1.360^{* * *} \\ (0.329) \end{gathered}$ | $\begin{aligned} & 0.918^{* *} \\ & (0.381) \end{aligned}$ |
| Treatment:Year(2015):OBC | $\begin{aligned} & -0.158 \\ & (0.321) \end{aligned}$ | $\begin{aligned} & -0.239 \\ & (0.268) \end{aligned}$ | $-0.004$ (0.254) |
| Treatment:Year(2015):SC | $\begin{aligned} & -0.072 \\ & (0.456) \end{aligned}$ | $\begin{aligned} & -0.052 \\ & (0.412) \end{aligned}$ | $\begin{aligned} & -0.057 \\ & (0.355) \end{aligned}$ |
| Treatment:Year(2015):ST | $\begin{aligned} & -0.571 \\ & (0.564) \end{aligned}$ | $-0.821^{*}$ <br> (0.432) | $\begin{aligned} & -0.893^{*} \\ & (0.528) \end{aligned}$ |
| Note: | * $\mathrm{p}<0$ | $1 ;{ }^{* *} \mathrm{p}<0.05$ | ${ }^{* * *} \mathrm{p}<0.01$ |

## Social Disadvantage and Learning Outcomes (II)

|  | Dependent variable: |  |  |
| :--- | :---: | :---: | :---: |
|  | English | Maths | Science |
|  | $(1)$ | $(2)$ | $(3)$ |
| Year(2015) | $-1.010^{* * *}$ | $-0.552^{* * *}$ | $-0.646^{* * *}$ |
| Treatment:Year(2015) | $(0.189)$ | $(0.125)$ | $(0.157)$ |
|  | 0.152 | 0.180 | 0.146 |
| Year(2015):OBC | $(0.283)$ | $(0.223)$ | $(0.224)$ |
|  | $0.435^{* *}$ | $0.425^{* *}$ | $0.299^{*}$ |
| Year(2015):SC | $(0.219)$ | $(0.193)$ | $(0.158)$ |
| Year(2015):ST | $0.682^{* *}$ | $0.646^{* *}$ | 0.167 |
|  | $(0.300)$ | $(0.275)$ | $(0.289)$ |
| Treatment:Year(2015):OBC | -0.158 | -0.239 | -0.004 |
| Treatment:Year(2015):SC | $(0.321)$ | $(0.268)$ | $(0.254)$ |
| Treatment:Year(2015):ST | -0.072 | -0.052 | -0.057 |
|  | $(0.456)$ | $(0.412)$ | $(0.355)$ |
| Note: | -0.571 | $-0.821^{*}$ | $-0.893^{*}$ |
|  | $(0.564)$ | $(0.432)$ | $(0.528)$ |

Does Intervention help in narrowing the social divide in terms of learning outcomes?

## Social Disadvantage and Learning Outcomes (II)

|  | Dependent variable: |  |  |
| :---: | :---: | :---: | :---: |
|  | English <br> (1) | Maths <br> (2) | Science <br> (3) |
| Year(2015) | $\begin{gathered} -1.010^{* * *} \\ (0.189) \end{gathered}$ | $\begin{gathered} -0.552^{* * *} \\ (0.125) \end{gathered}$ | $\begin{gathered} -0.646^{* * *} \\ (0.157) \end{gathered}$ |
| Treatment:Year(2015) | $\begin{gathered} 0.152 \\ (0.283) \end{gathered}$ | $\begin{gathered} 0.180 \\ (0.223) \end{gathered}$ | $\begin{gathered} 0.146 \\ (0.224) \end{gathered}$ |
| Year(2015):OBC | $\begin{aligned} & 0.435^{* *} \\ & (0.219) \end{aligned}$ | $\begin{aligned} & 0.425^{* *} \\ & (0.193) \end{aligned}$ | $\begin{aligned} & 0.299^{*} \\ & (0.158) \end{aligned}$ |
| Year(2015):SC | $\begin{aligned} & 0.682^{* *} \\ & (0.300) \end{aligned}$ | $\begin{aligned} & 0.646^{* *} \\ & (0.275) \end{aligned}$ | $\begin{gathered} 0.167 \\ (0.289) \end{gathered}$ |
| Year(2015):ST | $\begin{gathered} 1.240^{* * *} \\ (0.442) \end{gathered}$ | $\begin{gathered} 1.360^{* * *} \\ (0.329) \end{gathered}$ | $\begin{aligned} & 0.918^{* *} \\ & (0.381) \end{aligned}$ |
| Treatment:Year(2015):OBC | $-0.158$ <br> (0.321) | $\begin{aligned} & -0.239 \\ & (0.268) \end{aligned}$ | $\begin{aligned} & -0.004 \\ & (0.254) \end{aligned}$ |
| Treatment:Year(2015):SC | $\begin{aligned} & -0.072 \\ & (0.456) \end{aligned}$ | $\begin{aligned} & -0.052 \\ & (0.412) \end{aligned}$ | $\begin{aligned} & -0.057 \\ & (0.355) \end{aligned}$ |
| Treatment:Year(2015):ST | $\begin{aligned} & -0.571 \\ & (0.564) \end{aligned}$ | $-0.821^{*}$ <br> (0.432) | $\begin{aligned} & -0.893^{*} \\ & (0.528) \\ & \hline \end{aligned}$ |
| Note: | * $\mathrm{p}<0$ | ; ${ }^{* *} \mathrm{p}<0.05$ | ${ }^{* * *} \mathrm{p}<0.01$ |

Does Intervention help in narrowing the social divide in terms of learning outcomes?

No

## Social Disadvantage and Learning Outcomes (III)

|  | Dependent variable: |  |  |
| :--- | :---: | :---: | :---: |
|  | English | Maths | Science |
|  | $(1)$ | $(2)$ | $(3)$ |
| Year(2015) | $-1.010^{* * *}$ | $-0.552^{* * *}$ | $-0.646^{* * *}$ |
|  | $(0.189)$ | $(0.125)$ | $(0.157)$ |
| Treatment:Year(2015) | 0.152 | 0.180 | 0.146 |
|  | $(0.283)$ | $(0.223)$ | $(0.224)$ |
| Year(2015):OBC | $0.435^{* *}$ | $0.425^{* *}$ | $0.299^{*}$ |
|  | $(0.219)$ | $(0.193)$ | $(0.158)$ |
| Year(2015):SC | $0.682^{* *}$ | $0.646^{* *}$ | 0.167 |
| Year(2015):ST | $(0.300)$ | $(0.275)$ | $(0.289)$ |
|  | $1.240^{* * *}$ | $1.360^{* * *}$ | $0.918^{* *}$ |
| Treatment:Year(2015):OBC | $(0.442)$ | $(0.329)$ | $(0.381)$ |
|  | -0.158 | -0.239 | -0.004 |
| Treatment:Year(2015):SC | $(0.321)$ | $(0.268)$ | $(0.254)$ |
| Treatment:Year(2015):ST | -0.072 | -0.052 | -0.057 |
|  | $(0.456)$ | $(0.412)$ | $(0.355)$ |
| Note: | -0.571 | $-0.821^{*}$ | $-0.893^{*}$ |
|  | $(0.564)$ | $(0.432)$ | $(0.528)$ |
|  | ${ }^{*} \mathrm{p}<0.1 ;$ | ${ }^{* *} \mathrm{p}<0.05 ;{ }^{* * *} \mathrm{p}<0.01$ |  |
|  |  |  |  |

## Social Disadvantage and Learning Outcomes (III)

|  | Dependent variable: |  |  |
| :--- | :---: | :---: | :---: |
|  | English | Maths | Science |
|  | $(1)$ | $(2)$ | $(3)$ |
| Year(2015) | $-1.010^{* * *}$ | $-0.552^{* * *}$ | $-0.646^{* * *}$ |
|  | $(0.189)$ | $(0.125)$ | $(0.157)$ |
| Treatment:Year(2015) | 0.152 | 0.180 | 0.146 |
|  | $(0.283)$ | $(0.223)$ | $(0.224)$ |
| Year(2015):OBC | $0.435^{* *}$ | $0.425^{* *}$ | $0.299^{*}$ |
| Year(2015):SC | $(0.219)$ | $(0.193)$ | $(0.158)$ |
| Year(2015):ST | $0.682^{* *}$ | $0.646^{* *}$ | 0.167 |
|  | $(0.300)$ | $(0.275)$ | $(0.289)$ |
| Treatment:Year(2015):OBC | -0.158 | -0.239 | -0.004 |
|  | $(0.321)$ | $(0.268)$ | $(0.254)$ |
| Treatment:Year(2015):SC | -0.072 | -0.052 | -0.057 |
| Treatment:Year(2015):ST | $(0.456)$ | $(0.412)$ | $(0.355)$ |
|  | -0.571 | $-0.821^{* *}$ | $-0.893^{*}$ |
| Note: | $(0.564)$ | $(0.432)$ | $(0.528)$ |

## Does Intervention improve

 the learning outcomes within socially disadvantaged groups?
## Social Disadvantage and Learning Outcomes (III)

|  | Dependent variable: |  |  |
| :--- | :---: | :---: | :---: |
|  | English | Maths | Science |
|  | $(1)$ | $(2)$ | $(3)$ |
| Year(2015) | $-1.010^{* * *}$ | $-0.552^{* * *}$ | $-0.646^{* * *}$ |
|  | $(0.189)$ | $(0.125)$ | $(0.157)$ |
| Treatment:Year(2015) | 0.152 | 0.180 | 0.146 |
|  | $(0.283)$ | $(0.223)$ | $(0.224)$ |
| Year(2015):OBC | $0.435^{* *}$ | $0.425^{* *}$ | $0.299^{*}$ |
| Year(2015):SC | $(0.219)$ | $(0.193)$ | $(0.158)$ |
| Year(2015):ST | $0.682^{* *}$ | $0.646^{* *}$ | 0.167 |
|  | $(0.300)$ | $(0.275)$ | $(0.289)$ |
| Treatment:Year(2015):OBC | -0.158 | -0.239 | -0.004 |
| Treatment:Year(2015):SC | $\left(0.240^{* * *}\right.$ | $1.360^{* * *}$ | $0.918^{* *}$ |
| Treatment:Year(2015):ST | -0.072 | $(0.268)$ | $(0.254)$ |
|  | $(0.456)$ | $(0.442)$ | $(0.329)$ |
|  | -0.571 | $-0.821^{*}$ | $-0.893^{*}$ |
| Note: | $(0.564)$ | $(0.432)$ | $(0.528)$ |

## Does Intervention improve

 the learning outcomes within socially disadvantaged groups?|  | English | Maths | Science |
| :--- | :---: | :---: | :---: |
| OBC |  |  | $\checkmark$ |
| SC | $\checkmark$ | $\checkmark$ | $\checkmark$ |
| ST |  |  |  |

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Gender and Social Disadvantage

## Gender and Social Disadvantage

- Does Intervention help in narrowing gap in learning outcomes of Girls between communities?


## Gender and Social Disadvantage

- Does Intervention help in narrowing gap in learning outcomes of Girls between communities?
- Does Intervention help in improving the learning outcomes of Girls within socially disadvantaged communities?


## Gender and Social Disadvantage

- Does Intervention help in narrowing gap in learning outcomes of Girls between communities?
- Does Intervention help in improving the learning outcomes of Girls within socially disadvantaged communities?
- Does Intervention help in narrowing gender gap in learning outcomes within communities?


## Gender and Social Disadvantage

|  | Summary of impact of treatment on : |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Girls between caste ${ }^{\text {a }}$ |  |  | Girls within caste ${ }^{\text {b }}$ |  |  | Gender gap within caste ${ }^{\text {c }}$ |  |  |
| Dep. var. | English | Maths | Science | English | Maths | Science | English | Maths | Science |
|  | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| OBC | $\begin{aligned} & -0.456 \\ & (0.634) \end{aligned}$ | $\begin{aligned} & -0.037 \\ & (0.574) \end{aligned}$ | $\begin{gathered} 0.328 \\ (0.576) \end{gathered}$ | $\begin{aligned} & -0.305 \\ & (0.336) \end{aligned}$ | $\begin{aligned} & -0.369 \\ & (0.307) \end{aligned}$ | $\begin{aligned} & -0.033 \\ & (0.307) \end{aligned}$ | $\begin{aligned} & -0.492 \\ & (0.456) \end{aligned}$ | $\begin{aligned} & -0.579 \\ & (0.416) \end{aligned}$ | $\begin{aligned} & -0.266 \\ & (0.418) \end{aligned}$ |
| SC | $\begin{aligned} & -0.032 \\ & (0.445) \end{aligned}$ | $\begin{gathered} 0.544 \\ (0.356) \end{gathered}$ | $\begin{gathered} 0.106 \\ (0.308) \end{gathered}$ | $\begin{gathered} 0.097 \\ (0.504) \end{gathered}$ | $\begin{gathered} 0.170 \\ (0.456) \end{gathered}$ | $\begin{aligned} & -0.236 \\ & (0.437) \end{aligned}$ | $\begin{gathered} 0.025 \\ (0.635) \end{gathered}$ | $\begin{gathered} 0.104 \\ (0.567) \end{gathered}$ | $\begin{aligned} & -0.632 \\ & (0.577) \end{aligned}$ |
| ST | $-1.030$ <br> (0.867) | $-0.540$ <br> (0.785) | $-0.542$ <br> (0.788) | $-0.922$ <br> (0.638) | $\begin{gathered} -0.956^{*} \\ (0.570) \end{gathered}$ | $-0.956$ <br> (0.593) | $-0.803$ <br> (0.874) | $-0.492$ <br> (0.778) | $-0.268$ <br> (0.814) |
| Note: |  |  |  |  |  |  | <0.1; * | <0.05; | $\mathrm{p}<0.01$ |

${ }^{\text {a }}$ Data used for these regressions include all girls.
${ }^{\text {b }}$ Data used for these regressions include only girls from respective caste groups.
${ }^{\text {c }}$ Data used for these regressions include all students from respective caste groups.
Regressions also include a full set of interaction terms with a constant. Coefficients shown here are relevant interaction terms with Year, Treatment and Caste / Gender dummies as applicable. All regressions include district dummies and controls for school characteristics. Figures in brackets are standard errors and are clustered at taluk level.

## Is Technology Gender Neutral?

|  | Dependent variable: |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | English | Maths | Science |  |
| Prop.Female Teachers | 0.318 |  | 0.009 |  |
|  | (0.605) | (0.496) | (0.500) |  |
| Girls:Prop.Female Teachers | -1.130 | 0.468 | $-0.540$ |  |
|  | $(1.180)$ | (1.000) | (1.040) |  |
| Prop.Female Teachers:Treatment | -0.823 | $-0.183$ | $-0.539$ |  |
|  | (0.835) | (0.700) | (0.650) |  |
| Prop.Female Teachers : Year(2015) | -0.450 | $-0.692$ | -1.190* |  |
|  | $(0.750)$ | (0.557) | $(0.632)$ |  |
| Girls:Prop.Female Teachers:Treatment | 2.310 | 0.763 | 1.790 |  |
|  | (1.650) | (1.400) | (1.380) |  |
| Girls:Prop.Female Teachers:Year(2015) | 1.460 | 1.940* | $2.940 * *$ |  |
|  | (1.410) | (1.170) | (1.420) |  |
| Prop.Female Teachers:Treatment:Year(2015) | 0.619 | 1.190 | 1.000 | All regressions include district dummies and controls school characteristics. Figures in brackets |
|  | (1.010) | (0.810) | (0.853) |  |
| Girls:Prop.Female Teachers:Treatment:Year(2015) | -1.880 | -3.030* | -2.660 |  |
|  |  |  |  | Regressions also include a full set of interaction |
| Observations | 159,129 | 159,129 | 159,129 | terms with a constant. Only the relevant |
| $\mathrm{R}^{2}$ | 0.248 | 0.257 | 0.283 | coefficients are shown here. |
| Note: | ${ }^{*} \mathrm{p}<0.1$; | ${ }^{*} \mathrm{p}<0.05$; | ${ }^{* *} \mathrm{p}<0.01$ |  |

## Is Technology Gender Neutral?

|  | Dependent variable: |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | English | Maths | Science |  |
| Prop.Male Teachers | -0.314 | 0.369 | -0.006 |  |
|  | $(0.603)$ | (0.494) | $(0.499)$ |  |
| Girls:Prop.Male Teachers | 1.120 | $-0.464$ | 0.531 |  |
|  | (1.180) | (0.999) | $(1.040)$ |  |
| Prop.Male Teachers:Treatment | 0.830 | 0.205 | 0.539 |  |
|  | $(0.830)$ | $(0.698)$ | $(0.648)$ |  |
| Prop.Male Teachers:Year(2015) | 0.437 | 0.684 | 1.180* |  |
|  | (0.748) | $(0.555)$ | $(0.629)$ |  |
| Girls:Prop.Male Teachers:Treatment | -2.330 | $-0.800$ | -1.770 |  |
|  | (1.640) | (1.390) | $(1.380)$ |  |
| Girls:Prop.Male Teachers:Year(2015) | -1.440 | -1.920* | $-2.930^{* *}$ |  |
|  | (1.410) | $(1.170)$ | $(1.420)$ |  |
| Prop.Male Teachers:Treatment:Year(2015) | -0.610 | -1.190 | -1.010 | All regressions include district dummies and controls school characteristics. Figures in brackets |
|  | $(1.000)$ | $(0.808)$ | $(0.846)$ |  |
| Girls:Prop.Male Teachers:dummytT:Year(2015) | 1.860 | 3.020* | 2.630 | are standard errors and are clustered at taluk level. Regressions also include a full set of interaction |
|  | (1.970) | (1.660) | (1.890) |  |
| Observations | 159,129 | 159,129 | 159,129 | terms with a constant. Only the relevant |
| $\mathrm{R}^{2}$ | 0.248 | 0.257 | 0.283 | coefficients are shown here. |
| Note: | * $\mathrm{p}<0.1$; | p<0.05; | * $\mathrm{p}<0.01$ |  |

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## Results - School




Figure: School Average English score, Figure: School Average English score, 2014 2015

## Results - School



Figure: School Average Maths score, 2014


Figure: School Average Maths score, 2015

## Results - School




Figure: School Average Science score, Figure: School Average Science score, 2014 2015

## School Level Average Value-add Scores

|  | Dependent variable: |  |  |
| :--- | :---: | :---: | :---: |
|  | English | Maths | Science |
|  | $(1)$ | $(2)$ | $(3)$ |
| Treatment | 0.447 | 0.078 | 0.983 |
|  | $(0.666)$ | $(0.781)$ | $(0.634)$ |
| Avg.English(2014) | $-0.459^{* * *}$ |  |  |
|  | $(0.031)$ |  |  |
| Avg.Maths(2014) |  | $-0.420^{* * *}$ |  |
|  |  | $(0.043)$ |  |
| Avg.Science(2014) |  |  | $\left(0.398^{* * *}\right.$ |
|  |  |  | $18.2032)$ |
| Constant | $16.000^{* * *}$ | $19.300^{* * *}$ | $18.20{ }^{*}$ |
|  | $(1.430)$ | $(2.510)$ | $(2.500)$ |
| Observations | 1,246 | 1,246 | 1,246 |
| R $^{2}$ | 0.408 | 0.335 | 0.364 |
| Note: | ${ }^{*} \mathrm{p}<0.1 ;{ }^{* *} \mathrm{p}<0.05 ;{ }^{* * *} \mathrm{p}<0.01$ |  |  |

All regressions include district dummies.
Figures in brackets are standard errors and are clustered at taluk level.

## Impact by Quartiles

Table: Pooled Regression - Quartiles - School Level Average Scores District Dummies

|  | School Average Scores |  |  |  |
| :--- | :---: | :---: | :---: | :---: |
|  | Q1 | Q2 | Q3 | Q4 |
| English | 1.184 | $2.109^{* *}$ | -0.605 | 0.796 |
|  | $(0.911)$ | $(0.842)$ | $(0.962)$ | $(1.318)$ |
| Maths | 0.085 | 1.493 | -1.200 | 0.335 |
|  | $(1.030)$ | $(0.920)$ | $(0.973)$ | $(1.329)$ |
| Science | -0.412 | $1.830^{*}$ | 1.084 | $2.575^{* *}$ |
|  | $(1.005)$ | $(0.940)$ | $(0.942)$ | $(1.166)$ |
| Note: | ${ }^{*} \mathrm{p}<0.1 ;{ }^{* *} \mathrm{p}<0.05 ;{ }^{* * *} \mathrm{p}<0.01$ |  |  |  |

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## Summarizing the Results

## Summarizing the Results

- Overall - Positive but not significant (yet)


## Summarizing the Results

- Overall - Positive but not significant (yet)
- Overall gender gap seen narrowing in favor of boys.


## Summarizing the Results

- Overall - Positive but not significant (yet)
- Overall gender gap seen narrowing in favor of boys.
- Schools around the median performance level benefit


## Summarizing the Results

- Positive impact seen on some socially disadvantaged groups.


## Summarizing the Results

- Positive impact seen on some socially disadvantaged groups.
- Girls within some socially disadvantaged groups are seen benefiting.


## Summarizing the Results

- Positive impact seen on some socially disadvantaged groups.
- Girls within some socially disadvantaged groups are seen benefiting.
- Positive impact on gender gap within some socially disadvantaged groups.


## Summarizing the Results

- Positive impact seen on some socially disadvantaged groups.
- Girls within some socially disadvantaged groups are seen benefiting.
- Positive impact on gender gap within some socially disadvantaged groups.


## Conclusion and Way Forward

- Interim Results
- Project expected to generate richer data at student level
- Overall impact seems positive after 3 months of intervention
- Though more attention needed towards equity impact of technology use

Thank You ...

## Pooled Regression on Quartiles by School Level Average

## Scores

|  | School Average Scores |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | English |  |  |  | Maths |  |  |  | Science |  |  |  |
|  | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
|  | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| Treatment | $\begin{aligned} & -0.189 \\ & (0.683) \end{aligned}$ | $\begin{aligned} & -0.214 \\ & (0.603) \end{aligned}$ | $\begin{aligned} & -0.885 \\ & (0.697) \end{aligned}$ | $\begin{aligned} & -0.958 \\ & (0.956) \end{aligned}$ | $\begin{gathered} 0.369 \\ (0.773) \end{gathered}$ | $\begin{gathered} 0.161 \\ (0.658) \end{gathered}$ | $\begin{gathered} 0.427 \\ (0.704) \end{gathered}$ | $-0.178$ <br> (0.964) | $\begin{gathered} 0.926 \\ (0.754) \end{gathered}$ | $\begin{gathered} \hline-1.417^{* *} \\ (0.673) \end{gathered}$ | $\begin{aligned} & -0.686 \\ & (0.682) \end{aligned}$ | $\begin{aligned} & -1.253 \\ & (0.846) \end{aligned}$ |
| Year(2015) | $\begin{gathered} -3.951^{* * *} \\ (0.652) \end{gathered}$ | $\begin{gathered} -7.653^{* * *} \\ (0.591) \end{gathered}$ | $\begin{gathered} -6.973^{* * *} \\ (0.710) \end{gathered}$ | $\begin{gathered} -10.338^{* * *} \\ (0.991) \end{gathered}$ | $\begin{aligned} & 1.793^{* *} \\ & (0.737) \end{aligned}$ | $\begin{gathered} -2.662^{* * *} \\ (0.645) \end{gathered}$ | $\begin{gathered} -1.391^{*} \\ (0.718) \end{gathered}$ | $\begin{gathered} -4.596^{* * *} \\ (1.000) \end{gathered}$ | $\begin{gathered} -2.156^{* * *} \\ (0.720) \end{gathered}$ | $\begin{gathered} -5.869^{* * *} \\ (0.659) \end{gathered}$ | $\begin{gathered} -6.394^{* * *} \\ (0.695) \end{gathered}$ | $\begin{gathered} -8.814^{* * *} \\ (0.877) \end{gathered}$ |
| Treatment:Year(2015) | $\begin{gathered} 1.184 \\ (0.911) \end{gathered}$ | $\begin{aligned} & 2.109^{* *} \\ & (0.842) \end{aligned}$ | $-0.605$ <br> (0.962) | $\begin{gathered} 0.796 \\ (1.318) \end{gathered}$ | $\begin{gathered} 0.085 \\ (1.030) \end{gathered}$ | $\begin{gathered} 1.493 \\ (0.920) \end{gathered}$ | $-1.200$ (0.973) | $\begin{gathered} 0.335 \\ (1.329) \end{gathered}$ | $-0.412$ <br> (1.005) |  | $\begin{gathered} 1.084 \\ (0.942) \end{gathered}$ | 2.575** <br> (1.166) |
| Constant | $\begin{gathered} 40.699^{* * *} \\ (1.492) \\ \hline \end{gathered}$ | $\begin{gathered} 45.928^{* * *} \\ (1.029) \\ \hline \end{gathered}$ | $\begin{gathered} 49.178^{* * *} \\ (0.996) \\ \hline \end{gathered}$ | $\begin{gathered} 56.854^{* * *} \\ (1.694) \\ \hline \end{gathered}$ | $\begin{gathered} 38.022^{* * *} \\ (1.688) \\ \hline \end{gathered}$ | $\begin{gathered} 46.047^{* * *} \\ (1.124) \\ \hline \end{gathered}$ | $\begin{gathered} 48.540^{* * *} \\ (1.007) \\ \hline \end{gathered}$ | $\begin{gathered} 54.448^{* * *} \\ (1.708) \\ \hline \end{gathered}$ | $\begin{gathered} 40.990^{* * *} \\ (1.648) \\ \hline \end{gathered}$ | $\begin{gathered} 48.272^{* * *} \\ (1.149) \\ \hline \end{gathered}$ | $\begin{gathered} 51.342^{* * *} \\ (0.975) \\ \hline \end{gathered}$ | $\begin{gathered} 58.436^{* * *} \\ (1.499) \\ \hline \end{gathered}$ |
| Observations | 624 | 622 | 624 | 622 | 624 | 622 | 624 | 622 | 624 | 622 | 624 | 622 |
| $\mathrm{R}^{2}$ | 0.182 | 0.357 | 0.344 | 0.322 | 0.120 | 0.109 | 0.118 | 0.164 | 0.175 | 0.241 | 0.274 | 0.280 |
| Adjusted $\mathrm{R}^{2}$ | 0.155 | 0.335 | 0.323 | 0.300 | 0.091 | 0.080 | 0.088 | 0.136 | 0.148 | 0.216 | 0.250 | 0.256 |
| Residual Std. Error | 5.685 | 5.250 | 5.985 | 8.146 | 6.428 | 5.734 | 6.051 | 8.215 | 6.275 | 5.861 | 5.857 | 7.208 |
| F Statistic | $6.717^{* * *}$ | $16.654^{* * *}$ | $15.832^{* * *}$ | $14.292^{* * *}$ | $4.102^{* * *}$ | $3.695^{* * *}$ | $4.015^{* * *}$ | $5.899^{* * *}$ | $6.402^{* * *}$ | $9.560^{* * *}$ | $11.394^{* * *}$ | $11.678^{* * *}$ |
| Note: |  |  |  |  |  |  |  |  |  | * $\mathrm{p}<0$. | 1; **p<0.05 | ${ }^{* * *} \mathrm{p}<0.01$ |

