

# Wage Effects of Baccalaureate Time to Degree in the United States

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# Motivation

- Time to degree at the baccalaureate level has been increasing in the U.S. for the past three decades
  - We now examine “150% of normal time” graduation rates
  - Phenomenon is especially pronounced at non-top 50 public universities
    - NLS72            50% graduated within 4 years, 82% within 5 years
    - ELS:2002        34% graduated within 4 years, 69% within 5 years
- When does it make sense to pursue a “nontraditional” path to degree attainment?
- What are the implications of delayed graduation in the labor market? Does time to degree function as a productivity signal?



	time to degree distribution				
	4	5	6	7	mean
full sample:					
NLS72	53.1	81.8	90.6	96.3	4.48
NELS:88	39.4	72.7	88.3	94.7	4.81
ELS:2002	42.3	72.1	85.7	93.5	4.83
non-top 50 public:					
NLS72	49.7	82.3	91.1	96.3	4.49
NELS:88	29.1	68.8	87.8	95.1	4.93
ELS:2002	34.2	68.5	85.0	94.1	4.93
top 50 public:					
NLS72	52.7	81.5	89.2	96.4	4.49
NELS:88	39.7	82.0	93.7	96.6	4.66
ELS:2002	56.7	85.2	95.2	98.1	4.42
less selective private:					
NLS72	66.7	87.3	94.0	98.7	4.28
NELS:88	58.0	84.6	93.4	98.6	4.60
ELS:2002	56.1	83.4	92.5	96.1	4.51
highly selective private:					
NLS72	65.2	88.2	93.8	96.8	4.31
NELS:88	73.1	91.9	98.1	99.8	4.20
ELS:2002	68.6	91.7	96.3	98.2	4.28
community college:					
NLS72	36.5	67.8	83.0	92.6	4.90
NELS:88	15.5	44.2	70.8	83.6	5.58
ELS:2002	16.5	43.9	64.4	81.6	5.69

# Motivation

- Why do we care?
- In 2016, the Obama administration proposed two changes to encourage a 4-year track to degree completion:
  - Providing 700,000 students on track to a 4-year degree an additional \$1,915 in aid
  - An “on-track Pell bonus” to raise the maximum award by \$300 for 2.3M students taking at least 15 credits per semester

# Motivation

- Why do we care?
- Other proposals include:
  - Increased penalties for course withdrawal
  - Higher per credit tuition for students taking less than 15 credits per semester
  - Lockstep programs restricting student choice in courses to make it harder to change majors



# Literature

- Existing literature does not answer the question of whether lengthened time to degree penalizes workers
  - Groot and Oosterbeek, 1994; Brodaty *et al.*, 2009; Flores-Lagunes and Light, 2010; Aina and Pastore, 2012
- Previous studies find a negative relationship between earnings and time to degree
  - Most interpret the result driven by student ability, but lower student ability over time doesn't seem plausible
  - Brodaty *et al.*, 2009: in France they estimate that a one-year delay in graduation results in an 8% wage penalty

# Literature

- Time to degree is endogenous in the wage equation
- Previous studies do not control for one confounding factor or another:
  - None control for institutional characteristics, which likely impact both time to degree and earnings after graduation
  - Only one proxies for student ability (Groot and Oosterbeek, 1994)
- Previous estimates not likely reliable as to how time to degree affects wages shortly after college completion

# Approach

- 1<sup>st</sup>: Develop a simplified model of human capital that demonstrates when it makes sense to pursue a nontraditional path to degree attainment
- 2<sup>nd</sup>: Replicate results from existing literature which finds significant negative relationship between time to degree and wages
- 3<sup>rd</sup>: Control for institution quality, proxy for ability, and employ two stage least squares (2SLS), instrumenting the student's own time to degree with the average at their first institution



# Theoretical Model

- A simplified model of human capital
- A six-year path with .75 FTE of work is preferred to a four-year path with .25 FTE when:

$$\frac{3}{4} \sum_{t=1}^6 \frac{Y_{HS}}{(1+r)^t} + \sum_{t=7}^T \frac{Y_C}{(1+r)^t} - \sum_{t=1}^6 \frac{F}{(1+r)^t} > \frac{1}{4} \sum_{t=5}^T \frac{Y_C}{(1+r)^t} - \sum_{t=1}^4 \frac{F}{(1+r)^t}$$

- Simplifying the expression shows that this nontraditional path is preferred whenever:

$$\frac{4[Y_C + F]}{Y_{HS}} < \frac{2(1+r)^6 + (1+r)^2 - 3}{r(r+2)}$$

# Theoretical Model

- The model predicts that students are more likely to prefer a longer, nontraditional path to degree attainment when:
  - Discount rates are higher (current consumption is valued more)
  - Return to a degree is lower
  - Schooling costs are lower
- Applying actual tuition and earnings data...

# Theoretical Model

- College students at the University of Washington (UW) and the University of New Mexico (UNM)...
- Bureau of Labor Statistics:  $Y_{HS} = \$34,600$ ,  $Y_C = \$57,800$
- From university catalogues:  $F_{UW} = \$10,974$ ;  $F_{UNM} = \$7,146$ 
  - If  $r = .05$ , then UW students traditional, UNM students nontraditional
  - If  $r = .10$ , then UW students nontraditional, UNM students nontraditional

# Data

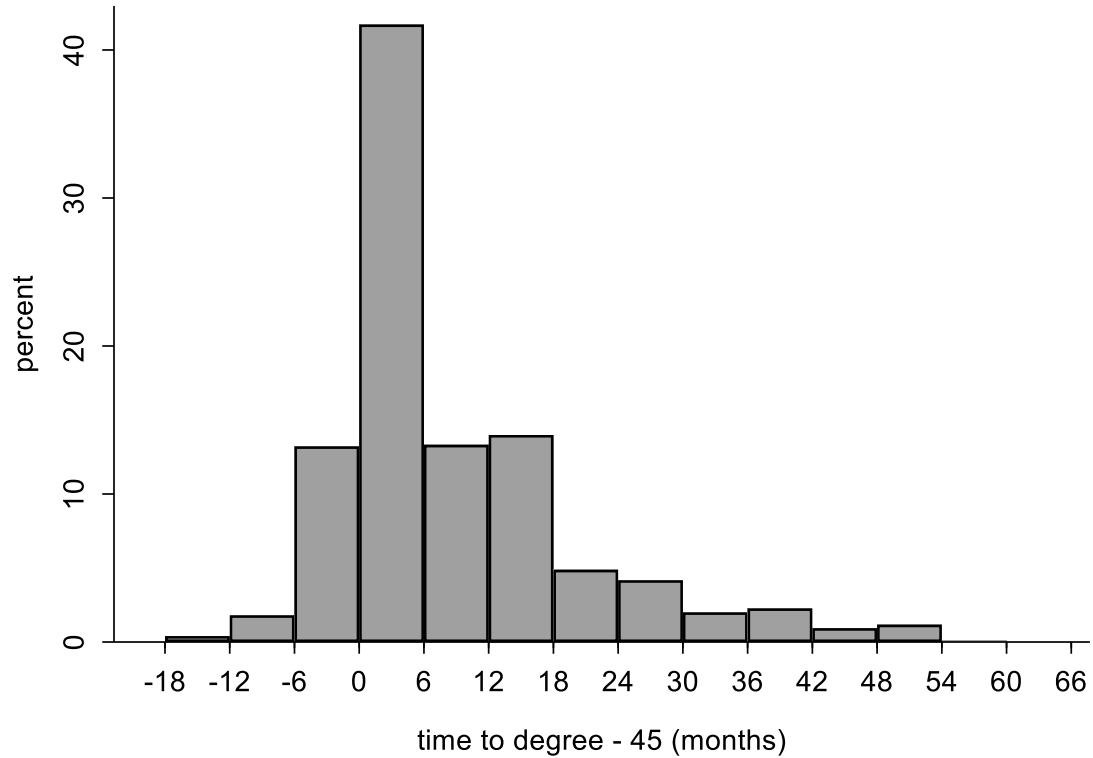
- Education Longitudinal Survey of 2002 (ELS:2002)
  - Nationally representative, restricted data
  - Begins following 10<sup>th</sup>-graders in 2002
  - Last follow-up is 8 years after expected high school graduation (2012)
- Sample limited to undergraduate degree recipients
- Outcome of interest: log-wages at last follow-up

# Data

- Explanatory variable of interest:
  - Graduation delay (in months, centered at 45 months, or “normal time”)
- Instrumental variable: ratio of 6- to 4-year graduation rates at the student’s first institution using the IPEDS

$$\overline{Delay} = \frac{6 - yr. grad. rate}{4 - yr. grad. rate}$$

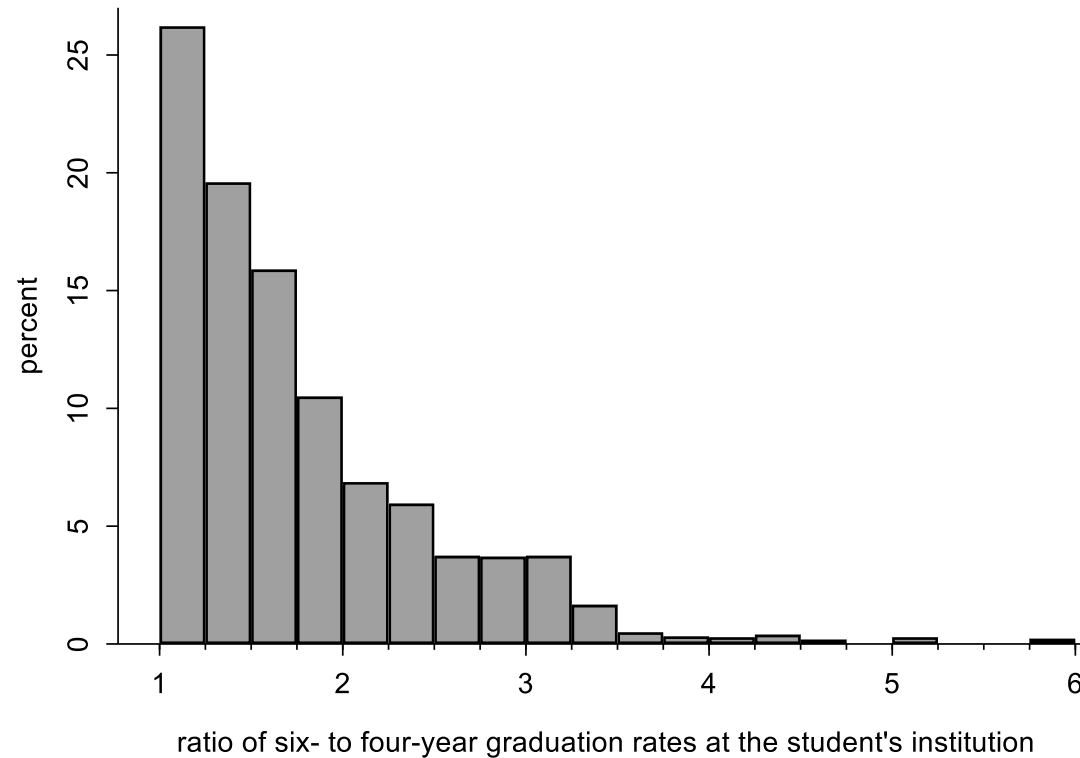
# Data



*Source:* Education Longitudinal Study of 2002.

Figure 1. Distribution of graduation delay, baccalaureate earners, ELS:2002

# Data



*Source:* Authors' calculations, IPEDS 2004, and ELS:2002. Outliers significantly above six, which constitute 0.41 percent of the sample, are not shown.

Figure 2. Distribution of ratio of six- to four-year graduation rates

# Data

- Also consider two alternative instrumental variables:
  1. ratio of FTE students to FTE instructional and advising staff at degree-granting institution
    - Histogram [here](#)
  2. expenditures per FTE student at degree-granting institution
    - Histogram [here](#)
- Exclusion restriction: these variables have no impact on future wages except through time to degree (after controlling for institutional quality and student ability)



# Data

- Bound *et al.* (2012):
  - Time to degree across 1972 and 1992 high school cohorts varies substantially with the student's first institution type
- *U.S. News & World Report* 2005 Rankings:
  - Non-top 50 public colleges
  - Top 50 public colleges
  - Less selective private colleges
  - Highly selective private colleges
  - Community colleges

# Data

- We use Barron's 2004 Admissions Competitiveness data as a control for institution quality:
  - Most competitive
  - Highly competitive
  - Very competitive
  - Competitive
  - Less competitive
  - Non-competitive
  - Special designation
- Based on number of applicants, number admitted, high school grades, standardized test scores, etc.



	<b>non-top 50 public</b>	<b>top 50 public</b>	<b>less selective private</b>	<b>highly selective private</b>
hourly wage (2011 USD)	19.06 (9.06)	21.43 (11.31)	20.06 (11.60)	24.49 (14.00)
graduation delay	10.51 (12.28)	4.77 (9.57)	3.39 (9.54)	2.24 (7.54)
time to degree ratio	2.29 (.81)	1.52 (.26)	1.33 (.35)	1.27 (.43)
student-faculty ratio	13.79 (4.35)	9.62 (1.93)	11.48 (8.12)	6.51 (2.66)
expenditure per student (\$1,000s 2004 USD)	15.13 (7.43)	32.63 (12.92)	20.28 (8.50)	70.22 (87.94)
distance college-work (1,000s miles)	.23 (.50)	.32 (.61)	.22 (.45)	.52 (.75)
master's	.15	.17	.18	.16
doctorate	.02	.05	.04	.07
unemployment rate at graduation	7.65 (2.31)	6.85 (2.15)	6.46 (2.13)	6.13 (1.73)
unemployment rate 4 years after enrollment	5.90 (1.19)	6.07 (1.08)	6.00 (1.22)	5.94 (1.09)
experience	3.50 (.93)	3.41 (1.06)	3.35 (3.36)	3.39 (1.15)
ACT composite	22.60 (3.96)	25.92 (3.77)	24.00 (4.15)	28.50 (3.62)
female	.53	.53	.59	.53
white	.75	.75	.80	.77
Hispanic	.07	.06	.09	.08
black	.11	.05	.06	.02
American Indian	.003	.01	.005	.002
Asian	.03	.08	.03	.10
two or More Races	.04	.05	.02	.02
Hawaiian/pacific islander	.002	.001	.00	.00
Barron's – most competitive	.001	.12	.00	.50
Barron's - highly competitive	.03	.30	.10	.27
Barron's - very competitive	.20	.45	.40	.22
Barron's - competitive	.58	.13	.38	.004
Barron's - less competitive	.12	.00	.05	.00
Barron's - non-competitive	.05	.00	.01	.00
Barron's - special designation	.001	.00	.01	.00
obs.	990	510	550	340

# Empirical Model

- 2SLS using the ratio of 6- to 4-year graduation rates ( $\overline{Delay_c}$ ) as an instrument for the student's graduation delay ( $Delay_{ic} = TTD - 45$ )
- For student  $i$  that attended college with selectivity  $c$  and works in state  $s$ :

1<sup>st</sup> Stage:

$$Delay_{ic} = \alpha_0 + \alpha_1 ACT_i + \alpha_2 \overline{Delay_c} + \mathbf{X}\boldsymbol{\beta} + \theta_c + \varepsilon_{ic}$$

2<sup>nd</sup> Stage:

$$W_{ics} = \gamma_0 + \gamma_1 ACT_i + \gamma_2 \widehat{Delay}_{ics} + \mathbf{X}\boldsymbol{\delta} + \sigma_c + \sigma_s + \epsilon_{ics}$$

- $\mathbf{X}$  controls for experience and its square, race, ethnicity, gender, educational attainment, local macroeconomic conditions, and college-work distance (in stage two)

# Empirical Model

- Also estimate system using three stage least squares (3SLS)
- More computationally costly but more efficient in the presence of cross-equation correlation
  - Allows the error terms to be correlated, which could occur if unobserved factors, such as unobserved ability, end up in each error term
- Results are similar using 2SLS and 3SLS

# Results

- Durbin-Wu-Hausman tests indicate that must cannot use OLS
- Instrument relevance assessed by simple t-test in 1<sup>st</sup> stage:
  - Strong positive relationship between student's own TTD and average TTD at institution
  - Consider a “peer effect” story
    - If there is a culture of students commonly taking longer than normal time to finish, then the student may also be more comfortable with this strategy
    - One student was quoted in “Crossing the Finish Line” as likening graduating in four years to “leaving the party at 10:30pm” (Chingos *et al.* 2009).

# Results

- Instrument exogeneity requires knowledge of the true model error so cannot be directly tested...
- We believe our instrument is exogenous because institutional policies and norms surely affect a student's college trajectory, but should have no bearing on labor market rewards apart from the institution's quality, which we also control for.

# Results

Table 3. Wage models of graduation delay penalty, all institutions, just identified

	OLS (1)	OLS (2)	2SLS (3)	3SLS (4)
<u>variable</u>	<u>Delay</u>	<u>Wages</u>	<u>Wages</u>	<u>Wages</u>
graduation delay		-.005*** (.001)	.009 (.009)	.007 (.009)
TTD ratio	2.268*** (.253)			
unemployment rate at graduation	3.353*** (.088)	< .001 (.007)	-.049 (.034)	-.040 (.033)
unemployment rate 4 years after enrollment	-3.453*** (.161)	.004 (.013)	.055 (.037)	.045 (.036)
master's		.093 (.086)	.160 (.099)	.099 (.095)
doctorate		.402** (.177)	.322* (.188)	.409** (.182)
experience	1.583*** (.575)	.094 (.121)	.057 (.126)	.081 (.121)
experience <sup>2</sup>	.156 (.108)	-.009 (.016)	-.006 (.126)	-.012 (.016)

- OLS:

- A one year delay results in a 6% decrease in earnings

- 2SLS

- No wage penalty associated with delayed graduation



Table 3. Wage models of graduation delay penalty, all institutions, just identified (continued)

	OLS (1)	OLS (2)	2SLS (3)	3SLS (4)
<u>variable</u>	<u>Delay</u>	<u>Wages</u>	<u>Wages</u>	<u>Wages</u>
ACT composite	-.211*** (.045)	.006** (.003)	.009** (.004)	.009** (.004)
female	-1.363*** (.329)	-.111*** (.022)	-.087*** (.027)	-.095*** (.027)
Hispanic	1.318** (.647)	-.043 (.042)	-.063 (.045)	-.061 (.044)
black	.996 (.638)	-.081* (.042)	-.096** (.044)	-.095** (.043)
American Indian	-.179 (2.478)	.002 (.161)	.014 (.164)	.007 (.161)
Asian	.707 (.747)	.006 (.049)	-.004 (.050)	-.003 (.049)
two or more races	-.461 (.849)	-.024 (.055)	-.018 (.056)	-.022 (.055)
Hawaiian/Pacific Islander	-3.638 (4.385)	.144 (.280)	.190 (.288)	.180 (.282)
institution quality controls	YES	YES	YES	YES
state fixed effects	NO	YES	YES	YES
college-work distance	NO	YES	YES	YES
observations				3,300
Kleibergen-Paap rk F Statistic			23.53	

# Results

- Ability measure has expected sign and significance
- Partial F-statistic rejects null hypothesis of weak instruments

Table 6. Estimates of graduation delay penalty by first institution type

	OLS	2SLS	3SLS	obs.	K-P Wald F stat.
	(1)	(2)	(3)		
full sample:					
just identified	-.005*** (.001)	.009 (.009)	.008 (.009)	3,300	23.53
overidentified	-.005*** (.001)	.008 (.009)	.006 (.009)	3,210	11.86
non-top 50 public:					
just identified	-.004** (.002)	.001 (.022)	-.001 (.022)	1,340	8.73
overidentified	-.004** (.002)	.008 (.022)	.003 (.021)	1,320	5.58
top 50 public:					
just identified	-.007** (.003)	.025 (.037)	.022 (.034)	680	5.23
overidentified	-.007** (.003)	.034 (.033)	.027 (.030)	670	4.39
less selective private:					
just identified	-.009*** (.003)	.016 (.039)	-.002 (.036)	730	6.24
overidentified	-.007** (.003)	.011 (.034)	.007 (.032)	710	2.47
highly selective private:					
just identified	-.006 (.006)	.020 (.030)	-.016 (.027)	550	9.97
overidentified	-.006 (.006)	-.034 (.029)	-.027 (.027)	510	5.56

# Results

- Instruments in the overidentified cases include student-faculty ratios and time to degree ratios
- Weak instruments in subanalysis

# Conclusions

- Under reasonable assumptions students may rationally prefer to delay college graduation beyond normal time
- Previous OLS estimates of delayed penalty suffer from significant bias
- Instrumenting for TTD and controlling for student ability and institutional characteristics produces no evidence of such penalties

# Policy Implications

- Students are not penalized for taking longer than normal time in the labor market, so policies designed to discourage lengthened time to degree must rest on other arguments:
  - e.g., fewer resources for incoming students at universities due to crowding, increased costs for colleges
- Policymakers should be cautious in penalizing students for acting rationally in delaying graduation
  - Policies such as restricting major changes, charging higher per credit costs for part-time students, and increasing withdrawal penalties may potentially decrease students' chances of completing college at all

# Next Steps

- Incorporate NELS:88 data for intercohort comparison
- Thank you for your time!
- Questions?
- Send questions/comments to [christopher.erwin@aut.ac.nz](mailto:christopher.erwin@aut.ac.nz)

