The Relative Academic Achievement of International Students: Evidence from an Ontario University

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Background

- Growing international student share of Canadian university enrolments (4.1% in 1992/93 to 8.2% in 2009/10 to 15.7% in 2018/19 and expected to be close to 17% in 2019/20).
- Shifting preference for former international students in immigrant selection policy (8.1% of new PRs in 2007 to 12.4% in 2016, IMDB).
- Disparities in labour market outcomes relative to domestic counterparts graduating from similar academic programs (Hou and Lu 2017; Chen and Skuterud 2018).
  - Evident in earnings, employment rates, occupations, and likelihood jobs match educational field and level of study
  - Some evidence that disparities growing over time

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Research questions

→ What explains labour market challenges of former international students?

- Relative labour market skills and abilities (e.g., language)
- Labour market inefficiencies (e.g., discrimination and job search frictions, but not credential recognition)

University course grades: (i) predict starting salaries (Jones and Jackson 1990; Chia and Miller 2008); and (ii) are less likely to reflect discrimination than labour market outcomes.

→ What is the relative academic performance of international students?

→ Has relative performance changed over time as their share of enrolments has increased?

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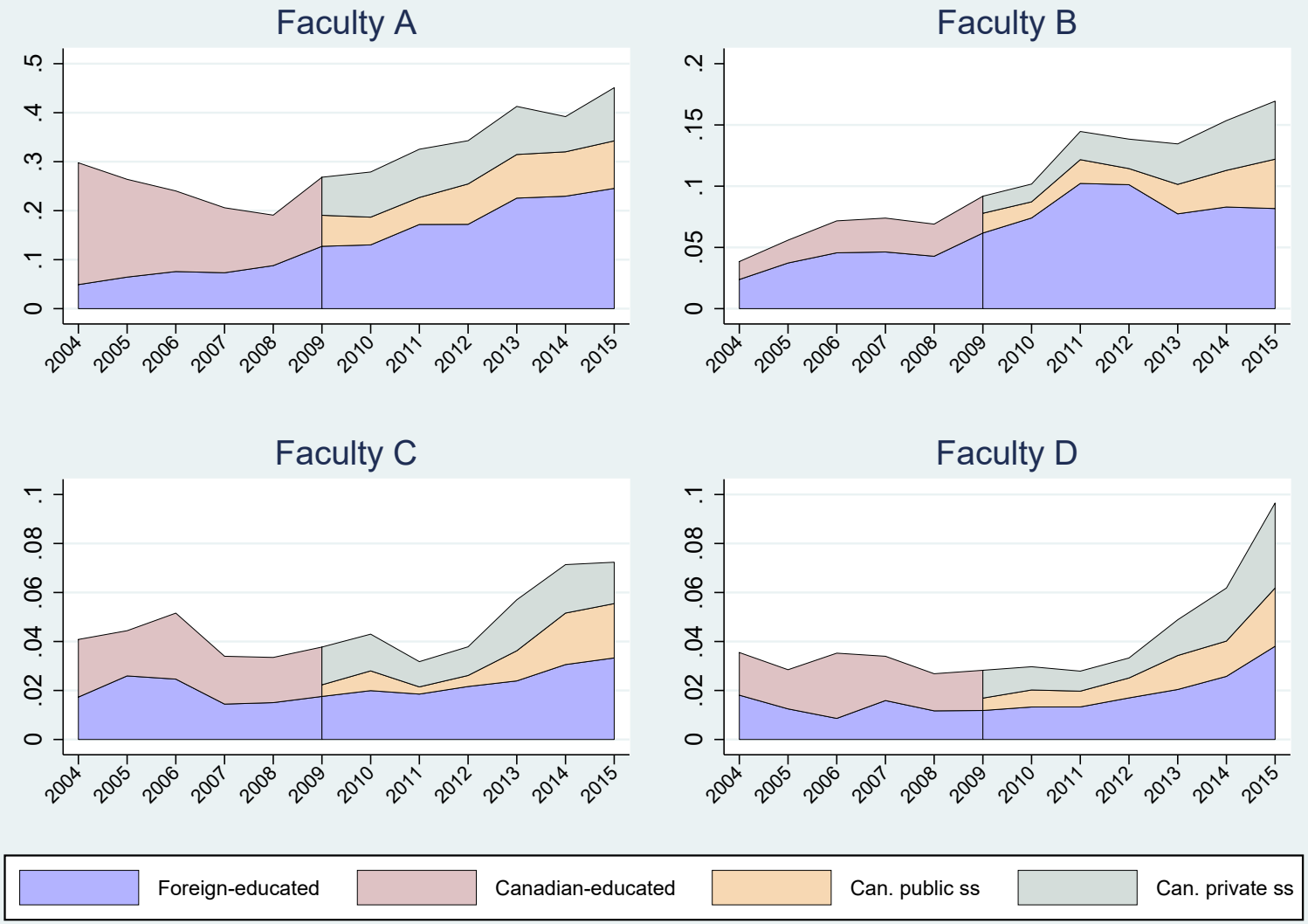
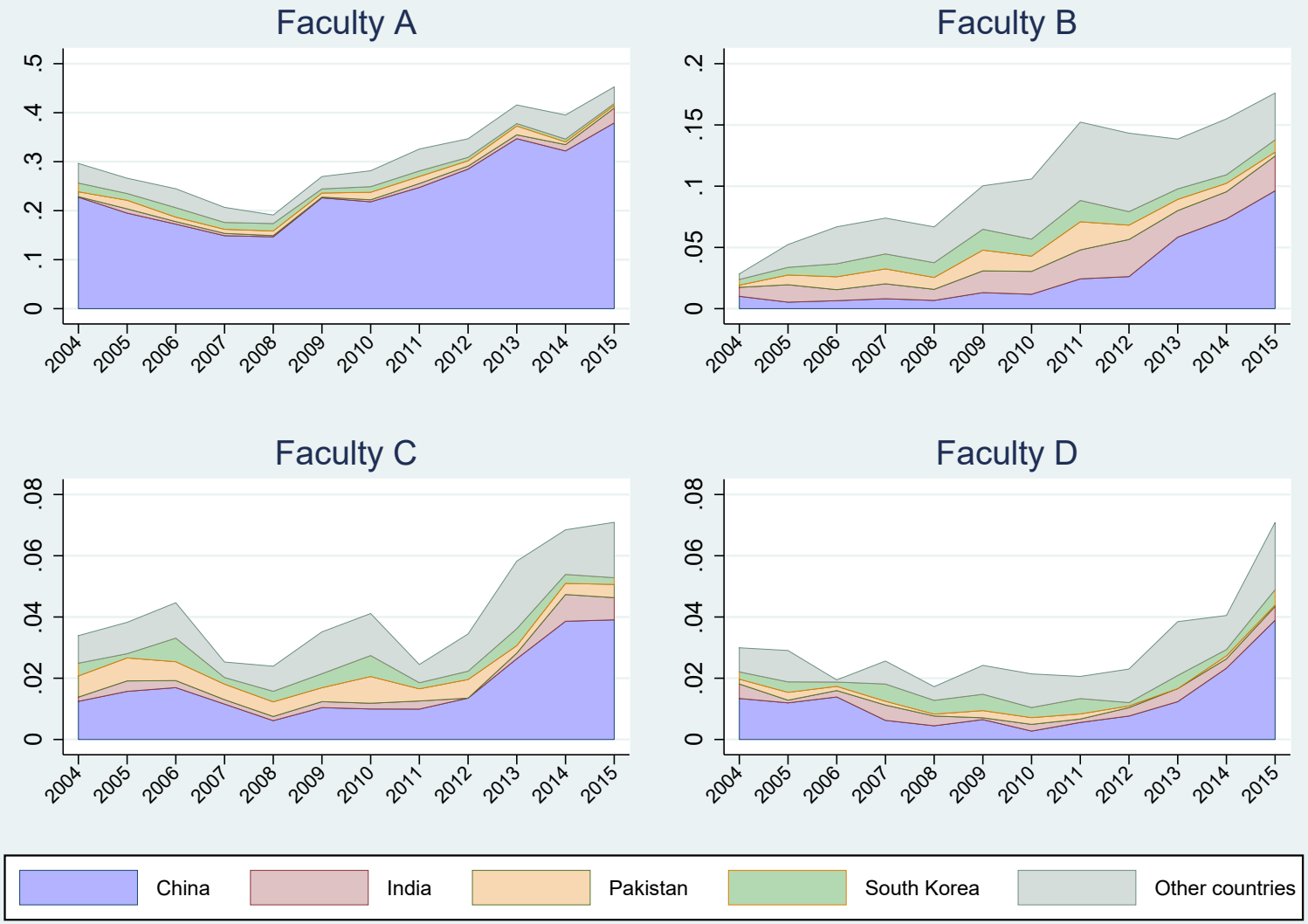
Data

- Publicly-funded university located in Ontario with a large and growing international student presence
- All undergraduate course grades of 2004-2015 entry cohorts
- Four faculty groups:
  - A & B: technology, engineering, and mathematics
  - C: arts, humanities, business, and social sciences
  - D: sciences
- Distinguish international students with foreign and Canadian high school diplomas (FEIS vs. CEIS)
- Sample sizes: 439,338 (A); 551,844 (B); 536,560 (C); 715,701 (D)

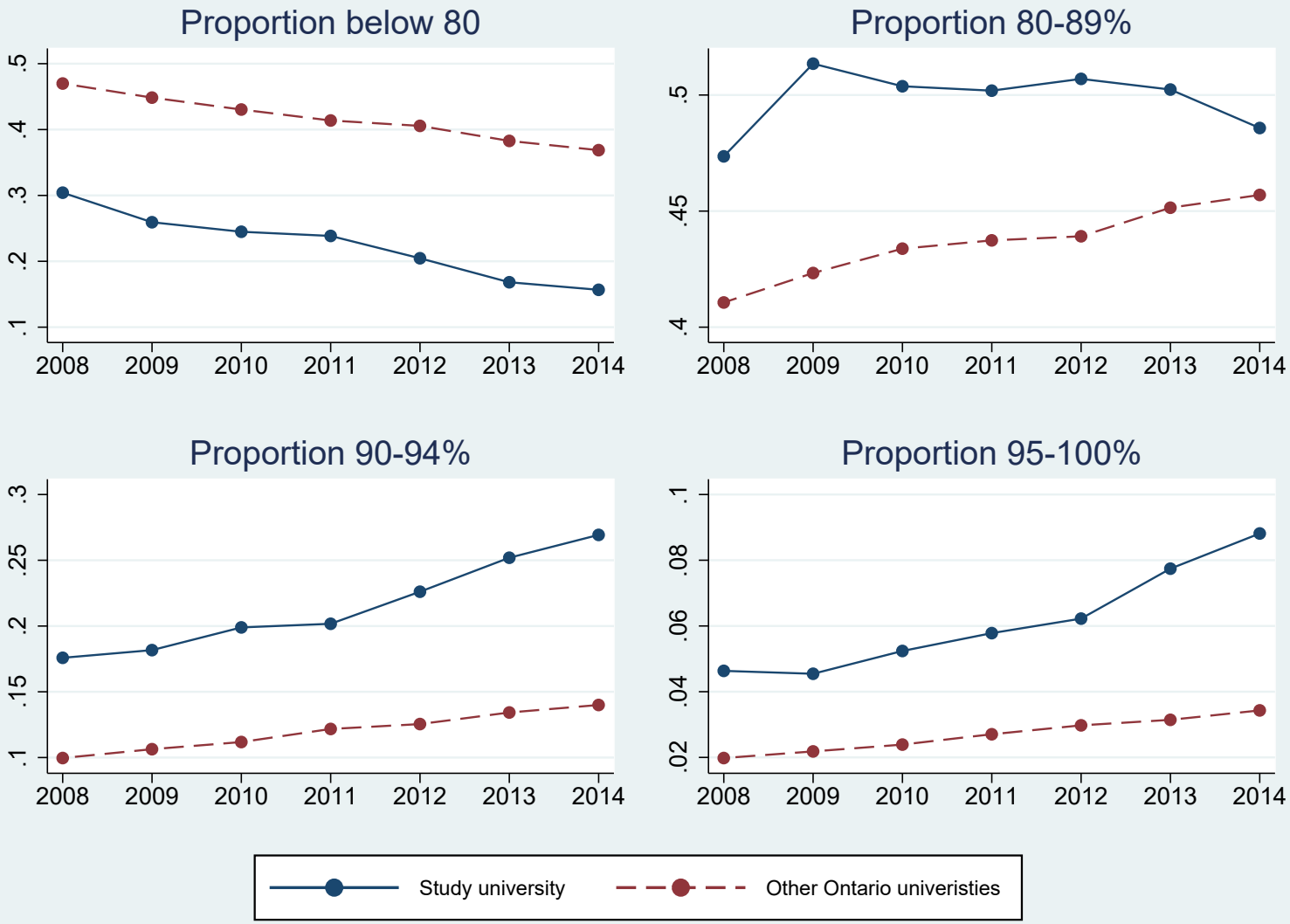
International student enrolment shares



Foreign student country of citizenship



Entering average grades of applicants



Theory

Student quality in foreign (f) and domestic (d) populations:

$$q_j \sim \mathrm{N}(\mu_j^q, \sigma_j^q) \text{ for } j = \{f, d\}.$$

University attracts foreign and domestic applicants with probability π_j in population n_j.

Uses high school entry grades e_j to signal student quality:

$$e_j = q_j + u_j, \text{where } u_j \sim \mathrm{N}(\mu_j^u, \sigma_j^u).$$

Pools applicants and sets $\underline{e}$ as a function capacity c, as well as n_j and π_j.

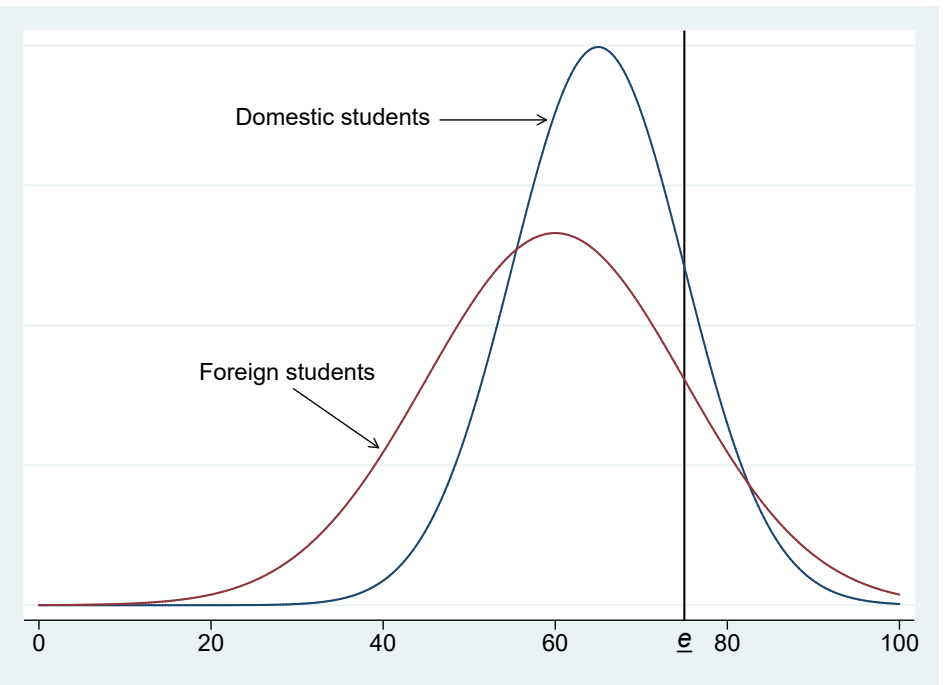
Relative quality of applicant pool

Assuming entry grades identify student quality perfectly ($q_j = e_j$), the mean quality of admitted foreign and domestic students is:

$$\mathrm{E}(e_j | e_j > \underline{e}) = \mu_j^q + \sigma_j^q \left[\frac{\phi(\mu_j^q, \sigma_j^q; \underline{e})}{1 - \Phi(\mu_j^q, \sigma_j^q; \underline{e})} \right].$$

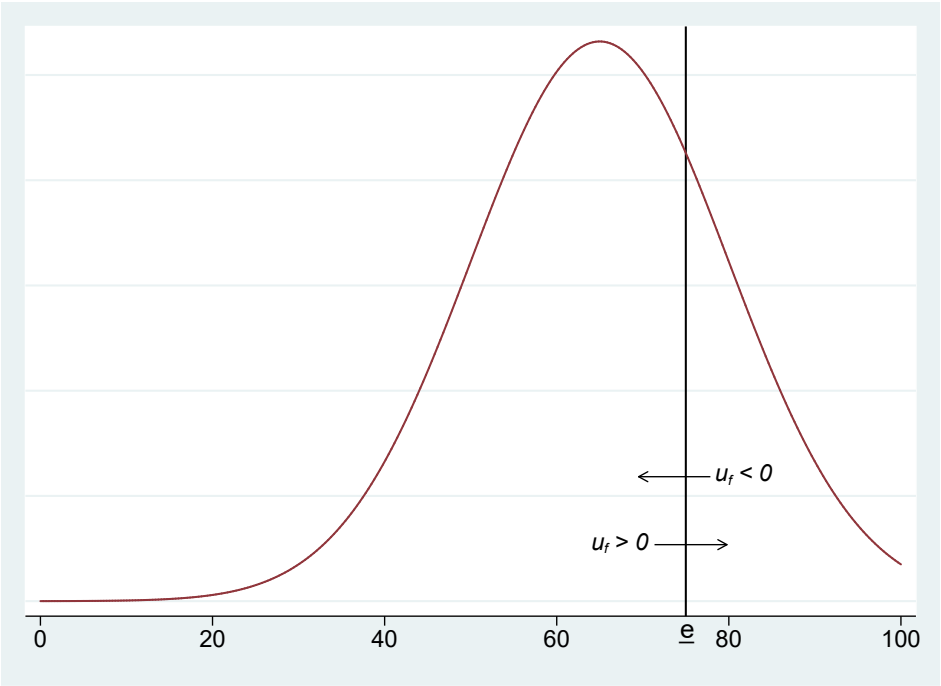
$\mu_f < \mu_d$, $\sigma_f > \sigma_d$:

If σ difference large relative to μ difference, mean quality of foreign students higher.
Difference larger at upper end of distribution.



Entry grades as imperfect quality signal

Foreign student entry grades are measured with mean-zero error ($e_f = q_f + u_f$ and $\mu_f^u = 0$, $\sigma_f^u > 0$).



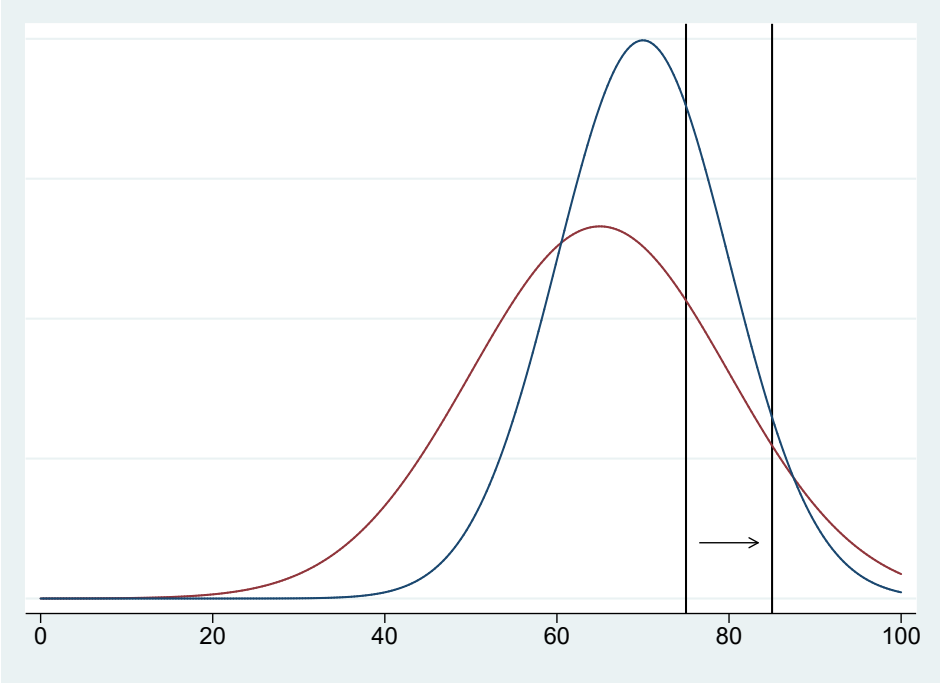
Noisy entry grades reduce mean quality of admitted students.
Difference largest at bottom end of distribution.

Increase in foreign student applications

Foreign recruitment produces a distribution-preserving increase in foreign applications. Without an equivalent increase in capacity, $\underline{e}$ increases.

$$\frac{d\mathrm{E}(e_j|e_j > \underline{e})}{d\underline{e}} = \lambda(\alpha_j)\left[\lambda(\alpha_j) - \alpha_j\right] > 0$$

which is increasing in:
$\alpha_j = (\underline{e} - \mu_j)/\sigma_j$.



Relative gains in academic performance should be largest at the top end of the grade distribution.

Empirical specification

1. Estimate two-way fixed effects model

$$\underbrace{g_{ijt}}_{\text{course grade}} = \underbrace{\theta_i}_{\text{student FEs}} + \underbrace{\alpha_j}_{\text{course-instructor FEs}} + \underbrace{\sum_a \gamma_a d_{it}^a}_{\text{terms since enrollment FEs}} + \underbrace{\varepsilon_{ijt}}_{\text{error}}$$

2. Relative fixed effects of foreign students

$$\underbrace{\hat{\theta}_i}_{\text{student FEs}} = \underbrace{\sum_c \pi_c d_i^c}_{\text{entry cohort FEs}} + \underbrace{f_i \left(\lambda^f + \pi^f c_i\right)}_{\text{relative foreign student quality}} + \underbrace{\mu_{ijt}}_{\text{error}}$$

3. Predictive error of entry grades

$$\underbrace{\hat{u}_i}_{\text{noise}} = \underbrace{e_i}_{\text{entry grade}} - \underbrace{\hat{\theta}_i}_{\text{student FEs}}$$

Relative fixed effects of foreign students

Faculty A						
	5th	25th	50th	75th	95th	ols
is	-3.775**	-2.809***	-3.495***	-4.918***	-3.617***	-3.531***
	(1.569)	(0.652)	(0.631)	(0.626)	(0.721)	(0.505)
is*cohort trend	0.071	0.006	0.101	0.331***	0.250**	0.117*
	(0.217)	(0.090)	(0.087)	(0.087)	(0.100)	(0.070)
observations	14,059	14,059	14,059	14,059	14,059	14,059
R-square	0.021	0.014	0.011	0.008	0.006	0.020
ceis	-5.484***	-4.405***	-5.630***	-7.518***	-7.583**	-5.643***
	(1.957)	(0.884)	(0.840)	(0.788)	(0.945)	(0.659)
ceis*cohort trend	0.115	0.061	0.189*	0.378***	0.442***	0.183**
	(0.249)	(0.113)	(0.107)	(0.100)	(0.120)	(0.084)
feis	0.634	1.988	2.223*	1.637	0.175	1.281
	(2.690)	(1.215)	(1.154)	(1.083)	(1.300)	(0.907)
feis*cohort trend	-0.279	-0.361***	-0.369***	-0.227*	-0.062	-0.269***
	(0.308)	(0.139)	(0.132)	(0.124)	(0.149)	(0.104)
observations	14,059	14,059	14,059	14,059	14,059	14,059
R-squared	0.022	0.016	0.014	0.014	0.011	0.026

Relative fixed effects of foreign students

Faculty B						
	5th	25th	50th	75th	95th	ols
is	-5.377***	-3.056***	-1.941***	-1.788**	-0.447	-2.357***
	(1.969)	(0.892)	(0.696)	(0.763)	(0.926)	(0.626)
is*cohort trend	-0.080	-0.109	-0.165*	-0.0466	-0.127	-0.119
	(0.258)	(0.117)	(0.091)	(0.100)	(0.121)	(0.082)
observations	16,053	16,053	16,053	16,053	16,053	16,053
R-square	0.026	0.012	0.012	0.010	0.011	0.024
ceis	-3.819	-3.477**	-2.003	-1.800	1.821	-2.022*
	(3.599)	(1.608)	(1.260)	(1.383)	(1.669)	(1.123)
ceis*cohort trend	-0.020	0.067	-0.047	-0.031	-0.390**	-0.066
	(0.400)	(0.179)	(0.140)	(0.154)	(0.186)	(0.125)
feis	-5.891**	-2.525**	-1.588	-1.662	-0.767	-2.156**
	(2.806)	(1.254)	(0.982)	(1.078)	(1.301)	(0.875)
feis*cohort trend	-0.222	-0.231	-0.212*	-0.077	-0.080	-0.180*
	(0.335)	(0.150)	(0.117)	(0.129)	(0.155)	(0.105)
observations	16,053	16,053	16,053	16,053	16,053	16,053
R-square	0.026	0.012	0.012	0.010	0.011	0.024

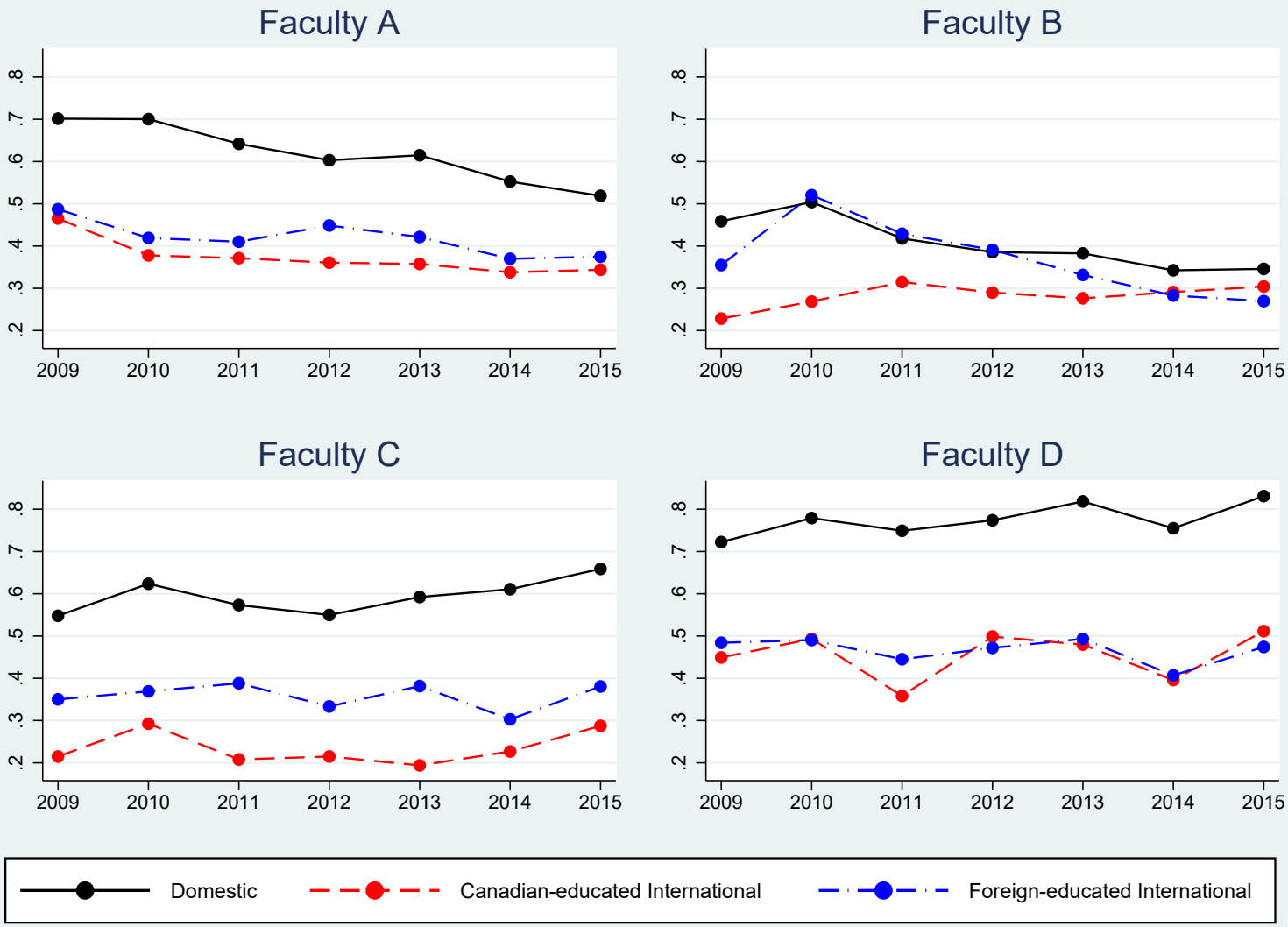
Relative fixed effects of foreign students

Faculty C						
	5th	25th	50th	75th	95th	ols
is	-5.616**	-2.829***	-3.804***	-3.396***	-0.992	-3.388***
	(2.388)	(1.005)	(0.842)	(0.948)	(1.223)	(0.756)
is*cohort trend	0.255	-0.020	0.110	0.178	0.194	0.173
	(0.338)	(0.142)	(0.119)	(0.134)	(0.173)	(0.107)
observations	17,530	17,530	17,530	17,530	17,530	17,530
R-square	0.006	0.009	0.009	0.007	0.008	0.013
ceis	-13.510***	-5.191***	-5.719***	-7.447***	-5.687***	-6.513***
	(3.605)	(1.520)	(1.282)	(1.461)	(1.862)	(1.161)
ceis*cohort trend	0.964**	0.157	0.143	0.605***	0.793***	0.440***
	(0.449)	(0.189)	(0.160)	(0.182)	(0.232)	(0.145)
feis	2.144	-0.352	-1.856	-0.394	-0.270	-0.360
	(3.773)	(1.591)	(1.342)	(1.529)	(1.949)	(1.215)
feis*cohort trend	-0.460	-0.185	-0.005	-0.182	0.020	-0.118
	(0.478)	(0.202)	(0.170)	(0.194)	(0.247)	(0.154)
observations	17,530	17,530	17,530	17,530	17,530	17,530
R-square	0.007	0.010	0.010	0.008	0.008	0.014

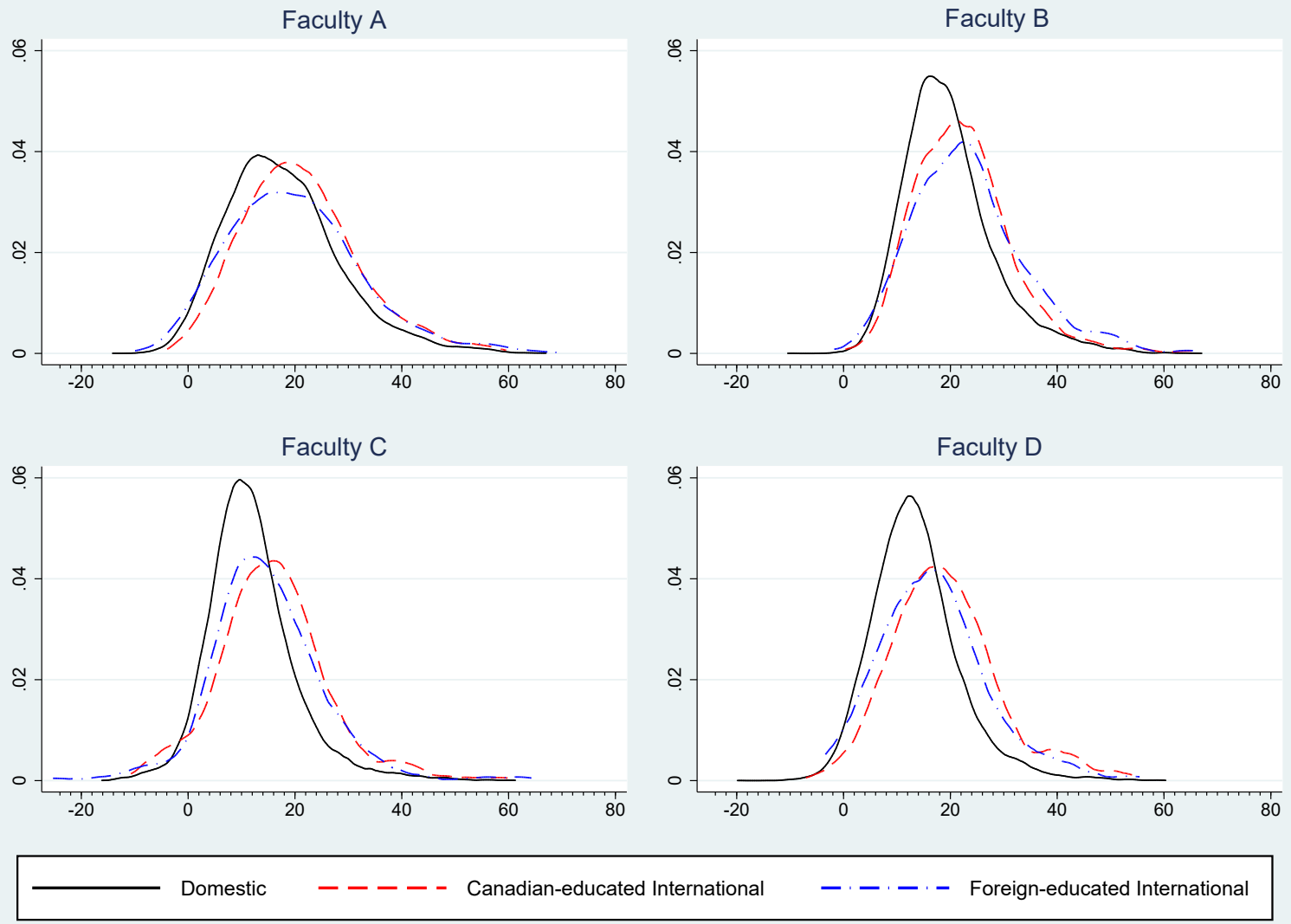
Relative fixed effects of foreign students

	Faculty D					
	5th	25th	50th	75th	95th	ols
is	-5.008**	-4.624***	-3.052***	-2.999***	-0.387	-3.435***
	(2.303)	(1.024)	(0.925)	(1.023)	(1.378)	(0.807)
is*cohort trend	-0.128	0.046	-0.005	-0.001	-0.119	-0.011
	(0.305)	(0.135)	(0.122)	(0.135)	(0.182)	(0.107)
observations	20,202	20,202	20,202	20,202	20,202	20,202
R-squared	0.010	0.006	0.005	0.005	0.004	0.010
ceis	-14.100***	-7.126***	-7.063***	-7.376***	-3.464*	-6.836***
	(3.280)	(1.516)	(1.390)	(1.492)	(2.009)	(1.185)
ceis*cohort trend	0.480	0.130	0.192	0.212	-0.133	0.134
	(0.385)	(0.178)	(0.163)	(0.175)	(0.236)	(0.139)
feis	3.407	1.150	-0.064	-0.443	1.925	0.934
	(3.754)	(1.735)	(1.591)	(1.708)	(2.299)	(1.356)
feis*cohort trend	-0.593	-0.122	-0.030	0.015	-0.163	-0.181
	(0.447)	(0.206)	(0.189)	(0.203)	(0.273)	(0.161)
observations	20,202	20,202	20,202	20,202	20,202	20,202
R-squared	0.012	0.007	0.006	0.006	0.005	0.012

Proportion of applications receiving admission offers



Distribution of error in entry grades



Other findings

- Disparities in foreign student grades:
  - appear related to English language ability (mandatory language training enrolment and linguistic distance)
  - tend to be larger in upper- than first-year courses
  - not smaller in program-required than elective courses
- Mean error in entry grades increasing across domestic, but not foreign, entry cohorts (convergence).

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- We identify gaps in the academic achievement of foreign students, which are remarkably similar in magnitude across fields of study.
- Gaps appear to overwhelmingly reflect the lower grade achievement of international students with Canadian high school diplomas.
- From the university perspective, the challenge appears to be in using high school grades to screen applicants and not in improving the quality of foreign applicants.

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Policy implications

- Academic challenges of foreign students are consistent with labour market evidence.
- Roughly one-third of international students transition to permanent residency (Lu and Hou 2015).
- How predictive are university grades of their labour market outcomes? What is the grade selectivity of PR transitions? Could postsecondary grades be used as a immigrant screening criterion?

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