College Choice, Credit Constraints and Educational Attainment

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Motivation

- Significant amount of empirical research has focused on the relationship between college attendance, family income and ability
- Strong correlation between family income, ability and college attendance.
  - This relationship has strengthened over time.
- Debate about whether this relationship is a result of credit constraints or differences family background.
  - Credit constraints thought to be result of imperfect capital markets for human capital.
  - Difficulty in using future skills as collateral for student loans could cause under investment.

Motivation

- There is significant heterogeneity in colleges tuition levels and quality (e.g. graduation and retention rates, avg ACT/SAT scores).
- Evidence that college quality matters for future labour market outcomes for certain groups
- Credit constraint literature has mostly ignored influence of credit constraints on quality of college attended.
  - College quality could be an important margin in which credit constraints influence educational and labour market outcomes.

Questions and Methodology

Questions

How do college characteristics, unobserved heterogeneity and credit constraints influence college choice and educational attainment?

How do changes in government aid and loan repayment policies influence education outcomes?

Methodology

Estimation of a discrete choice dynamic programming model of schooling and employment decisions using NLSY97 data.

Contribution

Contribution

Extend current literature by accounting more fully for college characteristics and financial aid programs in explaining college choice and educational attainment

Separate school related borrowing from other assets, allowing counterfactual experiments on loan limits and repayment.

More accurate representation of college progression and graduation through credit accumulation.

Presentation Overview

- Background Facts
- Model
- Overview of Data and Summary Statistics
- Model Solution and Estimation Strategy

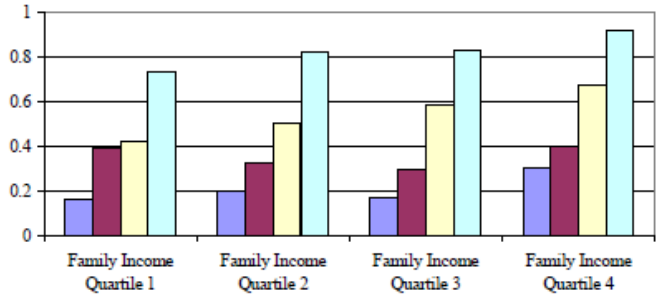
Background Facts

- NLSY dataset shows a correlation between both ability and college attendance as well as family income and college attendance.
- Relationship between ability and college attendance has remained strong over time.
- When compared to NLSY79, NLSY97 cohort shows a much stronger correlation between family income and college attendance.

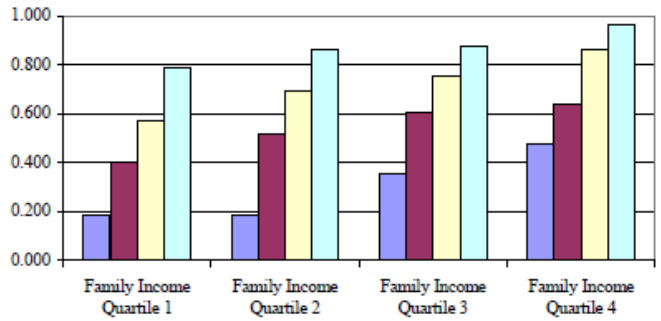
Lochner 2011, AER

Figure 1: College Attendance by AFQT and Family Income or Wealth (NLSY79 and NLSY97)

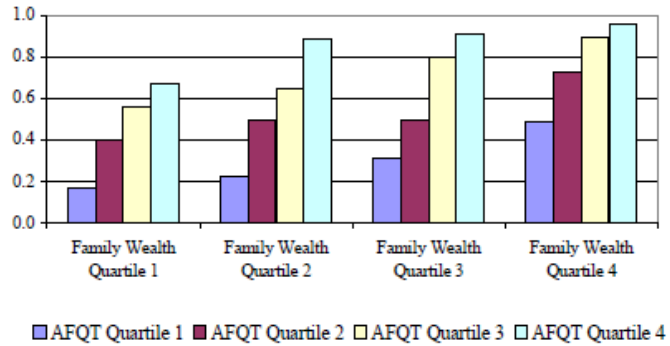
(a) Attendance by AFQT and Family Income (NLSY79)



(b) Attendance by AFQT and Family Income (NLSY97)



(c) Attendance by AFQT and Family Wealth (NLSY97)



Credit Constraints

- Evidence that the impact of credit constraints has increased over time:
  - Credit Constraints had little effect in the early 1980s (Keane and Wolpin, 2001, Carneiro and Heckman, 2002)
  - Evidence that credit constraints are more widspread in the late 1990s and 2000s (Lochner and Belley, 2007)
- Still some research that finds impact of credit constraints is small even in the 1990s and 2000s (Johnson, 2013).

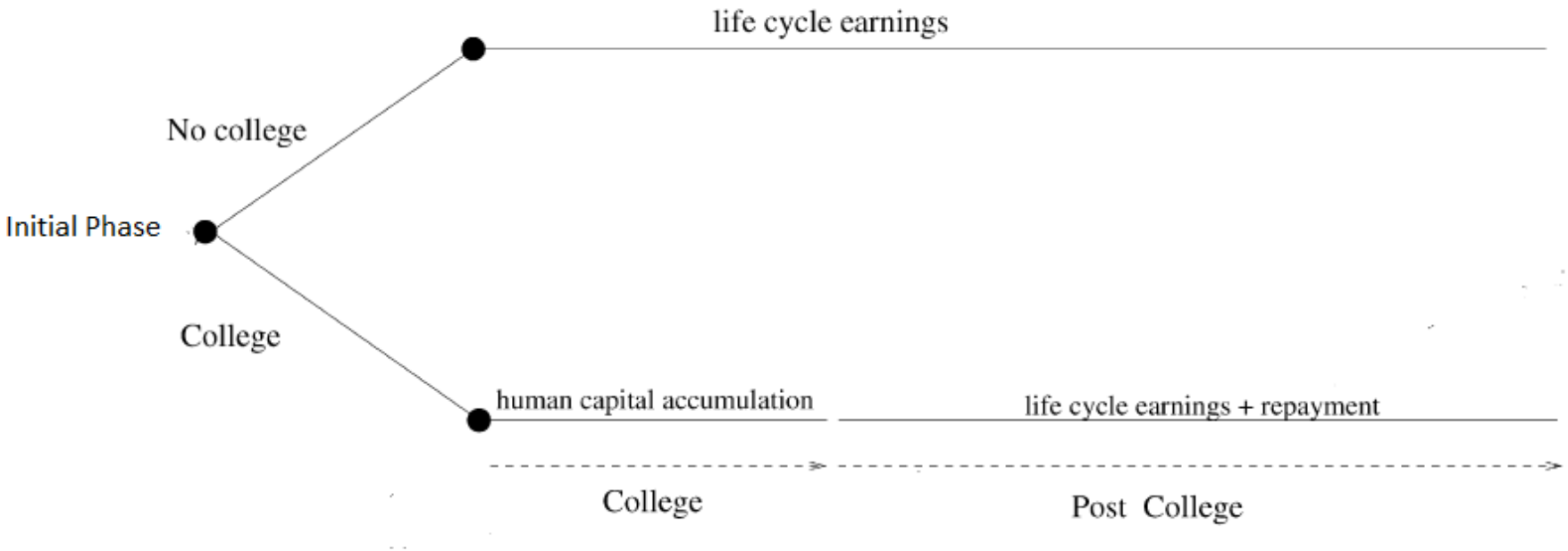
College Quality

- Research into college quality and future labour market outcomes has found:
  - Mixed results on if college quality has important effects on future wages (Black and Smith 2004, 2006, Hoekstra, 2009)
  - College quality can have heterogeneous effects (Dale and Krueger, 2002, 2011)
- Some evidence that credit constraints do impact college quality:
  - Kinsler and Pavan (2013) find credit constraints matter in terms of quality of college attended in both NLSY79 and NLSY97 dataset.

College Choice and Human Capital Accumulation Model

- Model begins in Sept. the year agents graduate highschool
- Initial Phase: College Choice Decision
  - Agents choose between three types of colleges, or to forgo college.
- First Phase: Credit Accumulation and Graduation (max 10 years)
  - Agents accumulate human capital, credits and can choose to participate in the labour market.
- Second Phase: Working and Loan Repayment (max 15 years)
  - Agents accumulate human capital and assets, pay back school related borrowing.
- Third Phase: Mature Working
  - Infinite horizon, savings problem with constant human capital.

Timing



Timing of decisions.

Initial Phase: College Choice, Tuition and Financial Aid

- At t = 0 agents choose the type of college they will attend.
- Three types of Colleges: Elite, Private, Public
  - Tuition is the same for colleges within each group
  - Financial Aid: Parental income, wealth, race, and test score.
- Can choose to attend college at some point, or to forgo college and enter second phase (working life).

Value Function: Initial Phase

- State Space Ω_0:
  - Family Background (B): Parental Income (INC), Parental Wealth (y), Race (R), Siblings enrolled (sib)
  - Ability ($AFQT$), Test Score (SAT), unobserved type ($type$)
- Choice set Θ_0:
  - College to attend ($j = 0, 1, 2, 3$)
- Value Function:
  - $V_0 = \max_{\theta_t \in \Theta_t}[V_1(\Omega_1|j = 1, \Omega_0), ..., V_1(\Omega_1|j = 3, \Omega_0), V_2(\Omega_1|j = 0, \Omega_0)]$

First Phase: College Eligibility

- During the first phase agents accumulate unobserved human capital through college attendance and can choose to participate in the labour market
- Time Period: $1 \rightarrow Ta$
- State Space Ω_t:
  - Family Background (B), Ability ($AFQT$), Test Score (SAT)
  - Outstanding student loans (a_t^s), college choice (j), Credits (Cr_t), Human Capital (HC_t)
- Choice Set Θ_t:
  - Attend school (att_t), Work Intensity (l_t), School Borrowing (a_{t+1}^s)

Preferences

- Preferences are composed of two terms:
- $u_t = \frac{c_t^{1-\sigma}}{1-\sigma} + \gamma(att_t, l_t; \Omega_t, \epsilon_t)$
- First term: Captures consumption smoothing behaviour
- Second term: Related to disutility of school/work
- $\epsilon_t = (\epsilon_t^j, \epsilon_t^l)$
  - Shocks can be correlated, but independent across time

Credit Accumulation, Human Capital, Wages

- Credit Accumulation (attempt 5 credits a year)
  - Cr_t are total credits, cr_t are credits earned that period
  - Probability of earning credits based on ability, type, and labour force participation
  - $\pi(cr_t|\Omega_t, \theta_t) = g^{\pi}(l_t, att_t; \Omega_t)$
  - $Cr_{t+1} = Cr_t + cr_t$
  - $BA_t = 1$ if $Cr_t \geq 20$
- Human Capital
  - Human capital modeled as an unobserved state that can take on a finite number of values
  - Human capital transition depends on ability, attendance, school choice, unobserved type and age.
  - Labour market participation does not contribute to human capital transition in first phase.
- Wages
  - Wages depend on human capital, college attendance, and age
  - $w_t = g^{w}(att_t, \Omega_t, \sigma_w)$

Parental Transfers and Borrowing Constraints

- Parental transfers
  - Parental transfers depend on college attendance, family income, family wealth, age
  - $tr_t = g^{tr}(att_t; \Omega_t)$
- In this first phase, school borrowing (a_t^s) is the only asset:
  - Yearly borrowing limits depending on college costs, family income, family wealth
  - $\underline{a}^s = g^{a^s}(\theta_t, \Omega_t)$

Value Function: First Phase

$$V_1(\Omega_t) = \max_{\theta_t \in \Theta_t} \frac{c_t^{1-\sigma}}{1-\sigma} + \gamma(att_t, l_t, \Omega_t, \epsilon_t) + \beta E[W(\Omega_{t+1})|\theta_t, \Omega_t)] \quad (1)$$

Subject to:

$$c_t = (1 + r_s)a_{t+1}^s + w_t l_t + tr_t + I(att_t = 1)(aid(\Omega_t) - tu(\Omega_t)) - a_t^s \quad (2)$$

$$a^s \geq \underline{a}^s \quad (3)$$

Where:

$$W(\Omega_{t+1})|\theta_t, \Omega_t) = max[V_1(\Omega_{t+1})|\theta_t, \Omega_t), V_2(\Omega_{t+1})|\theta_t, \Omega_t)] \quad (4)$$

Second Phase: Working Life and Loan Repayment

- During the second phase agents accumulate human capital through labour force experience and repay school related borrowing.
- Time Period: $Ta + 1 \rightarrow Tb$
- State Space:
  - Famly Background (B), Outstanding student loans (a_t^s), Human Capital (HC_t), Degree Status (BA_t) , Ability ($AFQT$)
  - Assets (a_t), in default (d_t).
- Choice Set:
  - Savings (a_{t+1}), Work Intensity (l_t)

Wages, Human Capital, Parental Transfers

- Human Capital
  - Similar to first phase, but ineligible for schooling
  - labour market participation influences transition of human capital.
- Wages
  - $w_t = g^w(HC_t, l_t, \Omega_t; \sigma_w)$
- Parental transfers depend on family income, family wealth, age
  - $tr_t = g^{tr}(\Omega_t)$

Borrowing Limits and Loan Repayment

- Agents can now accumulate assets as well as borrow
- Borrowing limit based on human capital and age:
  - $\underline{a}_t = g^{\underline{a}}(HC_t, t)$
- Agents must repay any student loans from the second phase:
  - Yearly payments: $\frac{a_t^s}{\sum_{t=0}^{Tb-Ta-1} \frac{1}{(1+r_s)^t}}$
- Agents default if they cannot make payments:
  - $d = 1$ if $w_t l_t + tr_t + a_t < \frac{a_t^s}{\sum_{t=0}^{Tb-Ta-1} \frac{1}{(1+r_s)^t}}$
- If default, 10% gets added to the total of the loan, get an extra 5 years to pay it off.
  - $a_{t+1}^s = (1 + .1)a_t^s$

Value Function: Second Phase

$$V_2(\Omega_t) = \max_{\theta_t \in \Theta_t} \frac{c_t^{1-\sigma}}{1-\sigma} + \gamma(I_t; \Omega_t, \epsilon_t) + \beta E[V_2(\Omega_{t+1})|\theta_t, \Omega_t] \quad (5)$$

Subject to:

$$c_t = a_t - (1+r)a_{t+1} - I(d=0)\frac{a_t^s}{1+\sum_{t=0}^{Tb-Ta-1}\frac{1}{(1+r_s)^{Tb}}} + w_t l_t + tr_t \quad (6)$$

$$a_t > \underline{a}_t \quad (7)$$

Mature Working Life

- In the third phase agents make savings decisions and human capital is assumed to be constant, assumed to work full-time.
- Agents who enter this phase in default, face higher interest rates.
- Time Period: $Tb + 1 \rightarrow \infty$
- State Space:
  - Assets (a_t), Human Capital (HC) and default (d)
- Choice Set:
  - Savings (a_{t+1})

Value Function: Third Phase

$$V_3(\Omega_t) = \max_{\theta_t \in \Theta_t} \frac{c_t^{1-\sigma}}{1-\sigma} + \beta E(V_3(\Omega_{t+1}|\Omega_t, \theta_t)) \tag{8}$$

Subject to:

$$a_{t+1} + c_t = w_t + (1 + r_i)a_t \tag{9}$$

$$a_{t+1} \geq \underline{a} \tag{10}$$

where:

$$i = nd, d; \ r_d > r_{nd} \tag{11}$$

$$ln(w_t) = w(HC) + \epsilon_t^w; \ \epsilon_t^w \sim N(0, \sigma^w) \tag{12}$$

Data Available

- NLSY97 contains rich schooling (ability measure, credits, degree status) and financial histories (earnings, employment status, parental income and wealth)
- Youths who were 12 to 16 years old as of December 31, 1996, latest round available 2011/2012
- Limited information on college characteristics - public/private, 2 or 4 year, tuition, financial aid
- Geocode version of the NLSY97 contains name of the institution, and a way to link this with dataset on college characteristics (IPEDS)
  - Geocode version not available outside U.S.

Data Overview

- As of now, I'm using results of Fu (JPE, 2014) to get a noisy signal of college type: Elite Private, Elite Public, Private, Public.

Table: Allocation over College Type

	E.Pri	E. Pub	Private	Public	None	Total
N	70	89	309	1,378	445	2,291
% of Sample	3.06	3.88	13.49	60.15	19.42	100

College Attendance by Age and College Type

Table: College Attendance by Age and College Type (percent of sample)

Age	N	Pri Elite	Pub Elite	Private	Public	None
18	2,291	2.9	3.5	10.1	46.9	36.6
19	2,285	2.8	3.3	7.7	37.9	48.3
20	2,280	2.4	3.4	7.1	36.5	50.6
21	2,279	2.4	3.3	7.1	32.6	54.6
22	2,274	2.2	3.0	6.2	29.0	56.6
23	2,261	0.8	1.4	2.7	17.9	77.2
24	2,249	0.3	0.6	1.8	12.9	84.4
25	2,220	0.0	0.3	1.3	11.5	86.9
26	2,009	0.0	0.2	1.1	10.0	88.7
27	1,514	0.0	0.2	1.2	8.5	90.1
28	1,046	0.0	0.2	2.6	6.4	90.8
29	600	0.0	0.3	0.8	6.5	92.4

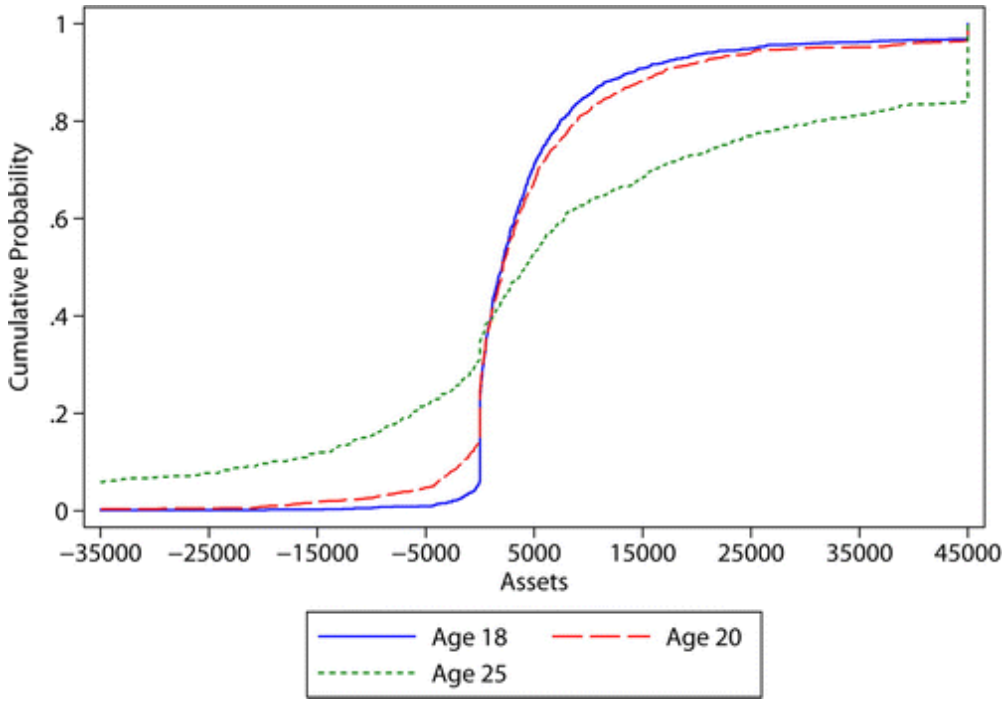
Table: Selected Statistics by College Type

Variable	E.Pri	E. Pub	Private	Public	None
ASVAB Pct.	75.0	69.3	60.1	60.2	33.4
SAT = 1	1.49	1.16	2.94	3.03	3.14
SAT = 2	50.75	67.44	67.32	72.80	89.91
SAT = 3	47.76	31.40	29.74	24.17	6.95
Race	17.9	41.0	30.8	23.7	30.7
Family Inc. = 1	28.36	18.6	31.70	31.89	49.55
Family Inc. = 2	19.40	48.84	38.24	32.61	33.41
Family Inc. = 3	52.24	32.56	30.07	35.50	17.04
Family Wealth. = 1	22.39	24.42	30.07	30.74	50.0
Family Wealth = 2	28.36	34.88	34.64	33.62	36.55
Family Wealth = 3	49.25	40.70	35.29	35.64	13.55

Table: Selected Statistics by College Type

Variable	E.Pri	E. Pub	Private	Public	None
Completed BA (by Age 26)	79.8	74.4	45.9	37.9	0
Ave College Loans/Year	4961.1	3737.1	5603.7	4254.2	.
Ave. Total Loans	7625.9	5278.7	8559.1	6829.9	.
Ave Grants/Year	4143.2	1998.6	9514.4	3683.9	.

Asset Distributions



Conclusion: Model Solution and Estimation Strategy

- The model is solved in two steps:
  - 1. Stationary third phase of the model is solved
  - 2. Solve by backward induction, using the stationary values as terminal values second phase.
- Model is (going to be) estimated using method of moments.
- Initial distribution over states: family background (parental income and wealth, race) as well as ability, unobserved human capital and unobserved type.
- match simulated moments from the model with observed moments from the data (in progress)

Conclusion:

- Past research on credit constraints has mostly ignored college heterogeneity and quality
- Research suggests that quality has a heterogenous impact on labour market outcomes
- Propose a lifecycle model of schooling, borrowing and work decisions
- Agents choose between college heterogenous in quality and tuition
- Estimate the model using NLSY97 data (in progress).