

A General Equilibrium Analysis of College Enrollment, Completion, and Labor Market Outcomes

**Maria Marta Ferreyra
The World Bank**

**Carlos Garriga
Federal Reserve Bank of St. Louis**

**Angelica Sanchez Diaz
The World Bank**

Motivation

- **Consider alternative mechanisms to provide student financial aid for higher education**
- **How do they affect aggregate human capital and labor market outcomes?**
- **We focus on Colombia – but relevant for other countries (including the US) as well**

Our research questions

- **What are the patterns of college enrollment, academic progress, and completion in Colombia?**
 - Who enrolls in higher ed?
 - Who drops out?
 - Who goes on track / behind?
- **What explains these patterns?**
- **What if funding mechanisms change?**
- **What are the predicted long-run outcomes for the economy?**
 - Skills
 - inequality

No straightforward answer

- **Feedback between higher ed and labor market**
 - More graduates → lower returns → less investment in higher ed
- **But increasing access may have other, unintended effects:**
 - Attract weak students
 - Extend time-to-degree
 - Raise dropout rate
 - Lower incentives to student effort
- **Final effect depends on selection, effort incentives, and general equilibrium feedbacks**

Our Approach

- **General equilibrium model (DSGE model):**
 - College enrollment
 - Student effort choice
 - College academic progress and graduation
 - Labor market returns
- **Quantitative version for Colombia**
- **Simulate alternative funding mechanisms**
- **Predict long-run outcomes**

Particularly important for Latin America

- **Gross enrollment rates: from 21 to 40% b/w 2000 and 2010.**
- **But only 14% of the WAP has completed higher ed**
 - 42% in the US
- **High returns to higher ed**
 - Mincer returns = 104% on average
- **Countries want to expand higher ed**
 - Free (or almost free) public colleges in several countries
 - Free college proposed in others
- **But low growth and tight fiscal constraints**
- **Critical to understand trade-offs**

Higher education in Colombia

- **Representative of other HE systems in the region**
- **Third largest economy in Latin America**
- **Almost even share of public and private enrollment**
 - **Public system: highly subsidized**
 - **Recently: some credit and scholarships, mostly for private institutions**
- **Focus on bachelor's programs**
 - **80% of higher ed enrollment**
 - **Usually 5 years**

Data

- **Universe of higher ed students (SPADIES)**
 - High school grads from 2005 (n=360,000)
 - For each student:
 - Score in mandatory high-school exit exam (ability measure)
 - Family income bracket at the end of high school
 - Full college trajectory
- **Household surveys**
 - Labor market outcomes by educational attainment

Enrollment rates

Overall = 41%

Income bracket	Ability quintile					Total
	1	2	3	4	5	
5+ MW						77
3-5 MW						69
2-3 MW						53
1-2 MW						38
<1 MW						24
Total	20	27	36	49	71	41

14-28 28-42 42-56 56-70 70-86

Dropout Rates

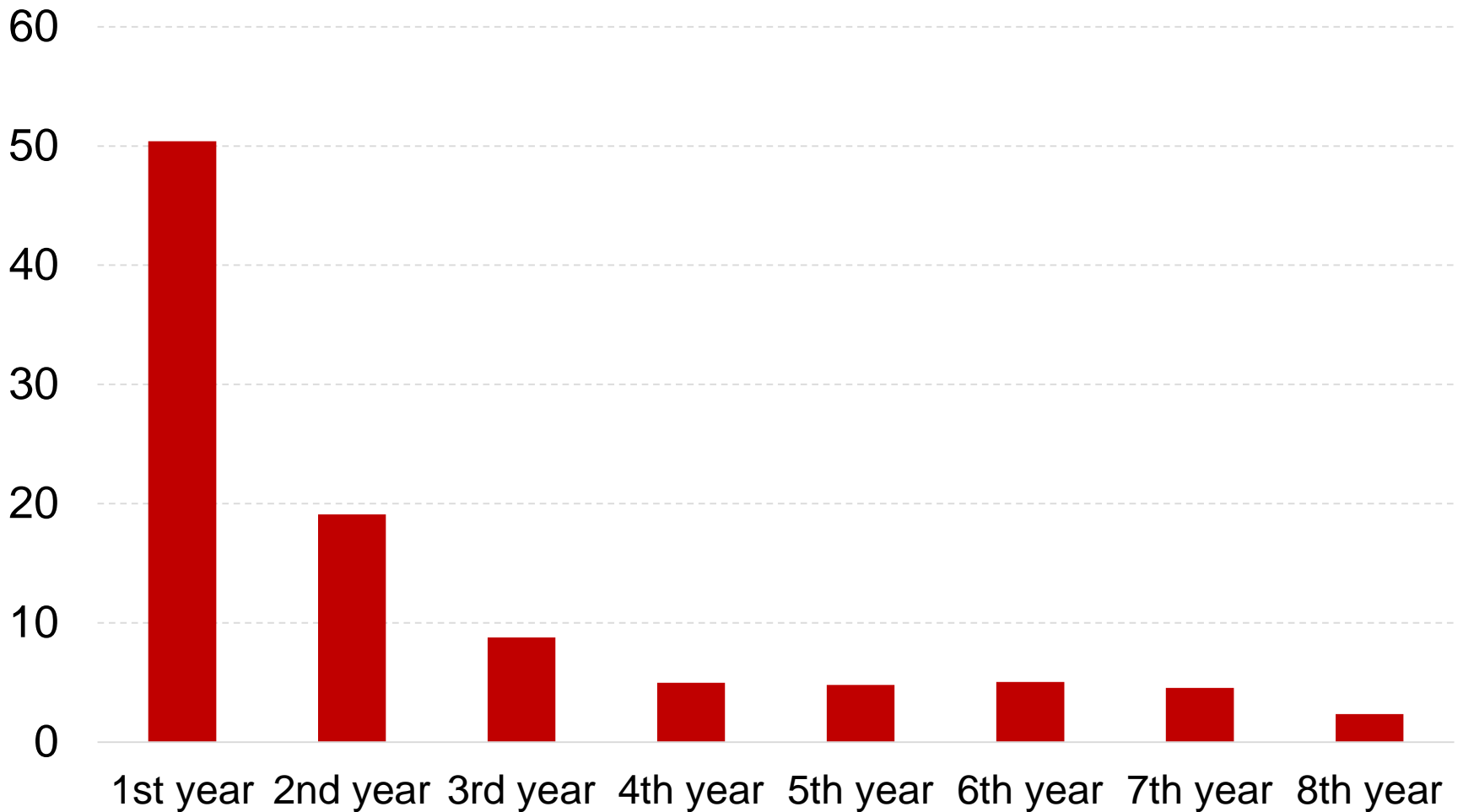
Overall = 54%

Income bracket	Ability quintile					Total
	1	2	3	4	5	
5+ MW						45
3-5 MW						51
2-3 MW						55
1-2 MW						58
<1 MW						59
Total	71	67	62	57	46	54

39-45 45-55 55-65 +65

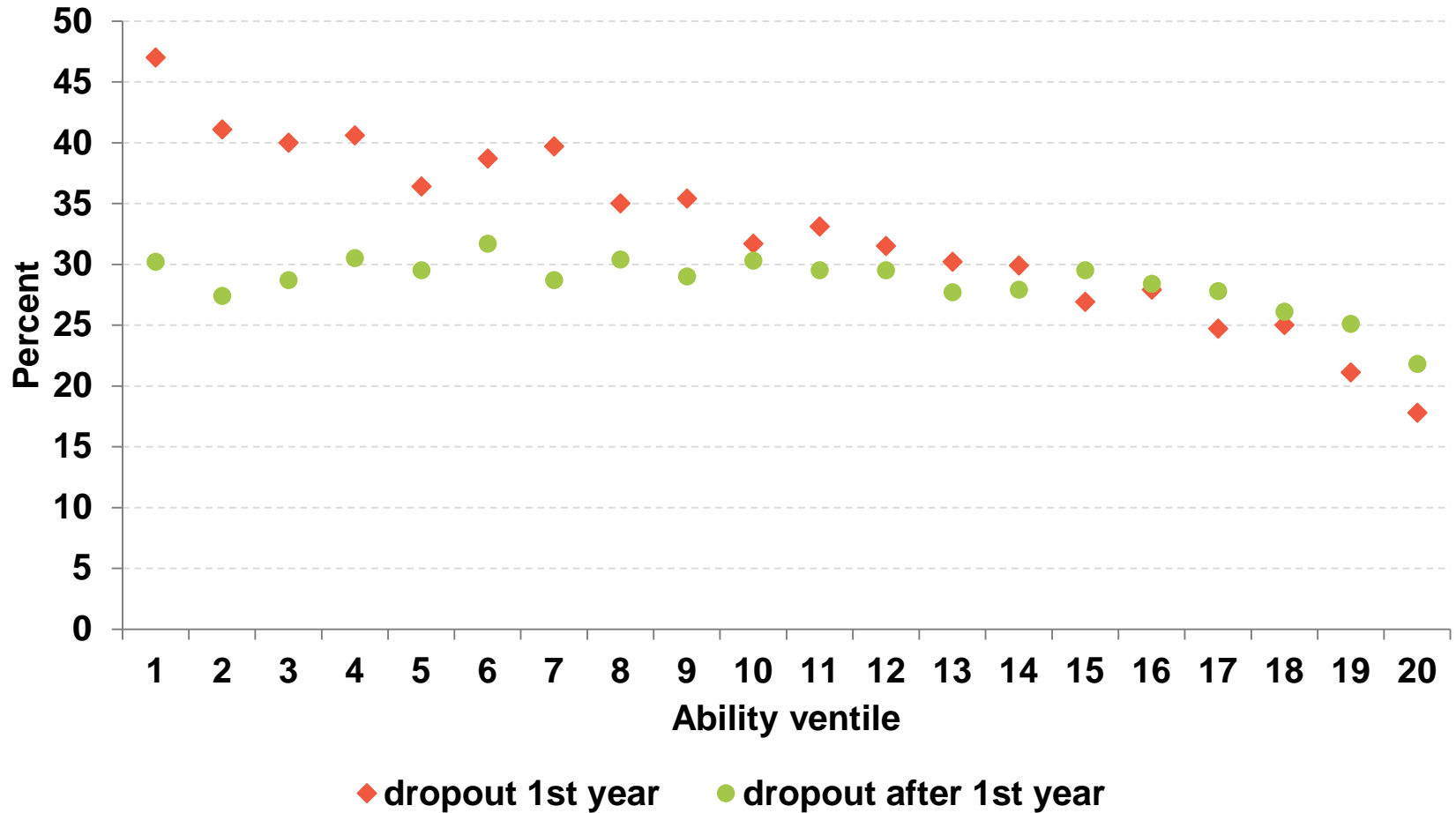
Dropout timing

Distribution of dropouts by year



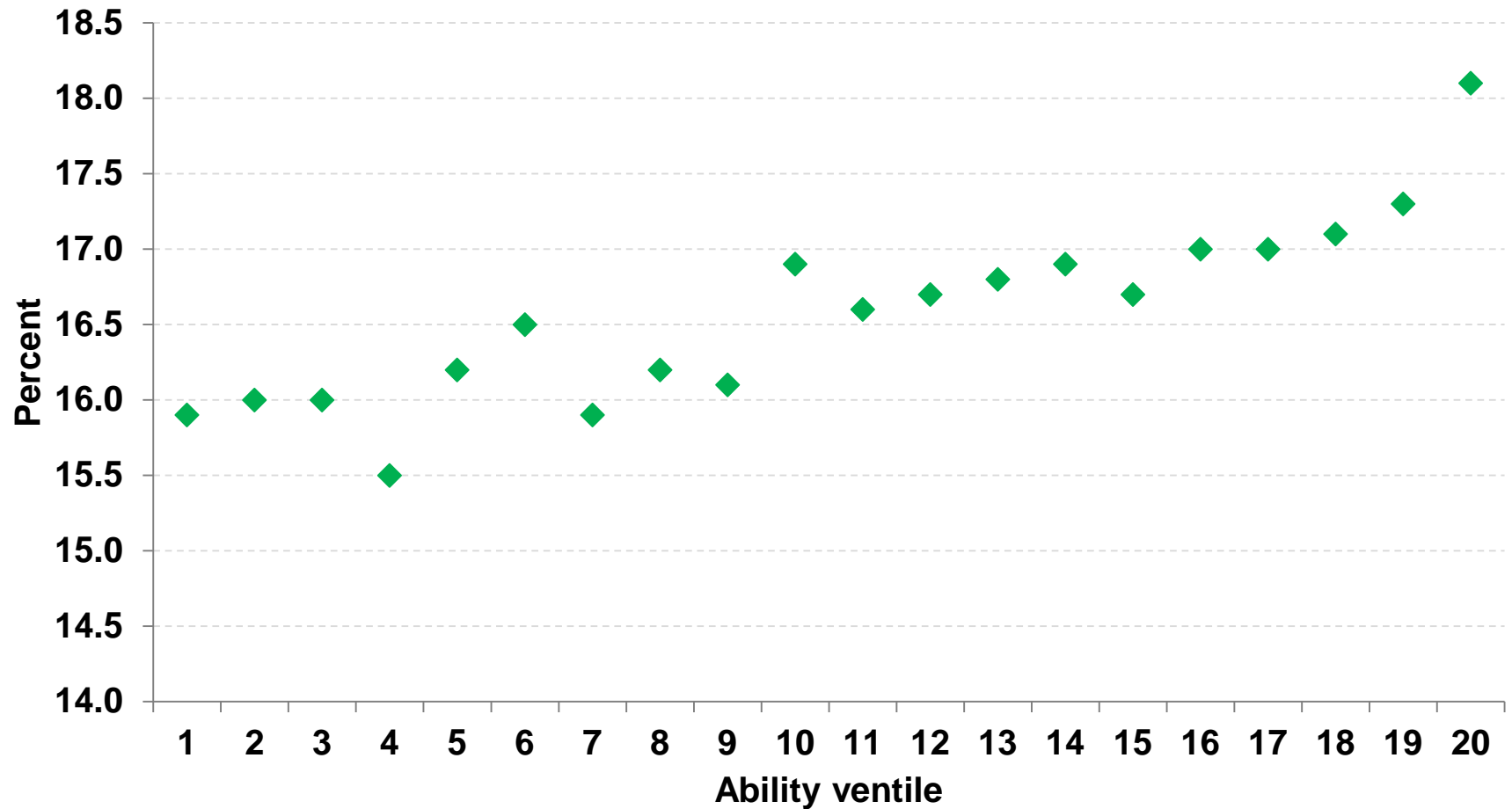
Dropout timing, by ability

Probability of dropping out the first year,
and after the first year (relative to entering cohort)



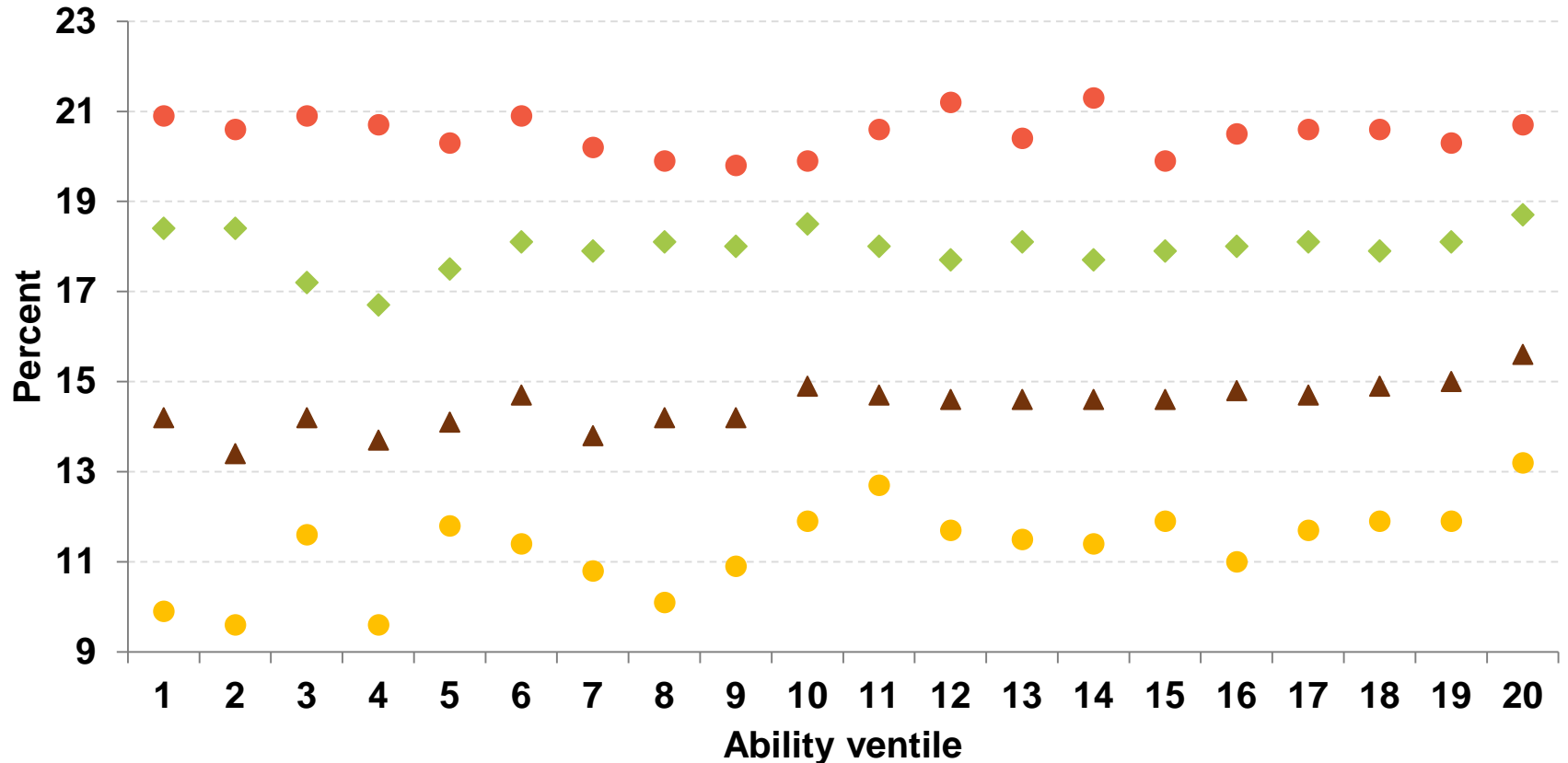
Academic progress, by ability

Percent of required classes completed by the end of the first year
(on-track students complete 20%)



Academic progress (end of first year)

Academic progression by end of year 1

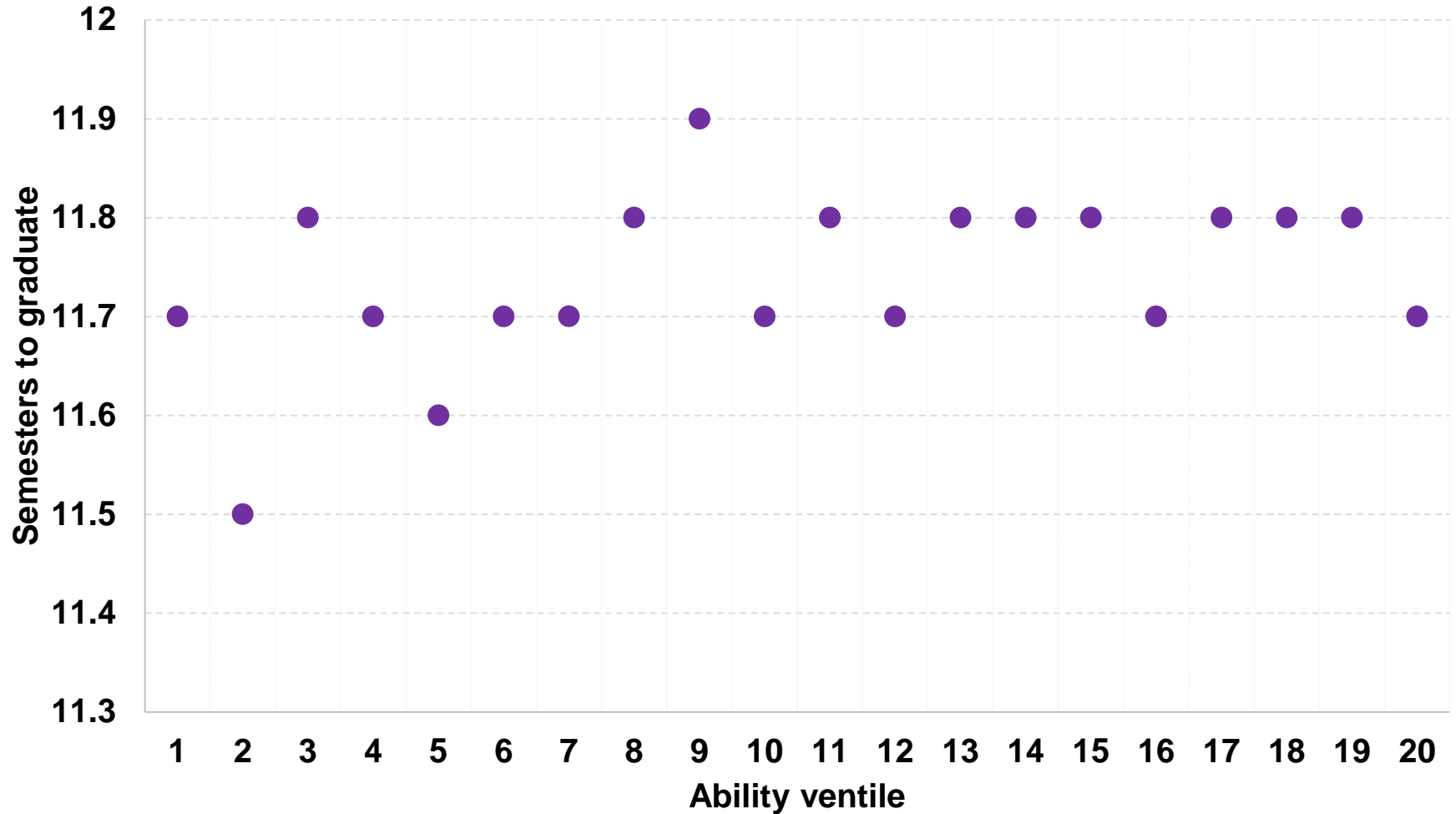


● On-time graduates ◆ Late graduates ▲ Dropouts (eventually) ● Dropouts (this year)

Time-to-Degree

Average = 11.8 semesters

Time to degree, by ability



Model Features

- **Overlapping generations model**
- **High school graduates are heterogeneous by ability and parental transfers**
- **Higher education**
 - **Investment decision: multi-period, risky, lumpy**
 - **Endogenous decisions:**
 - **Enrollment**
 - **Drop out**
 - **Effort**
- **Aggregate education decisions affect:**
 - **labor market → endogenous returns to college**
 - **Aggregate output**

College students

- **Must complete credit requirements to graduate**
 - **Minimum time-to-degree: 5 years**
 - **Maximum time-to-degree: 8 years**
- **May drop out and enter workforce at any time**
- **Can use time to study (e) or enjoy leisure (l)**
 - **Effort is costly**
- **Funding comes from parents, government grants, loans**

College students (cont.)

- Percent credits completed at the end of a period:

$$h' = h + \kappa ((1+h)^*\theta)^\alpha e^{1-\alpha} \exp(z)$$

κ = percent credits to be completed per year (usually 20%)

e = effort

θ = ability

z = idiosyncratic shock (per student and period) → not known at the beginning of the period

- At the beginning of each period, compute the expected value of:
 - Staying in college (given optimal effort)
 - Dropping out and entering the workforce
- At the end of the 8th year, either graduate or drop out

Workers

- **Standard life-cycle optimization problem**
 - **Choose consumption and leisure**
- **Workers differ in their life-time income**
 - **Function of education level (and how long it took them to attain it)**

Model (cont.)

- **High school graduate chooses college if:**
 - **Expected value of college > expected value of high school**
- **Expected value of college depends on:**
 - **Ability**
 - **Parental transfers**
 - **Financial aid**
 - **Expected shocks**
 - **Expected returns**

Labor market

- **Firms' technology**

$$Y=F(K,N)$$

K= capital

N = labor → high school (H) and college (G) graduates

- **Wages vary by skill (H, G, and college dropouts) and experience**

Simulating Funding Policies

Table 4.4 Baseline and Counterfactuals for Colombia, circa 2012

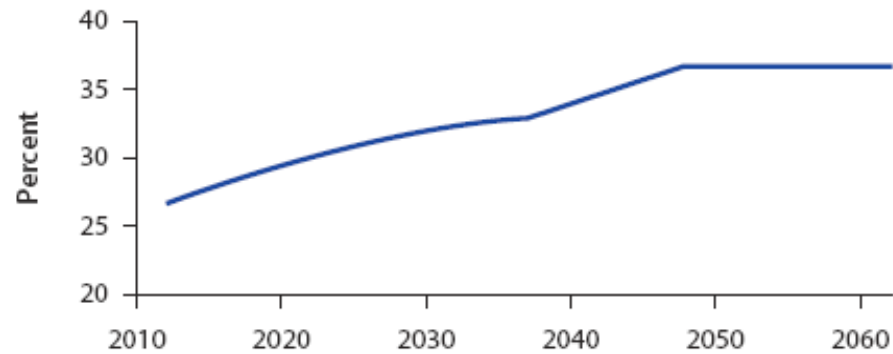
	<i>Data</i>	<i>Model</i>		
		<i>Baseline</i>	<i>Loan</i>	<i>Free tuition</i>
<i>Education</i>				
Enrollment rate (%)	41.5	38.6	39.5	53.0
Dropout rate (%)	39.0	23.1	20.7	43.5
Time-to-degree	1.28	1.1	1.0	1.15
<i>Labor market</i>				
Skilled workers (%)	27.2	27.6	31.4	33.5
Skill premium	2.72	2.6	2.45	2.38

Source: Ferreyra, Garriga, and Manuelli 2016.

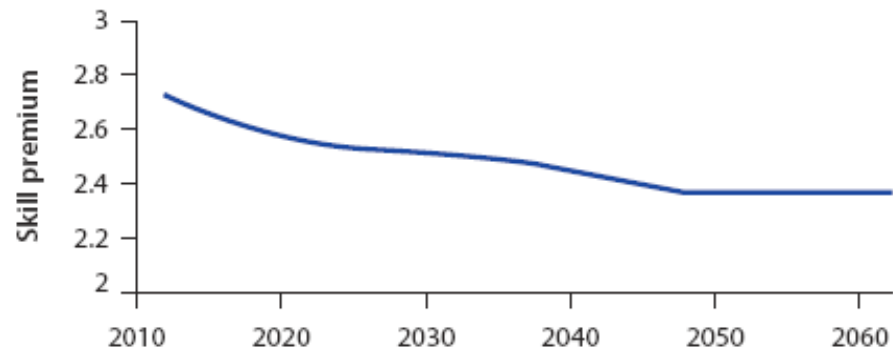
Note: *Data* reflect actual data; *baseline* is the predicted equilibrium without policy simulations; *loan* reflects the outcome of implementing private loans for higher education; *free tuition* reflects the outcome of publicly funded free tuition for all students. Time-to-degree is the average ratio between the actual time taken by students to obtain their degree, and the statutory duration of the program. The skill premium is the ratio of skilled and unskilled workers' wages.

Long-run effects: increasing number of graduates by 50%

a. Share of college graduates
in the labor force, Colombia



c. Colombia



Conclusions

- **Higher ed finance may have unintended consequences**
 - Selection into higher ed
 - Incentives for student effort
 - Greater supply of college-educated students
- **Be sober about long run effects**
- **May need other reforms:**
 - Shorten programs
 - General education requirements
 - Student advising
 - Remedial education
 - Non-financial supports