Safety First: Perceived Risk of Street Harassment and Educational Choices of Women
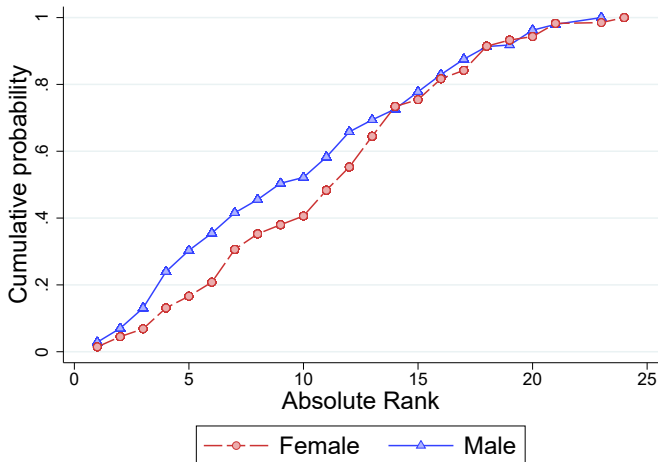
Girija Borker

World Bank

24 July 2020
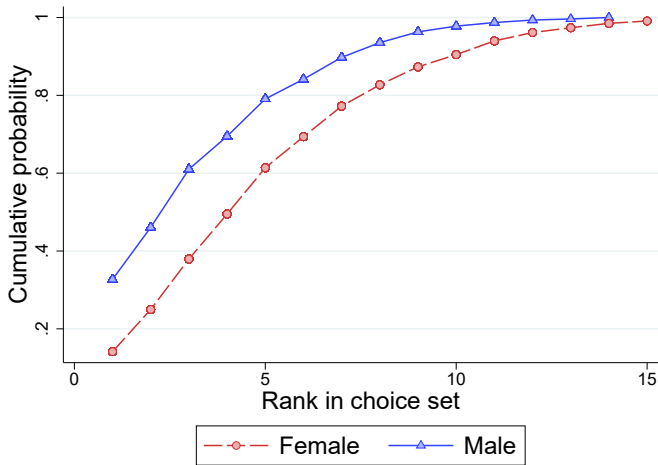
Educational Choices of Women

- Women in India choose to attend worse quality colleges than men
  - in absolute terms

Educational Choices of Women

- Women in India attend worse quality colleges than men
  - within their choice set

Impact of Educational Choices of Women

- Such sorting affects women's:
  - academic training *(Zhang 2005)*
  - network of peers *(Winston and Zimmerman 2004)*
  - access to labor opportunities *(Pascarella and Terenzini 2005)*
  - lifetime earnings *(Brewer, Eide, and Ehrenberg 1999)*

- This (mis)allocation has consequences for long term economic growth *(Hsieh et al. 2019)*

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Possible Explanations

- Many possible reasons why we see this allocation:
  - value of academics
  - value of time
  - competitiveness *(Niederle and Vesterlund 2007, Niederle and Vesterlund 2011, Buser et al. 2014)*

- I study one possible explanation = Safety in public spaces
  - in a context where majority of students live at home and travel to college daily and
  - men don't face sexual harassment in public spaces

Street Harassment

- 95% of females aged 16 to 49 years in Delhi feel unsafe in public spaces *(ICRW 2013)*

- 84% women under 40 in India report avoiding an area in their city because of harassment *(Livingston 2015)*
  - Delhi college students = 71%

Literature

- Fear of imagined dangers $\rightarrow$ individual behavior *(Becker and Rubinstein 2011)*

- Qualitative evidence in the psychology and criminology literature
  - women incur significant psychological costs from harassment *(Langton and Truman 2014)*
  - women change their behavior in response *(Pain 1997)*:
    mobility patterns *(Hsu 2011, Keane 1998, Portel et al. 2011)*
    labor force participation at the extensive margin *(Chakraborty et al. 2018, Siddique 2018)* and intensive margin *(Cook et al. 2020)*
    - ★ first study to measure the misallocation effects

- School attributes that matter from the school choice literature
  - proximity *(Carneiro, Das, and Reis 2013)*
  - academic attainment *(Gallego and Hernando 2009)*
  - student composition *(Hastings, Kane, and Staiger 2009)*
    - ★ first study to evaluate travel safety

- Spatial frictions $\rightarrow$ gender disparities in human capital acquisition
  - choice of location *(Mukherjee 2012, Burde and Linden 2013)*
  - better roads or provision of transport *(Muralidharan and Prakash 2017, Jacoby and Mansuri 2015, Cheema et al. 2020)*
    - ★ first study to measure the extent to which safety matters

Question

Does street harassment affect women's college choice?

This Paper

- Unique data
  - students' travel and college choices
  - route mapping using Google Maps
  - mobile app data on perceived safety

- Descriptive evidence
  - exploits admissions procedure to approximate changes in students' choice set

- Structural estimation
  - mixed logit model
  - uses spatial variation in students' origin, college locations and area safety
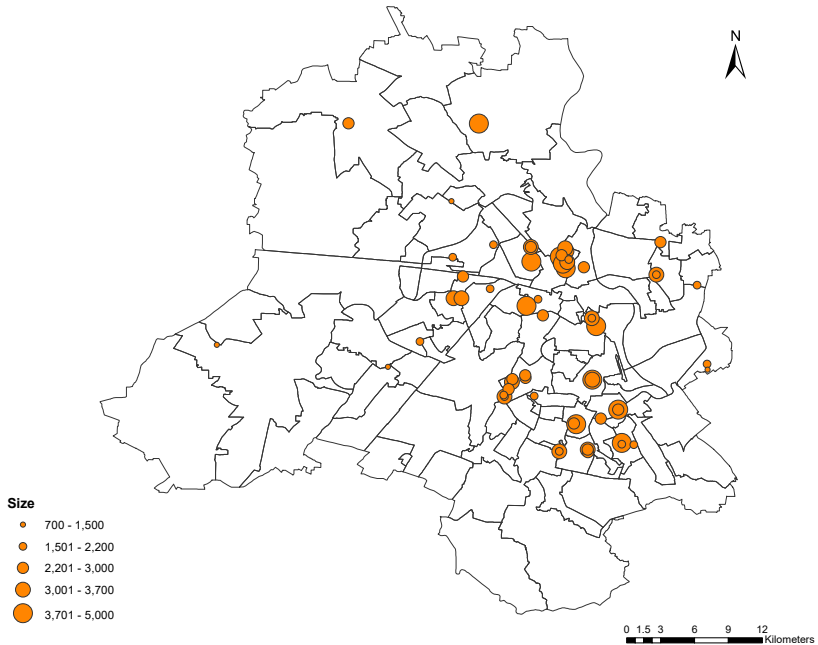
Background

Delhi University

- Delhi University (DU) is one of the best and largest universities in India:
  - 180,000 undergraduate students (2013-14) = 8% of students who passed high school exams in India

- DU is composed of 77 colleges:
  - each college has its own campus, staff, classes and placements

More about DU

Colleges in DU

Size
- 700 - 1,500
- 1,501 - 2,200
- 2,201 - 3,000
- 3,001 - 3,700
- 3,701 - 5,000

0 1.5 3   6   9   12
Kilometers

Delhi University

- Majority of the students (72%) are from Delhi NCR
  - 99.1% live at home with their parents and travel to college every day

- Students travel mostly by public transport
  - 83% use public transport

- Admissions in DU
  - strictly based on students' high school exam scores
  - cutoff scores for each college
    - determine each student's complete choice set of colleges

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Data

Data Overview
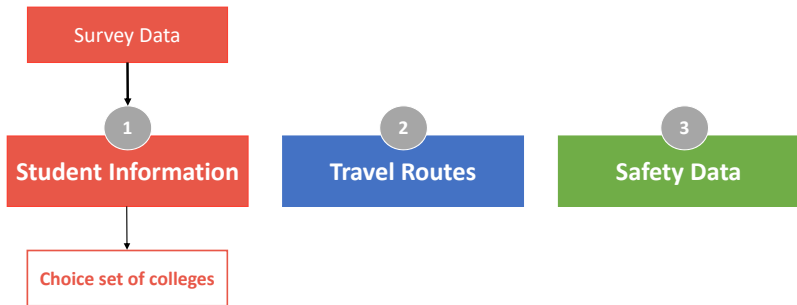
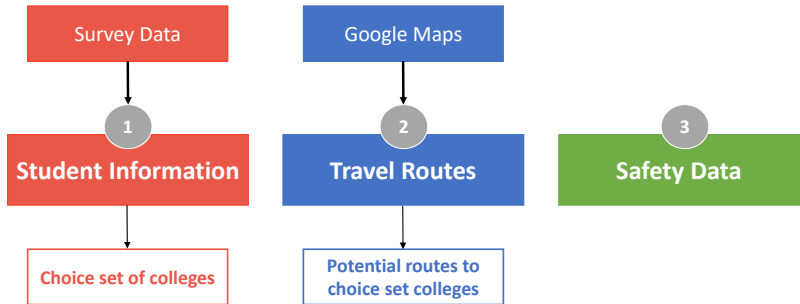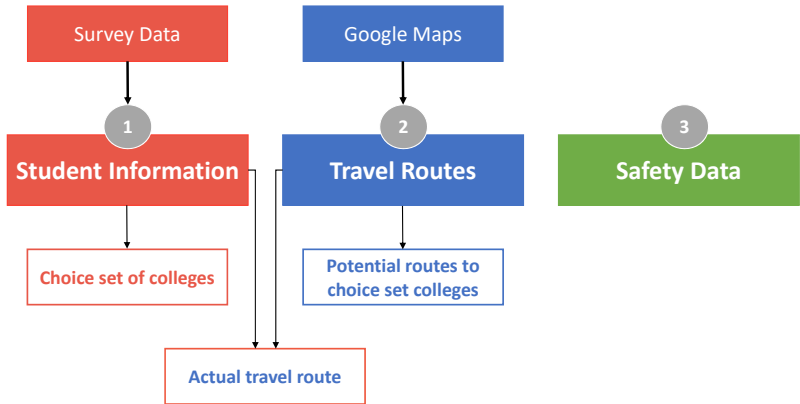**1** Student Information

2 Travel Routes

3 Safety Data

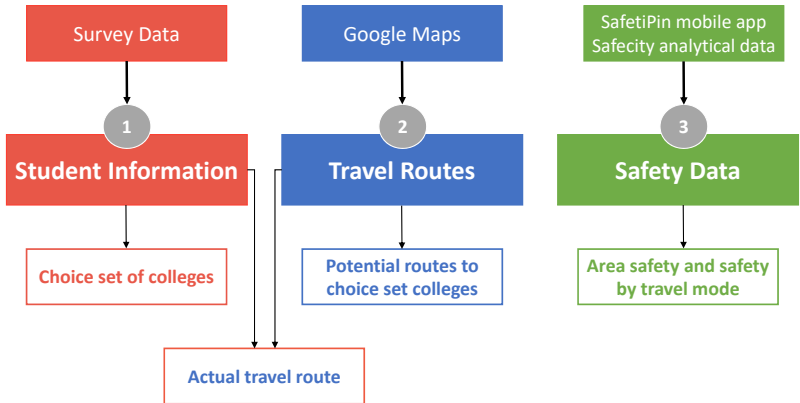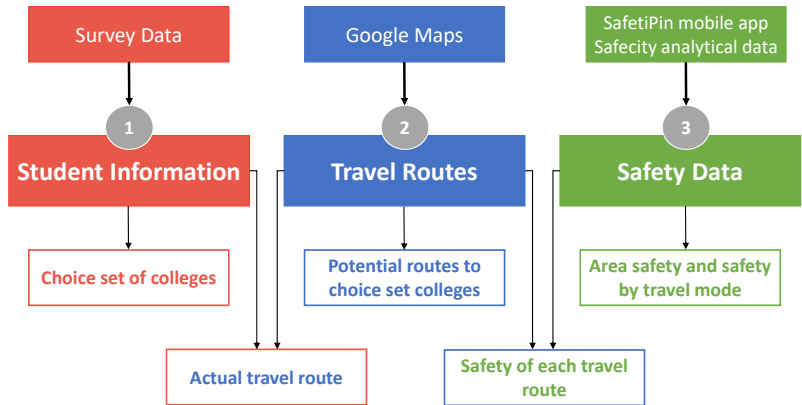# Data Overview

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Data

1 Student Information

2 Travel Routes

3 Safety Data

Survey Data on College Students

Detailed survey data of 3,800 male and female students across 8 colleges

- subject wise high school exam scores
- current and parental residential location
- exact travel route and modes
- household characteristics
- exposure to harassment

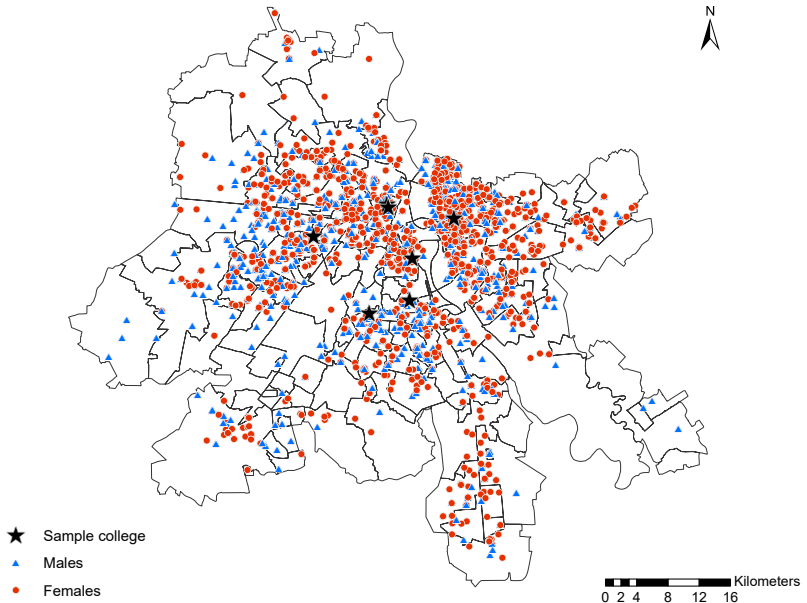Data collected during class at a time scheduled with the professor.

College in Sample   Quality distribution   Representative

Sample for Analysis

Delhi students who live with their parents and travel to college everyday

Data

Route Mapping using Google Maps

- Map potential routes to chosen college and each college in choice set
  - up to four routes per Google based travel option
    - ★ public transit
    - ★ driving only
    - ★ walking only
  - broken up into "travel legs" based on travel mode

- Map actual travel routes
  - landmarks
  - travel modes
  - departure time

- Overlap of reported routes with Google Map routes: 90%

Data

Safety Data

SafetiPin mobile app data on perceived safety (November 2013 - January 2016)

- characterizes the safety of location based on 9 parameters

- partially crowdsourced and in part collected by trained auditors
  - 98% contributors are 39 years or younger
  - 70% contributors are female

- over 26,000 audits across Delhi National Capital Region
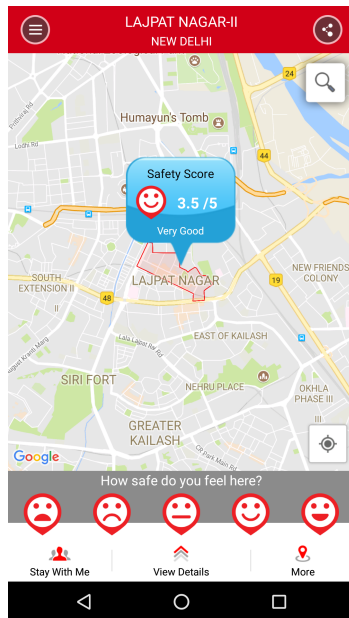
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Details

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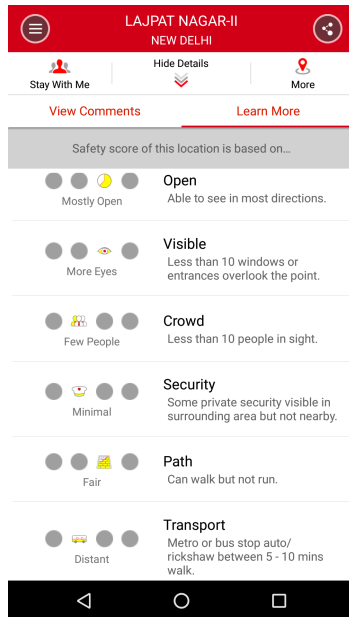
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Details

Safety Audit Data

Safety
- Low
- Medium
- High

Kilometers
0 2 4 8 12 16

Safety Surface

Safety
- Low
- Medium
- High

0 2 4   8   12   16 Kilometers
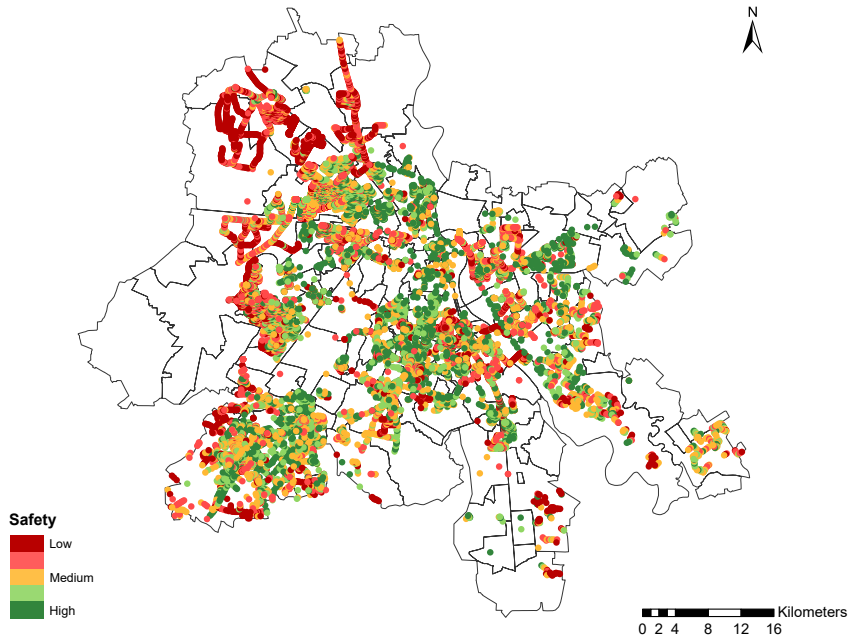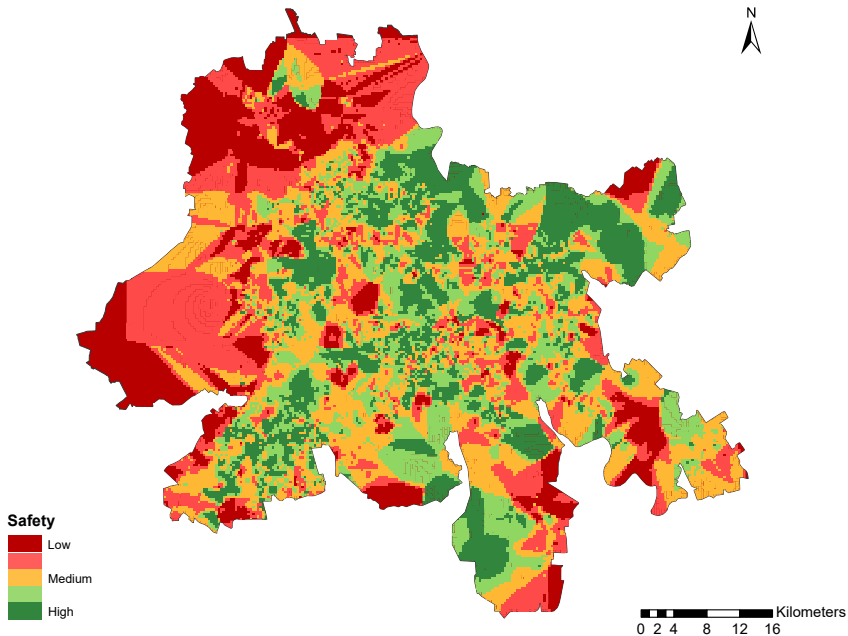
Safety Data by Travel Mode

Analytical data based on Safecity mobile app

- records personal stories of harassment in public spaces
  - ▸ data based on over 5,500 crowd-sourced reports

Travel Mode	% Harassment Incidents
Bus	0.40
Metro	0.16
Taxi	0.14
Auto Rickshaw	0.07
Train	0.05

- used to weight area safety by travel mode

How it all comes together

N

Student
Chosen college

Kilometers
0 2 4   8   12   16
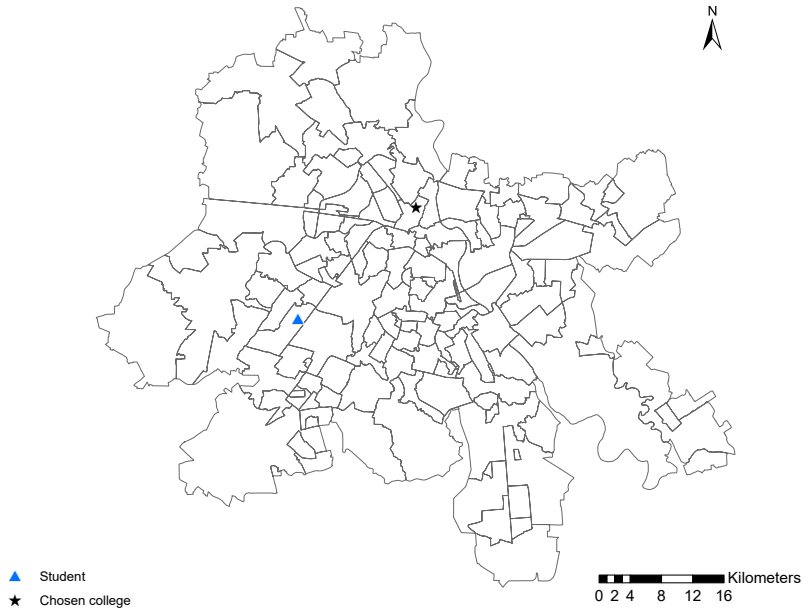
Reported Travel Route
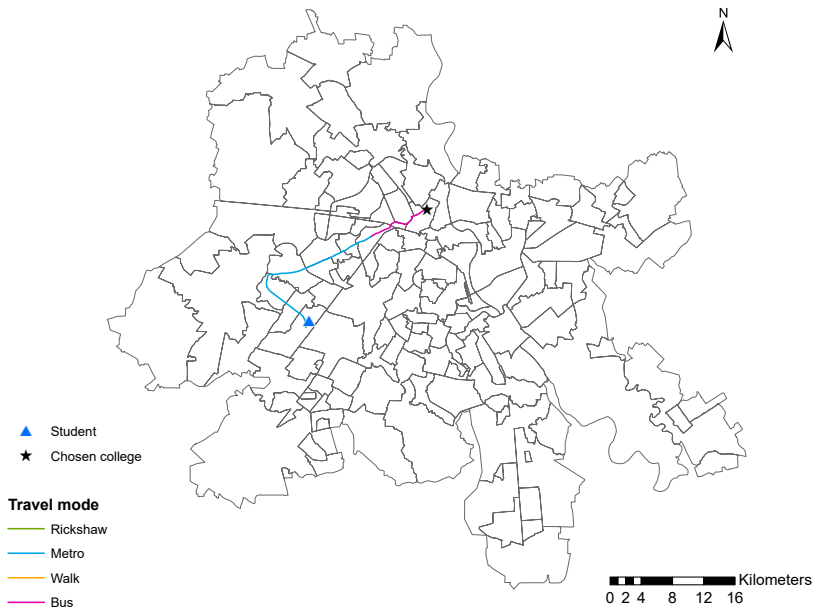
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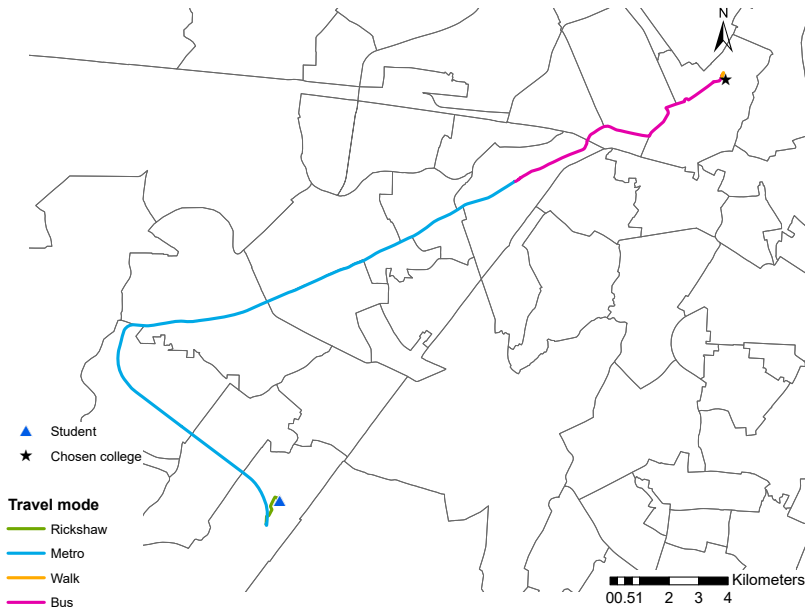
Potential Travel Routes

Colleges in Choice Set

Student
Chosen college
Choice set colleges

Kilometers
0 2 4   8   12   16
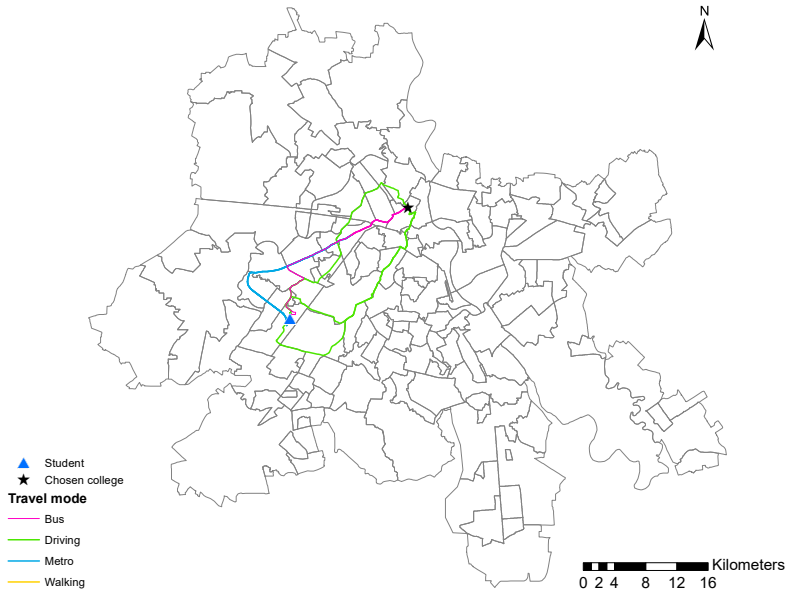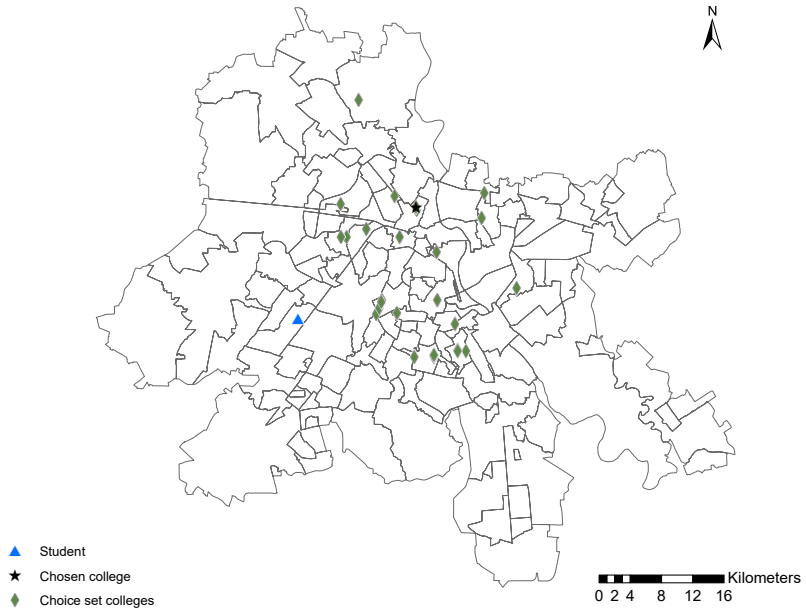
Potential Routes to Choice Set Colleges

Legend:
- ▲ Student
- ★ Chosen college
- ◆ Choice set colleges

Travel mode
- Bus
- Driving
- Metro
- Walking

N

0 2 4 8 12 16 Kilometers
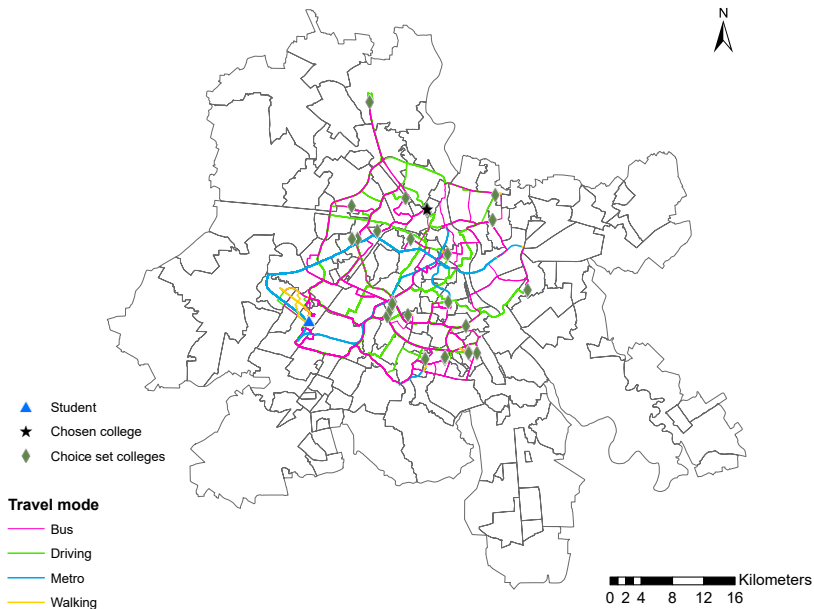
Travel across Safety Zones
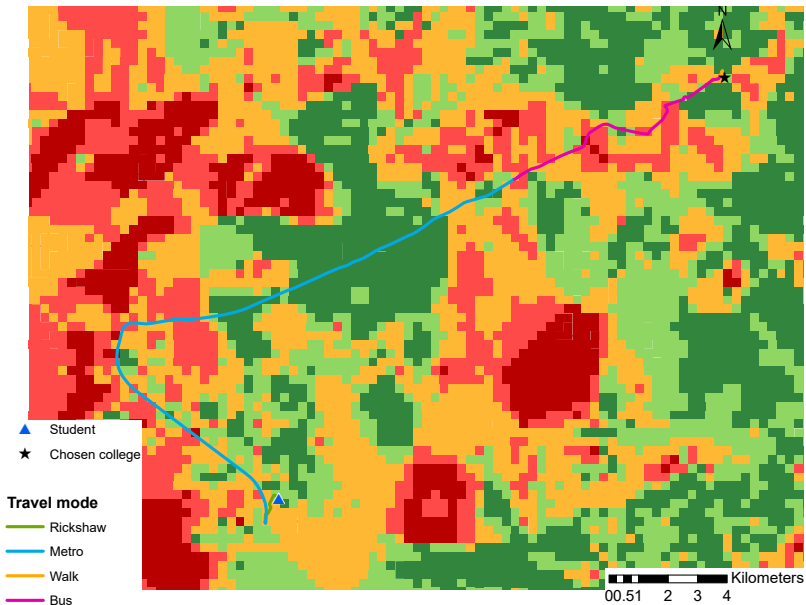
Safety Score of Travel Route

$$Safety\ of\ travel\ route =$$

$$\sum_m \sum_p \left[\frac{Area\ safety_p \times Route\ length_{mp}}{Total\ route\ length} \times (1 - Harassment_{mp}) \right]$$

▲ Student

★ Chosen college

Travel mode
— Rickshaw
— Metro
— Walk
— Bus

Kilometers
0 0.5 1 2 3 4
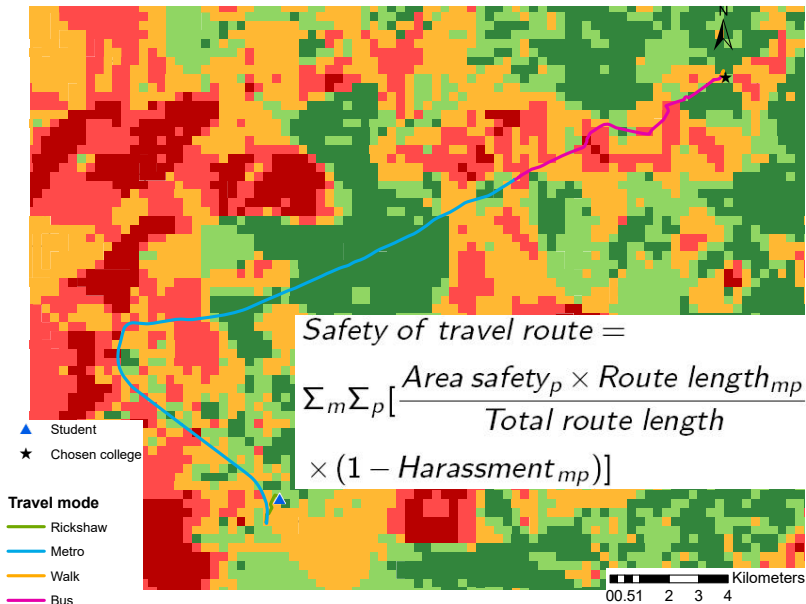
Descriptive Evidence

Changes in Students' Choice Set

- The ideal experiment = random allocation of college choice sets
  - student responses to variation in college and route attributes →
    underlying trade-offs

- Exploit DU's admissions procedure to approximate the ideal
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  - strictly based on high school exam scores

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Choice Relative to Neighbors

- Case-control match - compare choice of index student with neighbor:
  - ▸ lives in a 1.5km radius
  - ▸ same gender
  - ▸ same major
  - ▸ same year of admission

1,228 unique pairs

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Choice Relative to Neighbors

△ index student's choice response:
- safety
- quality
- time
- cost

(underlying preferences)

△ index student's exam score relative to neighbor →
(changes students' choice set)

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Travel Safety and College Quality
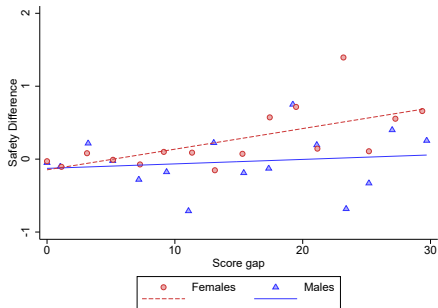
- women choose relatively safer routes as their choice set expands

- men don't respond in terms of safety
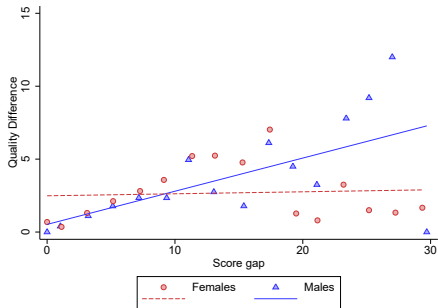
- positive quality gradient for both women and men

- significantly greater for men

Structural Model

Student Choice Model

Student i's utility is given by:

$$U^c_{ir} = \beta_{iq}\, Q^c_i + \beta_{is}\, S^c_{ir} + \beta_{it}\, T^c_{ir} + \beta_{ip}\, P^c_{ir} + \varepsilon^c_{ir}$$

where

- Q^c_i is college quality
- S^c_{ir} is safety of the travel route to college
- T^c_{ir} is the daily travel time to college
- P^c_{ir} is the monthly travel cost to college

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where

- Q_i^c is college quality = cutoff score More
- S_{ir}^c is safety of the travel route to college
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where

- Q_i^c is college quality
- S_{ir}^c is safety of the travel route to college
- T_{ir}^c is the daily travel time to college, in minutes
- P_{ir}^c is the monthly travel cost to college

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where

- Q_i^c is college quality
- S_{ir}^c is safety of the travel route to college
- T_{ir}^c is the daily travel time to college
- P_{ir}^c is the monthly travel cost to college, in thousand Rs.

Student Choice Model

- Student i's chooses college c and route r ($d_{ir}^c = 1$) such that the choice maximizes his or her utility over all possible colleges and routes in their choice set:

$$d_{ir}^c = 1 \quad \text{if and only} \quad \text{if} \quad U_{ir}^c > U_{is}^b \qquad \forall b \neq c \qquad \forall r \neq s$$
$$d_{ir}^c = 0 \quad \text{otherwise}$$

- Main variable of interest:

$$MRS_i^{QS} \equiv \frac{\triangle Q_i^c}{\triangle S_{ir}^c} = \frac{\beta_{is}}{\beta_{iq}} \tag{1}$$

Identification assumption:

- the location and attributes of the students, colleges, and possible routes are exogenous to the process of college and route choice

Mixed Logit Model

- Flexible substitution patterns albeit by imposing structure on the distribution of preferences

- Heterogeneity of preferences
  - eg. dislike harassment vs. + differential exposure
  - eg. value quality vs. + high decision making costs

- Estimation
  - random coefficients on safety, quality, time and cost
  - separately estimated for men and women
  - augment with fixed coefficients on additional college and route attributes

Distributional assumptions

- Random coefficients:
  - route safety, β_s and college quality, $\beta_q \sim$ triangular
  - travel time, β_t *and* travel costs, $\beta_c \sim$ restricted triangular, assumed to be non-positive

Identification

Several aspects of the context and data help in identification of parameters

1. **Students live at home with their parents**
   - ▶ parents unlikely to base their residential choices on location of their children's future preferred colleges
   - ▶ high rates of home ownership: 82% of Delhi residents live in owned houses
   - ▶ identify parameters separately from residential sorting

2. No sorting of colleges by quality and neighborhood or student characteristics
   - ▶ student characteristics Exam scores Gender SES
   - ▶ area characteristics Area safety
   - ▶ route characteristics Route safety

3. Admission cutoffs do not seem to take into account safety concerns
   - ▶ unable to predict the advantage given to women in cutoffs Predict advantage

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Results

Willingness to Pay

	Female	Male
	(1)	(2)
MRS (Safety, Score)	-8.80	-2.11
pp per SD of safety	[-39.05, -3.15]	[-3.30, -1.56]
MRS (Safety, Cost)	1.45	0.83
'000 Rs. per SD of safety	[1.33, 1.75]	[0.76, 1.05]
MRS (Safety, Time)	26.77	20.80
minutes per SD of safety	[24.63, 30.47]	[19.02, 24.41]

Notes: MRS are measured in terms of the SD of route safety *within* a students' choice set. Confidence interval in square bracket, computed using delta method.

Coefficients SD of safety Augmented Crime

Willingness to Pay

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Ranks per SD of safety

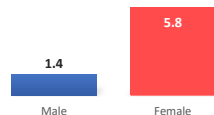Coefficients   SD of safety   Augmented   Crime

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Rupees per SD of safety

9,950

17,500

Male   Female
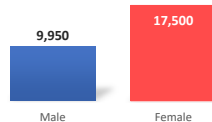
Coefficients   SD of safety   Augmented   Crime

Robustness

- Alternative majors Overlap

- Alternative safety measures Results

- Alternative samples Results

Conclusion

- Highlights the long term consequences of everyday harassment
  - 17% decline in PDV of post-college salaries using estimates from Sekhri (2019)

- Gender gaps in parental investments $\rightarrow$ wider gender gaps in lifetime earnings
  - this paper identifies an additional mechanism – the lack of safety

- Implications for other economic decisions
  - e.g. can help explain the puzzle of low female labor force participation in India

Thank you

gborker@worldbank.org

Delhi University

- Of the 58 general education undergraduate colleges:
  - 22 colleges are women only
  - 8 of the colleges are evening colleges

- 14 colleges have on-campus accommodation
  - for 5% of the students in the University

- 21 colleges have lower cutoffs for women (2014)
  - advantage varies from 1pp to 5pp

- DU fees is on average $\frac{1}{18}th$ to $\frac{1}{9}th$ of the fees in a private university in Delhi

Safety Parameters

		0	1	2	3
1	Light (Night)	**None.** No street or other lights.	**Little.** Can see lights, but barely reaches this spot.	**Enough.** Lighting is enough for clear visibility.	**Bright.** Whole area brightly lit.
2	Openness	**Not Open.** Many blind corners and no clear sightline.	**Partly Open.** Able to see a little ahead and around.	**Mostly Open.** Able to see in most directions.	**Completely Open.** Can see clearly in all directions.
3	Visibility	**No eyes.** No windows or entrances (to shops or residences) or street vendors.	**Few eyes.** Less than 5 windows or entrances or street vendors.	**More eyes.** Less than 10 windows or entrances or street vendors.	**Highly visible.** More than 10 windows or entrances or street vendors.
4	People	**Deserted.** No one in sight.	**Few people.** Less than 10 people in sight.	**Some crowd.** More than 10 people visible.	**Crowded.** Many people within touching distance.
5	Security	**None.** No guards or police visible in surrounding area.	**Minimal.** Some private security visible in surrounding area but not nearby.	**Moderate.** Private security within hailing distance.	**High.** Police/ reliable security within hailing distance.
6	Walk Path	**None.** No walking path available.	**Poor.** Path exists but in very bad condition.	**Fair.** Can walk but not run	**Good.** Easy to walk fast or run
7	Public Transport	**Unavailable.** No metro or bus stop, auto/ rickshaw within 10 minutes walk.	**Distant.** Metro or bus stop, auto/ rickshaw within 10 minutes walk.	**Nearby.** Metro or bus stop, auto/ rickshaw within 2-5 minutes walk.	**Very Close.** Metro or bus stop, auto/ rickshaw available within 2 minutes walk.
8	Gender Usage	**Not diverse.** No one in sight, or only men.	**Somewhat diverse.** Mostly men, very few women or children.	**Fairly diverse.** Some women and children.	**Diverse.** Balance of all genders or more women and children.
9	Feeling	**Frightening.** Will never venture here without sufficient escort.	**Uncomfortable.** Will avoid whenever possible.	**Acceptable.** Will take other available and better routes when possible.	**Comfortable.** Feel safe here even after dark.

Score distribution

Colleges in Sample

Full Survey Sample
Other colleges

0 1.5 3   6   9   12
Kilometers

Back
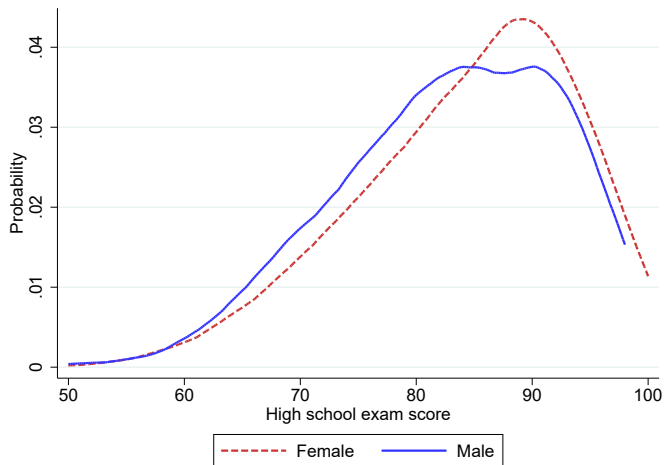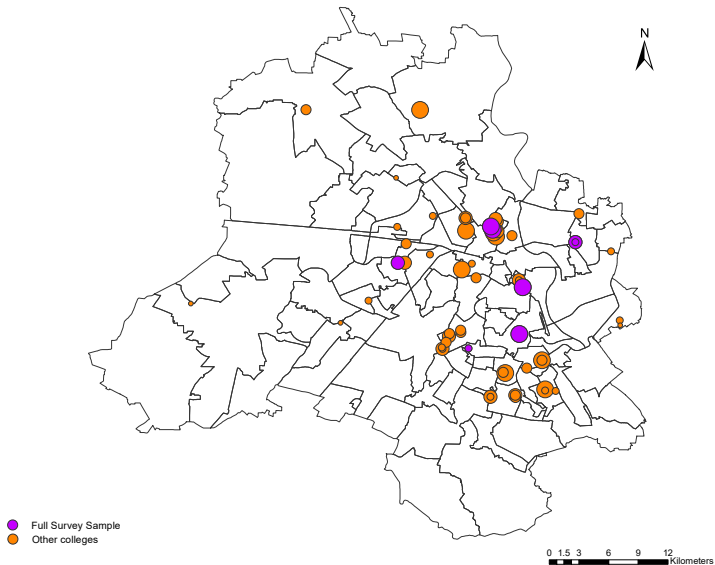
Colleges' Quality Distribution

The sample colleges are fairly evenly spread across the quality distribution

Political Science (Hons.)
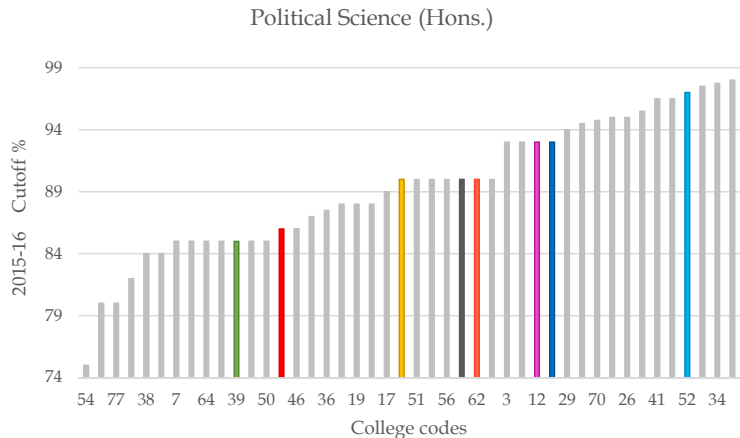
Each colored bar represents a college in the Full Survey Sample

Quality = first cutoff score for general category male students

Representative of DU

Confidential administrative data for all students in the 8 Full Survey Sample colleges Students

- current and parental residential location
- social category

Short survey data for 800 male and female students across 32 other colleges in DU Students

- combination of intercept and online survey
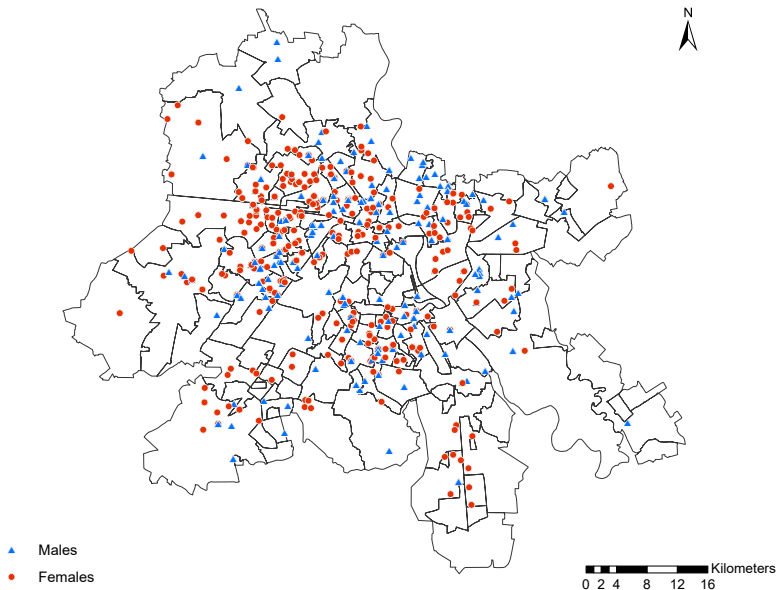- current and parental residential location
- high school exam scores
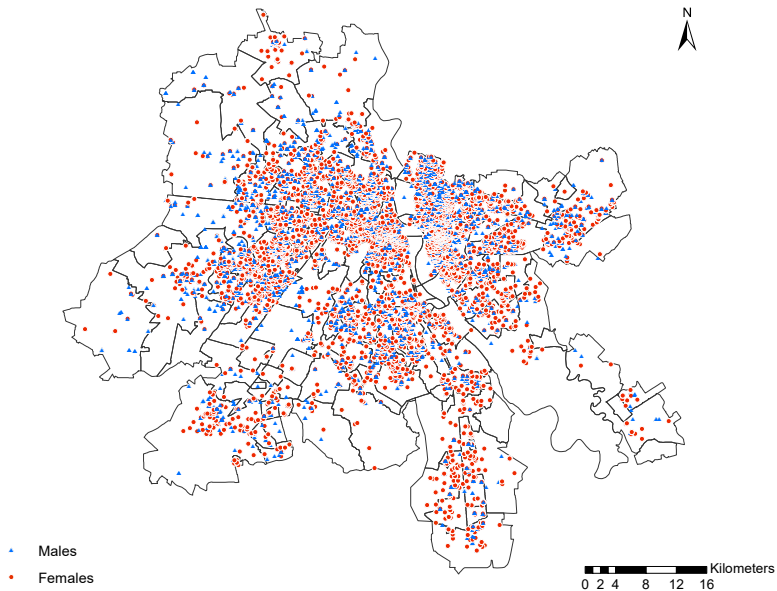
All Colleges Back

Comparing Samples

Data	Female			Male		
	Full Survey	Short Survey	Admin. Data	Full Survey	Short Survey	Admin. Data
Delhi residents	1,767	459	11,450	946	171	8,288
Proportion of surveyed	0.74	0.82	0.80	0.67	0.62	0.68
Social Category						
General	0.75	0.70	0.73	0.56	0.59	0.50
		[2.19]	[2.25]		[0.81]	[-3.05]
SC	0.12	0.11	0.14	0.20	0.14	0.19
		[-0.39]	[2.39]		[-1.91]	[-0.79]
ST	0.01	0.01	0.02	0.02	0.02	0.03
		[-1.07]	[1.80]		[-0.22]	[2.07]
OBC	0.11	0.18	0.11	0.22	0.25	0.27
		[3.69]	[-0.94]		[0.97]	[3.34]
High school exam score (%)	84.88	83.90	-	82.70	82.03	-
		[-2.05]			[-0.84]	
Distance to college (kms.)	13.06	11.98	13.34	13.05	15.63	14.30
	[-2.14]	[1.28]		[2.87]	[3.68]	
Distance to center (kms.)	15.42	12.11	15.05	15.99	15.93	16.49
		[-7.96]	[-1.92]		[-0.09]	[1.65]

Short Survey Sample

N

Males
Females

Kilometers
0 2 4   8   12   16

Back

Administrative Data

- ▲ Males
- ● Females

0 2 4 8 12 16 Kilometers

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Colciges in Sample

Full Survey Sample
Short Survey Sample
Other colleges

0 1.5 3   6   9   12
Kilometers

Back
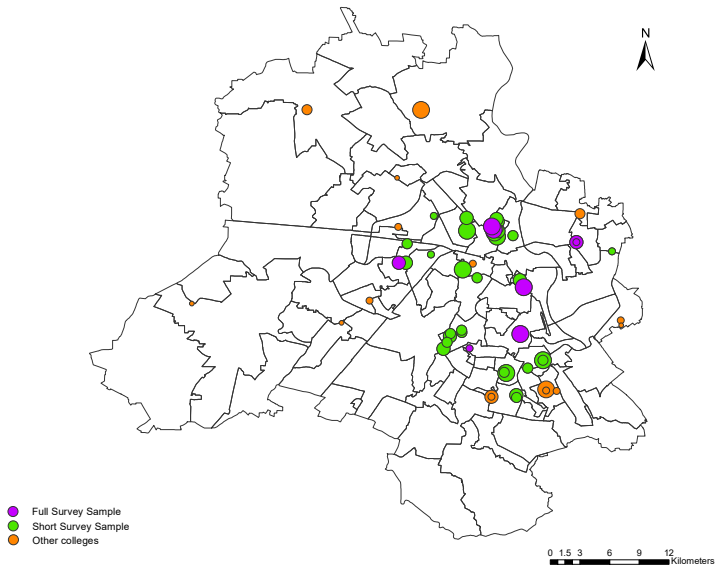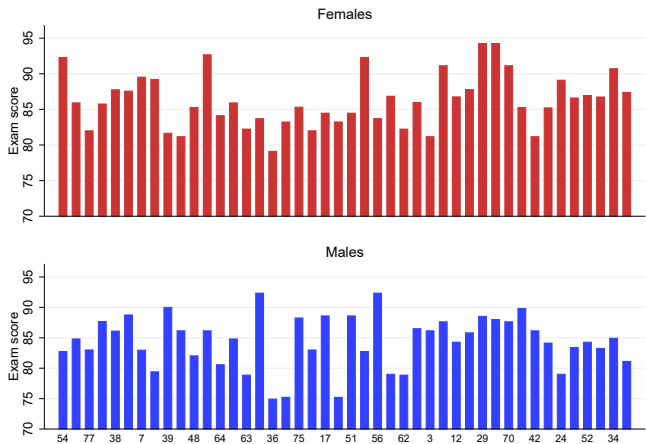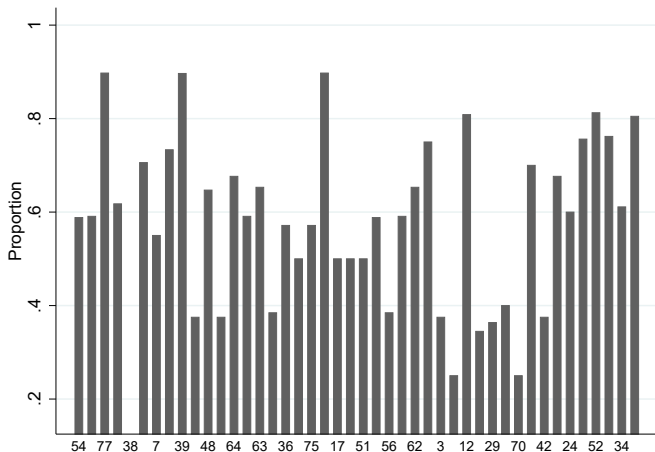
Proportion of accepted students who enrolled
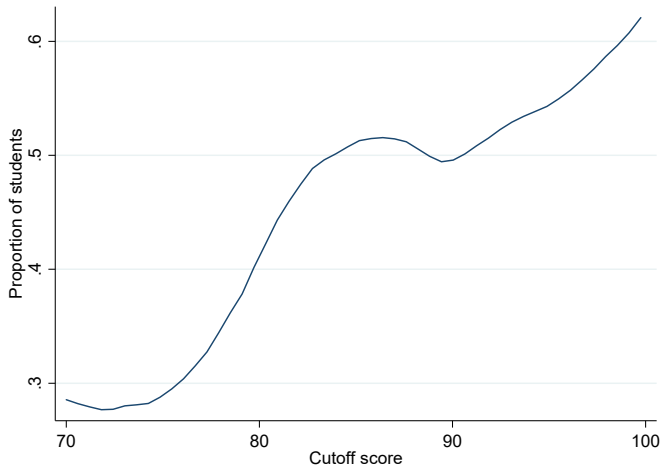
Exam Scores of Students

Each bar represents average exam scores for students in the neighborhood of a college.
The colleges are sorted in ascending order of quality.

Proportion of Female Students

Each bar represents proportion of female students in the neighborhood of a college. The colleges are sorted in ascending order of quality.
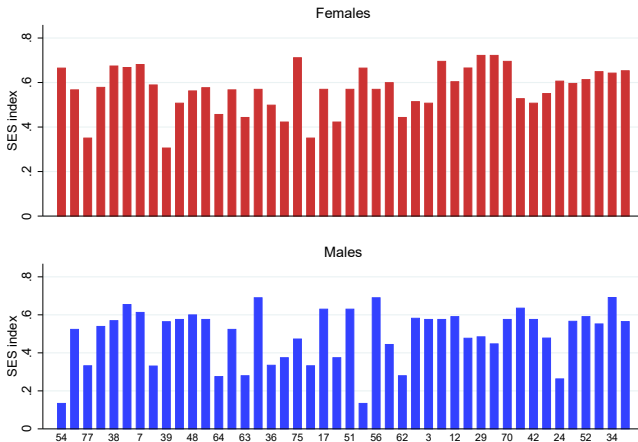
SES of Students

Each bar represents average SES index for students in the neighborhood of a college. The colleges are sorted in ascending order of quality.

Neighborhood Safety
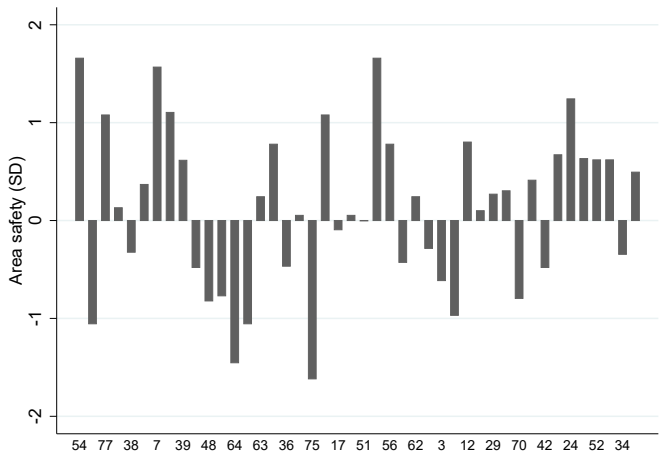
Each bar represents neighborhood safety for a college. The colleges are sorted in ascending order of quality.

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Route Safety

Each bar represents neighborhood safety for a college. The colleges are sorted in ascending order of quality.

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Proportion of Female Students

	Advantage to women in 2014
Proportion female in 2013	-0.088
	(2.049)
College neighborhood safety	0.057
	(0.244)
Boarding	-1.967
	(0.626)
Number of majors	0.037
	(0.054)
Size of college	0.000
	(0.000)
Annual tuition	-0.000
	(0.000)
Constant	1.597
	(0.994)
Mean of Y	1.415
Observations	41

Estimating the MRS

```
┌─────────────────────┐     ┌─────────────────────┐     ┌─────────────────────┐
│ Predict optimal route│     │  Assume predicted   │     │ Predict college based│
│      for each        │────▶│  route is chosen    │────▶│  on predicted route  │
│  student x college   │     │                     │     │                      │
└─────────────────────┘     └─────────────────────┘     └─────────────────────┘
```
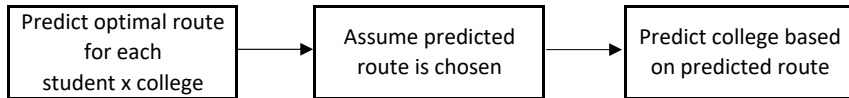
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Mixed Logit Coefficients

	Female		Male	
	(1)	(2)	(3)	(4)
Random coefficients				
Route safety	0.705	1.010	0.468	0.570
	(0.025)	(0.033)	(0.034)	(0.043)
Cutoff score	0.065	0.045	0.143	0.162
	(0.007)	(0.007)	(0.012)	(0.014)
Daily travel time	-0.014	-0.023	-0.014	-0.019
	(0.001)	(0.002)	(0.002)	(0.002)
Monthly travel cost	-0.256	-0.115	-0.352	-0.303
	(0.015)	(0.018)	(0.026)	(0.029)
Fixed coefficients				
College neighborhood safety		0.159		0.088
		(0.037)		(0.042)
Size of college		0.001		0.001
		(0.000)		(0.000)
Women's only college		0.591		-
		(0.056)		
Public transport mode		1.581		0.601
		(0.077)		(0.109)
Number of students	1,767	1,767	946	946
Observations	289,121	298,121	112,958	112,958
Log-likelihood	-7985.66	-6825.76	-3901.95	-3807.22

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Augmented Specification

	Female (1)	Male (2)
MRS (Safety, Score) pp per SD of safety	-13.52 [-28.79, -7.69]	-2.93 [-12.20, -1.19]
MRS (Safety, Cost) '000 Rs. per SD of safety	4.47 [4.28, 4.86]	1.13 [1.04, 1.39]
MRS (Safety, Time) minutes per SD of safety	22.70 [19.70, 27.74]	18.13 [16.11, 22.62]

Notes: MRS are measured in terms of the SD of route safety *within* a students' choice set. Confidence interval in square bracket, computed using delta method. This specification includes controls for college size, college neighborhood safety, an indicator for women's only colleges and an indicator for whether the dominant mode of the travel route is public transport characterized by group travel.

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Major Overlap

- All results conditional on major choice
- Students apply to several majors $\rightarrow$ could be a margin of choice

Number of Majors	% students
1	0.41
2	0.20
3	0.18
4	0.08
5	0.13

Notes: This table shows the number of majors students applied for at the time of admission and the proportion of students.

- Related majors have significant overlap

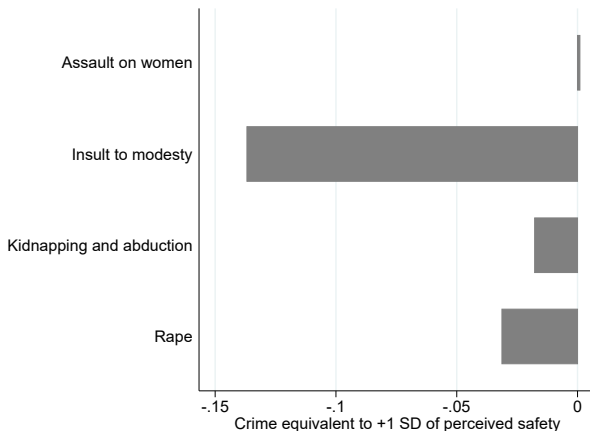| Related Majors	Overlap in choice set
Arts General, Commerce General	0.96
Commerce, Commerce General	0.78
Commerce, Economics	0.84
History, English	0.77
Political Science, Hindi	0.93
Political Science, English	0.82
Political Science, History	0.76

Notes: This table shows the percentage overlap in college choice sets for related majors.

Alternative Safety Measures

	Female (1)	Male (2)
Panel A: Excluding "Crowd"		
Route safety (SD)	0.504	0.394
	(0.027)	(0.039)
Cutoff score	0.062	0.142
	(0.006)	(0.012)
Route time (mins.)	-0.015	-0.015
	(0.001)	(0.002)
Monthly travel cost (thousand Rs.)	-0.173	-0.278
	(0.013)	(0.024)
Panel B: Excluding "Light"		
Route safety (SD)	0.496	0.325
	(0.027)	(0.039)
Cutoff score	0.060	0.139
	(0.006)	(0.011)
Daily travel time (mins.)	-0.015	-0.016
	(0.001)	(0.002)
Monthly travel cost (thousand Rs.)	-0.175	-0.279
	(0.013)	(0.024)
Number of students	1,767	946
Observations	289,121	112,958

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Reported Crime and Perceived Safety

Figure: Reported Crime and Perceived Safety

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