Modeling Choices

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- Via a few examples, this talk attempts to illustrate how one makes modeling choices: individual decision vs equilibrium.

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  - Is an individual decision model enough?

Individual Decision Models
An Example

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  2. find the underlying forces that explain students' choices of majors.

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- Peers: peer quality matters for one's achievement and one's utility in college.

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- Findings
  - Even after controlling for selection, large earnings premiums exist for certain majors.
  - Differences in monetary returns explain little of the ability sorting across majors; virtually all ability sorting is because of preferences for particular majors.

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- In many other countries, e.g., China, college admissions are college-major-specific: A student has to choose a college-major pair in making enrollment decision: Sys. J (joint choice of college and major).

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    - Peer effects.

Equilibrium Models
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  - it allows for more specialized training;
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- However, if non-trivial uncertainty exists, i.e., if students are not sure about what major fits them the best, Sys.J can lead to serious mismatch problems.

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- An equilibrium model, instead of individual decision model, is required because, e.g.,
  - The new admissions policy applies to all students, under which peer quality might change due to student re-sorting.
  - Without an equilibrium model, one cannot predict what peer quality will be in the new environment, hence cannot predict the outcomes under the new policy.

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  - uncertainty about fits to various majors;
  - endogenous peer quality that affects individual outcomes.
- We apply our model to and estimate the structural parameters for the case of Chile.

Approach

- In our counterfactual experiment, we solve for new equilibrium in a game between
  - A social planner:
    chooses college-specific, rather than college-major-specific, admissions policies
  - Potential college students:
    make enrollment decisions, learn about their fits and then choose majors.

Background: Education in Chile

- High School Tracks:
  - In 11th grade, students choose to follow one of the three tracks:
    - Humanities, Sciences, Arts
  - Receive more advanced training in subjects on the chosen track.

Background: College Admissions to Traditional Universities

- Single Admissions Process: University Selection Test (PSU)
  - Similar to the National College Entrance Exam in China.
  - Subjects: Math, Language, Social Science, Science
- Admission is college-major specific, based on a single index.
  - Index: a weighted average of various PSU scores and HS GPA.
  - Weights differ across college programs.
  - A student is admitted to a college-major if his/her index, calculated using relevant weights, is above the program's cutoff.

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    - Various components of knowledge are combined with major-specific weights to form major-specific ability

$$a_m = \sum_{l=1}^{S} \omega_m^l s^l,$$

where $\omega_m = [\omega_m^1, ..., \omega_m^S]$ is the vector of major-specific weights, and $\sum_{l=1}^{S} \omega_m^l = 1$.

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- Major-specific Human Capital Production in (j, m): A function of own ability a_m, peer quality A_{jm}, and own efficiency at various courses.
- Wages are major-specific function of major-specific human capital, work experience, and transitory wage shocks.

Model: Timing

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- We can solve the model by backward induction.

Student Problem

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- Enrollment: Given the peer quality of each program $\{A_{jm}\}_{jm}$ and the program-specific cutoffs $\left\{a^*_{jm}\right\}_{jm}$, the student chooses the best among the programs he/she is admitted to and the outside option.

Equilibrium

- Equilibrium requires that
  - each student make optimal choices given peer quality;
  - peer quality in various programs be consistent with individual choices.

Data Sources

- PSU scores and enrollment: Chilean Dept. of Evaluation and Educational Testing Service
- Wage data: Futuro Laboral (Ministry of Education of Chile)
- College data: Indices Database (Ministry of Education of Chile)
  - admissions cutoffs $\left\{a^*_{jm}\right\}_{jm}$
  - weights used to form major-specific ability index: $\{\omega^l_m\}$
  - tuition
  - enrollments in consecutive years

Aggregation

- Colleges are aggregated into 3 tiers by prestige, student quality, admissions std.

Table 1 Aggregation of Colleges

Tier	No. Colleges	Mean Score[a]	Total Enrollment	Tuition[b]
1	2	702 (4.2)	21440 (2171)	3609 (568.7)
2	10	616 (17.7)	10239 (4416)	2560 (337.2)
3	13	568 (7.2)	5276 (2043)	2219 (304.2)

[a] The average of $\frac{math+language}{2}$ across freshmen within a college.

[b] The average tuition across majors within a college.

[c] Cross-college std. deviation shown in parenthesis.

Higher-ranked colleges have better students, larger enrollment and higher tuition.

Aggregation

- Majors are aggregated into 8 categories by coursework, admissions std., mean wage.
  - Business
  - Law
  - Education
  - Engineering
  - Sciences
  - Arts and Social Sciences
  - Medicine
  - Health

Table 2 Student Distribution (%)

Tier 1	5.1
Tier 2	14.1
Tier 3	9.0
Outside	71.8

Table 3 Summary Statistics By Major (Conditional on Enrollment)

	Distribution (%)	Math	Language
Medicine	3.4	**750** (66.0)	**719** (55.5)
Law	4.6	607 (74.2)	671 (72.1)
Engineering	36.6	**644** (79.7)	**597** (75.4)
Business	9.9	620 (87.3)	605 (73.9)
Health	11.7	628 (58.3)	632 (64.3)
Science	8.5	631 (78.2)	606 (82.1)
Arts&Social	11.2	**578** (70.7)	**624** (72.4)
Education	14.0	569 (59.5)	593 (664.2)

Simulated Generalized Method of Moments (GMM)

- PSU Data and College Data
  - Enrollment status across tier-major
  - Student ability by enrollment status
  - Retention rates
- Wage Data
  - Graduate ability
  - Wage levels
  - Wage growth

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  - the planner can use only student ability a to distinguish students.

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- Stage 3: An enrollee learns her efficiency levels in courses she has taken, she chooses her final major from this set or drops out.
- Stage 4: A stayer spends enough time in college to finish the requirements of her major of choice and then enters the labor market. The length of college time depends on her first-period course taking intensity.

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- Compare different admissions decisions and choose the best one: admissions policy will depend on the whole ability vector a, not a single index.
- Overall, optimal admissions policies guide student sorting toward the maximization of their total welfare.

Sys.S vs Sys.J

Table 11 Enrollment, Retention & Welfare: Sys.S

	Baseline	New
Enrollment (%)	28.0	31.4
Retention (%)	74.9	85.6
Welfare (1,000 pesos)	146,495	147,834

Sys.S vs Sys.J

Table 13 Outcome by Test Score Quartiles

	$\leq$ 1st Qua.	1st~2nd Qua.	2nd~3rd Qua.	$>$ 3rd Qua.
Enrollment (%)				
Baseline	1.8	11.0	37.1	62.1
New	7.6	20.3	43.0	54.9
Retention (%)				
Baseline	83.9	78.3	72.1	76.0
New	87.3	85.8	85.2	85.6
Welfare				
Baseline	129,034	133,396	150,629	173,118
New	129,856	136,993	152,666	172,004

Test score: (math+language)

Sys.S vs Sys.J

Table B2 Welfare Gain and Student Characteristics

	Female	Low Income	$\frac{(language-math)^2}{1000}$
Coefficient	0.42^{**}	9.62^{**}	-0.025^{**}
Std. Dev.	0.10	0.43	0.0058

Ordered logistic regression: positive/zero/negative welfare change.

- Sys.J favors more advantaged students, a switch into Sys.S would improve equity.

Conclusion

- Structural approaches allow researchers to conduct counterfactual policy experiments, hence providing information for policy makers without having to run costly social experiments. The benefit comes with the cost of imposing more structure.
- Relative to individual decision models, equilibrium models allow the researcher to study larger-scale policies, at the cost of making more assumptions.
- The modeling choice depends on the question we are seeking to answer.