Education, Credit Constraints, Insurance and Inequality

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The way educational investments are financed affects social mobility, the distribution of income, and economic growth and development.

- Credit constraints and the nature of loan contracts play an important role in determining policy and resulting allocations.
US Context:

- Rising costs of and labor market returns to college since the early 1980s, coupled with stable real government student loan limits, have made college financing much more difficult for students.
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- Private student credit increased rapidly from virtually zero in the early 1990s to roughly 25% of all student loan dollars distributed in the mid-2000s.
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- 26% of all dependent undergraduate students at 4-year public schools borrowed the max from the Stafford Loan Program in 1999-2000, compared to under 4% in 1989-90.

- Private student credit increased rapidly from virtually zero in the early 1990s to roughly 25% of all student loan dollars distributed in the mid-2000s.

- Growing concern about rising student debt levels and capacity to repay (especially given current economic situation).
Overview:

- discuss college costs and financial aid in US (and Canada)
- study a two-period canonical model to examine frequently tested implications of constraints for schooling
- discuss U.S.-based evidence on the impacts of credit constraints on college-going, as well as consumption and work during college
- discuss early vs. late human capital investment and constraints
- discuss models with richer, more realistic forms of credit constraints/contracts:
  - GSL programs
  - private lending with incentive problems
  - consider implications of uncertainty & private information
- Highlight some important open questions/areas
Education Costs and Student Aid in the US
US Tuition Levels

Average Tuition & Fees in US 1981 to 2011 (Current $)

Source: College Board, Trends in College Pricing 2011 (Table 4a).
Types of Aid in US

- Merit aid and scholarships
  - federal and state governments (e.g. HOPE Scholarships)
  - institutional aid
- Tax-based aid
- Need-based grants & institutional aid
- Student loans
Tax-based Aid in US

- Tax-advantaged savings:
  - Section 529 College Savings Accounts
  - Coverdell Education Savings Account

- Income-based tax deductions and credits:
  - Tuition and fees deduction
  - Lifetime Learning tax credit: 20% of tuition expenses up to $2,000 (per family)
  - American Opportunity tax credit: undergraduates only, up to $2,500 (per student)
Main Federal Need-Based Grants (US)

- **Pell Grants**
  - up to $5,550/yr for 4 years
  - undergraduate and vocational students
  - 9 million recipients received $35 billion (significant ↑ since 2009)
  - 75% of recipients have family income less than $30,000

- **Supplemental Educational Opportunity Grant**
  - up to $4,000/yr
  - 1.3 million recipients received $758 million
  - ≈60% of dependent undergraduate recipients have family income less than $30,000
Federal Student Loans (US)

- Perkins Loans
  - undergraduate and graduate students
  - ≈500,000 recipients received $971 million
  - need-based: ≈60% of dependent undergraduate recipients had family income < $60,000
  - 95% of recipients attended 4-year public and private schools

- Stafford Loans
  - undergraduate and graduate students
  - subsidized and unsubsidized
  - 8.7 million undergraduate recipients received $59 billion

- Parent PLUS
  - parents of undergraduate and graduate students
  - 884,000 undergraduate borrowers totalling $10.4 billion

- Grad PLUS - directly to graduate students
## Current US Federal Student Loan Programs

<table>
<thead>
<tr>
<th></th>
<th>Perkins</th>
<th>Subs. Stafford</th>
<th>Unsubs. Stafford</th>
<th>Parent PLUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Need-based?</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>interest rate</td>
<td>5%</td>
<td>3.4/6.8%</td>
<td>6.8%</td>
<td>7.9%</td>
</tr>
<tr>
<td>interest subsidy</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>loan fees</td>
<td>0</td>
<td>1%</td>
<td>1%</td>
<td>4%</td>
</tr>
<tr>
<td>UG ann. limit ($)</td>
<td>5,500</td>
<td>3,500-5,500</td>
<td>5,500-7,500</td>
<td>none</td>
</tr>
<tr>
<td>UG life. limit ($)</td>
<td>27,500</td>
<td>23,000</td>
<td>31,000</td>
<td>none</td>
</tr>
<tr>
<td>G ann. limit ($)</td>
<td>8,000</td>
<td>8,500</td>
<td>20,500</td>
<td>none</td>
</tr>
<tr>
<td>Lifetime limit ($)</td>
<td>60,000</td>
<td>65,500</td>
<td>138,500</td>
<td>none</td>
</tr>
<tr>
<td>Deferment period</td>
<td>school +</td>
<td>school +</td>
<td>school +</td>
<td>school +</td>
</tr>
</tbody>
</table>

Notes: UG limits for dependent undergraduates. Subsidized Stafford borrowers can take out balance of limits from Unsubsidized Stafford.
Repaying Federal Student Loans

- **Standard Repayment** – fixed payments, 10 year term
- **Extended Repayment** – fixed/graduated payments, 25 year term
- **Income-Based Repayment (IBR)**
  - 15% of discretionary income \( (\text{AGI} - (1.5 \times \text{poverty line})) \)
  - remaining debt/interest after 25 years is forgiven
- **Income Contingent Repayment (ICR)**
  - pay lesser of
    - 20% of discretionary income
    - standard monthly repayment amount for 12-year term \( \times \)
      Income Percentage Factor \( \geq 0.5 \)
  - remaining debt/interest after 25 years is forgiven
Default on Federal Student Loans

- Default
  - 6 or 9 month grace period after leaving school
  - non-payment for 9 months implies default
- Consequences of default:
  - collection costs (20-40%)
  - wage garnishment up to 15% of ‘disposable’ pay (weekly garnishment cannot leave worker with < 30 times minimum wage)
  - income tax refund offset
  - report to credit agencies
  - no additional federal aid, deferments
- Student loans not dischargeable through bankruptcy
Private Student Loans

- Many specific private lending programs targeted to students
  - amounts and terms may depend on school, year in school, major, degree, credit score, cosigner, etc.
  - not dischargeable through bankruptcy
  - garnishments require a court settlement
  - may offer lower/longer repayment plans

- Credit cards

- Home equity loans and HELOC for parents
<table>
<thead>
<tr>
<th>Academic Year</th>
<th>Percentage of Parents with PLUS Loans</th>
<th>No Stafford Loans</th>
<th>Subsidized Only</th>
<th>Unsubsidized Only</th>
<th>Both Subsidized and Unsubsidized Loans</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010-11</td>
<td>(3.4% with PLUS)</td>
<td>66%</td>
<td>5%</td>
<td>25%</td>
<td>Average Stafford in 2010 Dollars $6,744</td>
</tr>
<tr>
<td>2005-06</td>
<td>(3.6% with PLUS)</td>
<td>72%</td>
<td>11%</td>
<td>5%</td>
<td>Average Stafford in 2010 Dollars $5,538</td>
</tr>
<tr>
<td>2000-01</td>
<td>(2.5% with PLUS)</td>
<td>78%</td>
<td>10%</td>
<td>8%</td>
<td>Average Stafford in 2010 Dollars $5,628</td>
</tr>
</tbody>
</table>

Source: College Board, Trends in Student Aid 2011 (Figure 6).
Types of Loans

In 2010-11, nonfederal loans, which usually have less favorable repayment terms than federal loans, constituted only about 7% of education borrowing. From 2005-06 through 2007-08, nonfederal loans accounted for about a quarter of this borrowing.

FIGURE 4
Growth of Federal and Nonfederal Loan Dollars in Constant 2010 Dollars, 2000-01 to 2010-11

- Nonfederal Loans
- Perkins and Other Federal Loans
- Grad PLUS Loans
- Parent PLUS Loans
- Unsubsidized Stafford Loans
- Subsidized Stafford Loans

Over the course of the decade from 2000-01 to 2010-11, subsidized loans, on which the government pays the interest while students are in school, declined from 41% to 35% of all education borrowing, and from 56% to 46% of all Stafford Loans.

Some colleges and universities make loans to students and parents to supplement their federal loans. While no precise measure of these loans is available, reports from institutions indicate that institutional loans have grown from about $500 million in 2007-08 to about $720 million in 2010-11. For-profit institutions have increased their lending to students over this time period, while other institutions have reduced this activity.

After growing at an average annual rate of about 17% for three years (from $52.9 billion in 2010 dollars in 2006-07 to $85.7 billion in 2009-10), total Stafford Loan volume grew by only an estimated 0.1% in 2010-11, to $85.8 billion.

The private student loan market has consolidated in recent years, with a number of smaller lenders leaving the business and some larger lenders selling their loans to others. The estimate of $6 billion of private loans for 2010-11 combines information from the Consumer Bankers Association/MeasureOne with data from credit unions.

Dependent undergraduate students can borrow up to $5,500 in Stafford Loans (including a maximum of $3,500 in subsidized loans) in their first year of study, and up to $6,500 (including up to $4,500 in subsidized loans) in their second year. The limit for the third year and beyond is $7,500 (including up to $5,500 in subsidized loans).

Graduate students can borrow up to $20,500 per year in Stafford Loans. The lifetime maximum for graduate students is $138,500, including their undergraduate borrowing. The total limit for subsidized loans is $65,500. Beginning in 2012-13, all Stafford Loans for graduate students will be unsubsidized.

Source: College Board, Trends in Student Aid 2011.
Government and Private Student Borrowing

Table 4. Percentage Borrowing and Average Amounts Borrowed Among All Students and Among Full-Time Students by Dependency and Sector, 2007-08

<table>
<thead>
<tr>
<th>Percent Borrowing Any Loan</th>
<th>Percent Borrowing Federal Loans</th>
<th>Average Federal Loan per Borrower</th>
<th>Average Federal Loan per Student</th>
<th>Percent Borrowing Private Loans</th>
<th>Average Private Loan per Borrower</th>
<th>Average Private Loan per Student</th>
<th>Private Loans as Percentage of Total Borrowed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total All Students</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>39%</td>
<td>35%</td>
<td>$5,100</td>
<td>$1,793</td>
<td>14%</td>
<td>$6,522</td>
<td>$931</td>
<td>34%</td>
</tr>
<tr>
<td><strong>Total Full-Time Students</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>54%</td>
<td>50%</td>
<td>$5,432</td>
<td>$2,715</td>
<td>19%</td>
<td>$7,809</td>
<td>$1,502</td>
<td>36%</td>
</tr>
<tr>
<td><strong>Dependency</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dependent</td>
<td>50%</td>
<td>46%</td>
<td>$4,781</td>
<td>$2,212</td>
<td>18%</td>
<td>$8,411</td>
<td>$1,516</td>
</tr>
<tr>
<td>Independent</td>
<td>65%</td>
<td>62%</td>
<td>$6,971</td>
<td>$4,297</td>
<td>23%</td>
<td>$6,327</td>
<td>$1,457</td>
</tr>
<tr>
<td><strong>Sector</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public Four-Year</td>
<td>54%</td>
<td>50%</td>
<td>$5,248</td>
<td>$2,603</td>
<td>15%</td>
<td>$6,990</td>
<td>$1,078</td>
</tr>
<tr>
<td>Private Four-Year</td>
<td>66%</td>
<td>62%</td>
<td>$5,613</td>
<td>$3,494</td>
<td>28%</td>
<td>$10,208</td>
<td>$2,895</td>
</tr>
<tr>
<td>Public Two-Year</td>
<td>23%</td>
<td>20%</td>
<td>$4,094</td>
<td>$821</td>
<td>7%</td>
<td>$4,416</td>
<td>$287</td>
</tr>
<tr>
<td>For-Profit</td>
<td>92%</td>
<td>88%</td>
<td>$6,413</td>
<td>$5,658</td>
<td>43%</td>
<td>$7,123</td>
<td>$3,071</td>
</tr>
</tbody>
</table>

Source: NPSAS 2007-08
Note: Includes U.S. citizens and residents. PLUS loans, loans from friends and family, and credit card debt are not included. Private loan data in this table do not include state or institutional loans.

New data from the U.S. Department of Education's National Postsecondary Student Aid Study reveal that while many students are accumulating high levels of debt, these students remain the exception. Between 2003-04 and 2007-08, debt levels increased rapidly for students in the for-profit sector and for all of those earning certificates and two-year degrees. However, the increase was relatively small for bachelor's degree recipients in public and private four-year colleges.

Because averages do not tell the story of most individual borrowers, it is important to understand the distribution of debt levels among college graduates. While the typical debt levels of college graduates are manageable for those who successfully enter the workforce, there is growing concern about the minority of students who borrow much more than average and who end up with unduly burdensome repayment obligations. The new federal Income-Based Repayment program offers considerable protection for those who rely only on federal loans, but these benefits do not extend to nonfederal loans.

Figure 1 shows that among all of the students who completed a degree or certificate in the 2007-08 academic year, 41 percent graduated with no debt. This was the case for 34 percent of bachelor's degree recipients, 52 percent of associate degree recipients and 37 percent of those receiving certificates. On the other end of the spectrum, those who borrowed in excess of $40,000 made up 6 percent of all 2007-08 degree/certificate recipients and 10 percent of those who completed bachelor's degrees. About one-third of 2007-08 bachelor's degree recipients had total loan debt exceeding $20,000.

Figure 1 shows how total debt levels are distributed across all graduates, but Table 1 shows the distribution of debt levels among just those who borrowed. It also shows the differences in debt levels across sectors. For example, in the public four-year sector, 10 percent of borrowers receiving a bachelor's degree had total debt levels exceeding $40,000, but 22 percent of borrowing graduates of other sectors had similar levels of debt.

Source: National Postsecondary Student Aid Study (NPSAS) 2007-08
Note: Includes U.S. citizens and residents. PLUS loans, loans from friends and family, and credit card debt are not included. Components may not sum to 100 percent due to rounding.

Federal Student Loan Cohort Default Rates 1987-2009

National Student Loan Cohort Default Rates 1987-2009

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Education, Credit Constraints, Insurance and Inequality
Aid: Who Gets What?

(Belley, Frenette and Lochner, 2012)
Determining Financial Aid

- **Total Aid** = \( \min \{ \text{Costs} - \text{EFC, Upper Limit} \} \)
  - distributed via grants and loans
- **Costs** depend on
  - tuition
  - living expenses (\( \approx \$6,000 \) in 2003-04)
- **EFC** includes student and parental contributions
  - Key: EFC increases in parental income/assets above exemption amounts
  - In US, students must contribute 50% of income above a modest exemption amount
Consider tuition and financial aid
- annual averages for a 4-year PS ‘career’
- students living away from home
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- students living away from home

For US aid and tuition amounts (values PPP adjusted):
- financial aid forms from NPSAS04
- 18-24 year-old dependent students in 4-year public schools
- roughly 80% of US students attend public institutions
Calculating Aid in Canada and the US (2003-04)

- Consider tuition and financial aid
  - annual averages for a 4-year PS ‘career’
  - students living away from home
- For US aid and tuition amounts (values PPP adjusted):
  - financial aid forms from NPSAS04
  - 18-24 year-old dependent students in 4-year public schools
  - roughly 80% of US students attend public institutions
- Use federal CSLP and provincial rules for Canada
Measuring Price and Liquidity

- **Net Tuition** = Tuition − Grants − Tax Credits
  - measures actual price paid

- **Out-of-Pocket Costs** = Net Tuition − Loans
  - measure of liquidity: how much a family must come up with out of pocket, through work, or from private lenders
  - *available* federal loans
Tuition Levels (4-year, 2003-04)

- US 4-year public institutions (in-state):
  - Median: $4,350
  - Avg. of bottom half: $3,300
  - Avg. of top half: $6,000

- Canada
  - Ontario: $5,600
  - British Columbia: $4,800
  - Quebec: $2,500

* These amounts not adjusted for PPP. All graphs that follow adjust for PPP $\approx 1.2.$
Figure 4: Expected Family Contribution

Parental Income ($1,000)

ON  QC  BC  US

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Figure 2: Total Grants and Scholarships

Parental Income ($1,000)
Figure 3: Tax Benefits

Parental Income ($1,000)
Figure 5: Total Tax Credits, Grants and Scholarships

Parental Income ($1,000)

ON QC BC US Low Tuition US High Tuition
Figure 7: Net Tuition

Parental Income ($1,000)

ON QC BC US Low Tuition US High Tuition

Lochner
Figure 6: Total Government Student Loans
Figure 9: Out-of-Pocket Costs
Credit Constraints and Education

(Lochner & Monge-Naranjo, AR 2012)
Consider two-period-lived individuals who invest in schooling in the first period and work in the second period. Here are the key points:

- Investments increase future earnings but provide no additional utility benefits/costs.
- Abstract from the choice of leisure time.
Given financial assets $W \geq 0$ and ability $a > 0$, individuals choose borrowing $d$ and investment $h$ to maximize utility:

$$U = u(c_0) + \beta u(c_1)$$

where

$$c_0 = W + w_0(1 - h) - \tau h + d \quad (1)$$
$$c_1 = w_1af(h) - Rd \quad (2)$$

- $f(\cdot)$ is positive, strictly increasing and concave
- Education costs:
  - foregone wages: $w_0 \geq 0$
  - tuition costs: $\tau > 0$
Unconstrained Optima

- In the absence of credit market frictions, individuals maximize utility $U$ subject to (1) and (2)
- Problem can be solved in two stages:
  - Choose $h$ to maximize PDV lifetime income
  - Choose $d$ to smooth consumption
- Unconstrained human capital investment equates its marginal return with that on financial assets:
  $\frac{w_1af'\left[h^U(a)\right]}{w_0 + \tau} = R$
- Optimal unrestricted investment $h^U(a)$ is strictly increasing in ability $a$ and independent of initial assets $W$
Unconstrained Borrowing

- Unconstrained optimal borrowing $d^U(a, w)$ smooths consumption over time, satisfying the Euler equation:

$$u' \left[ W + w_0 + d^U(a, W) - (w_0 + \tau)h^U(a) \right]$$

$$= \beta Ru' \left[ w_1af \left[ h^U(a) \right] - Rd^U(a, W) \right]$$

- Unconstrained borrowing is strictly decreasing in wealth and increasing in ability.

- Greater ability increases borrowing for two distinct reasons:
  - More able individuals wish to finance more investment.
  - Given any level of investment, more able individuals earn higher net lifetime income and wish to consume more in the first period.
Suppose borrowing is constrained as follows:

\[ d \leq \bar{d} \]

- A threshold level of assets \( W_{\min}(a) \) determines who is
  - constrained: \( W < W_{\min}(a) \)
  - unconstrained: \( W \geq W_{\min}(a) \)
- \( W_{\min}(a) \) is increasing in ability
- Being ‘unconstrained’ may require greater wealth than is needed to cover tuition, since individuals also borrow to smooth consumption
Borrowing Constraint

FOCs for $d$ and $h$:

\[ u'(c_0) = \beta R u'(c_1) + \lambda \]
\[ u'(c_0)(w_0 + \tau) = \beta u'(c_1)w_1af'(h) \]

Combining these yields:

\[ \frac{w_1af'(h)}{w_0 + \tau} = R + \frac{\lambda}{\beta u'(c_1)} \]

- $\lambda > 0$ when constraint binds $\rightarrow MR(h) > R$
- equivalent to Becker-like formulation where constrained individuals face higher interest rates
Borrowing Constraint

Substituting constraint directly into problem shows that optimal constrained investment $h^X$ satisfies

$$(w_0 + \tau)u'[W + w_0 - (w_0 + \tau)h^X + \bar{d}]$$

$$= \beta u'[w_1af(h^X) - R\bar{d}]w_1af'(h^X)$$

$h^X(a, W)$ strikes a balance between increasing lifetime earnings and smoothing consumption

easy to differentiate this with respect to $a$ and $W$ to analyze how constrained investment varies with ability and wealth
Empirical Predictions for Investment

1. Constrained individuals under-invest in their human capital: 
   \( h^X (a, W) < h^U (a) \)

2. Unconstrained investment is independent of wealth, while constrained investment is strictly increasing in wealth and the borrowing limit \( \bar{d} \)

3. Marginal return on human capital \( MR(h) \equiv \frac{w_1 af'[h]}{w_0 + \tau} \)
   - equals return on savings for unconstrained individuals
   - strictly greater than return on savings and strictly decreasing in wealth for constrained individuals

4. Direct vs. opportunity costs
   - Constrained investment decreases more with an increase in direct costs than with an equal increase in opportunity costs (i.e., \( -\partial h^X / \partial w_0 < -\partial h^X / \partial \tau \))
   - Unconstrained investment responds equally to both costs (i.e., \( \partial h^U / \partial w_0 = \partial h^U / \partial \tau \))
The first three results are well-known since Becker (1967)

- They derive from the fact that the marginal cost of investment is higher for constrained individuals, since they cannot borrow to smooth consumption over time.
- This causes constrained individuals to invest less, stopping school when the marginal return is still relatively high.

The fourth implication is derived by Cameron and Taber (2004)

- an increase in opportunity costs also raises ‘full wealth’ levels, while an increase in direct costs does not
Ability and Investment

- Unconstrained investment is strictly increasing in ability.
- Relationship between ability and constrained investment is shaped by two opposing forces:
  1. More able individuals earn a higher return on human capital investment, so they would like to invest more.
  2. More able individuals have higher lifetime earnings, so they would like to consume more at all ages. This discourages investment, since constrained borrowers can only increase early consumption by lowering investment.
- With empirically relevant preferences for intertemporal consumption smoothing, the second effect can dominate, implying that constrained investments should be decreasing in ability.
Incorporating Tastes for Schooling

- Can introduce non-pecuniary benefits/costs of education $\xi$, so
  \[
  U = u(c_0) + \beta u(c_1) + \xi h
  \]

- Implies that unconstrained investment is not generally independent of wealth $W$
  - If $\xi > 0$, then $\frac{\partial hU}{\partial W} > 0$ and $MR(hU) < R$
  - If $\xi < 0$, then $\frac{\partial hU}{\partial W} < 0$ and $MR(hU) > R$

- Results 2 and 3 no longer imply simple ‘tests’ for borrowing constraints
  - Low-wealth individuals may acquire low levels of schooling (and have a high marginal return to investment), because they are more likely to be constrained or because schooling offers non-pecuniary benefits

- Result 4 continues to hold
Changing returns to college:

- Absent borrowing constraints, the correlation between family resources and the probability of attendance should *weaken* (or become negative) as the net financial returns to college increase (Belley & Lochner 2007)
  - an increase in the return to college raises the relative value of college less for individuals with high wealth due to diminishing marginal utility of consumption
- This need not be true when borrowing constraints limit the consumption of low-wealth individuals
  - Constrained youth may benefit little from an increase in future labor market returns to school
Constrained youth:

- are likely to have low levels of consumption during school
- may substitute leisure for work to alleviate the negative impacts of constraints on consumption and investment
- may delay college entry (and its labor market rewards) to accumulate savings
- should attend lower quality institutions
  - implies that wage returns from college attendance may be lower for constrained youth
US Evidence on Borrowing Constraints and College

(Lochner & Monge-Naranjo, AR 2012)
In the early 1980s (NLSY79), family income played little role in college attendance decisions after controlling for adolescent ability and family background (Cameron & Heckman 1998, 1999, Carneiro & Heckman 2002).

Comparing the NLSY79 with the NLSY97, Belley and Lochner (2007) find that family income is a much more important determinant of college attendance in the early 2000s.

Youth from high income families in the NLSY97 are 16 percentage points more likely to attend college than are youth from low income families conditional on adolescent cognitive achievement and family background.

Roughly twice the effect observed in the NLSY79.

In the NLSY97, the combined effects of family income and wealth on college attendance are roughly double the effects of income alone.
Role of Tastes for College

- One explanation for the observed positive relationship between family income and schooling is that higher income families place greater value on education.
- Not clear why this relationship would have strengthened so much since the early 1980s.
- Increase in net returns to schooling should have *weakened* the income – attendance relationship in the absence of borrowing constraints (if the relationship between ‘tastes’ for college and family income had remained stable).
Housing Wealth (Lovenheim 2011)

- Uses the PSID to estimate the impacts of exogenous changes in housing wealth (driven by local housing booms and busts) on post-secondary enrollment decisions.

- Estimates suggest that an additional $10,000 in housing equity raises college enrollment by 0.7 percentage points, with much larger effects among lower income families.
  - Wealth – schooling correlation not just a wealth – tastes correlation.

- Impacts of housing wealth have become more important in the 2000s.
  - Increased liquidity of housing wealth or a general increase in the effect of family resources on schooling?
Work and College Entry Delay (Belley & Lochner 2007)

- Among lower ability groups, weak effects of income on work (during the school year) for both NLSY cohorts.
- Among the most able, effects of income on work increase substantially over time.
  - In the NLSY97, the most able youth from low-income families work more weeks and nearly twice as many hours per week during the school year than their higher income counterparts.
- Estimated effects of family income on college entry delay are weak for both NLSY cohorts.
Relationship between family income and attendance at 4-year (relative to 2-year) institutions strengthened considerably from early 1980s to early 2000s (Belley & Lochner 2007)

Relationship between family income and attendance at selective high quality institutions weakened (Kinsler & Pavan 2010)
- among top (often private) schools, both tuition and need-based aid increased dramatically
- effectively increased the price of college quality more for high-income students
Cameron & Taber (2004) Examine returns to schooling, basing their analysis on predictions 3 and 4. They argue that the set of individuals whose college-going is affected by a change in direct costs should disproportionately include more credit constrained youth than the set of individuals affected by a change in opportunity costs. They measure direct costs by ‘college in county’ indicator and opportunity costs by local low-skill wage rates. IV estimates of the return to schooling using ‘college in county’ as an instrument should exceed those using ‘local low-skill wages’ if borrowing constraints are important. This ignores differences in college quality. There is no evidence in support of credit constraints for NLSY79 men.
A few studies estimate lifecycle schooling models.

Exploiting data on schooling choices, earnings, and in some cases, assets and family transfers, to identify the role of borrowing constraints.
Cameron & Taber (2004)

- Estimate a lifecycle model with a discrete set of schooling options
- Test whether individuals face different interest rates when making their schooling decisions
- Evidence that some individuals face high interest rates relative to others would imply that borrowing constraints distort their education decisions
- Main source of identification is potential asymmetry in impacts of opportunity costs and direct costs
- Finding: no heterogeneity in interest rates (NLSY79 men)
Keane & Wolpin (2001)

- Estimate a dynamic model of schooling, work, and consumption
- Incorporate borrowing constraints and (exogenous) parental transfers
- Panel data on schooling and work (full-time and part-time), wages, and assets (white males, NLSY79)
- Allow for unobserved heterogeneity in the ability to acquire human capital, tastes for work and school, and borrowing limits
Keane & Wolpin (2001)

Key findings:

- Estimated borrowing limits are very tight (ranging from $600 to $1000 across individuals, in 1987 dollars)
  - less than 1/3 the estimated cost of a single semester of school (about $3,700)

- Important role for parental transfers and part-time work in enabling school attendance
  - parents provide between $3,300 and $10,000 in transfers while enrolled in school
  - transfers increasing in parental education
  - transfers are substantially lower when students are not enrolled in school
  - transfers act as a subsidy for education (larger for children with more educated parents)
Keane & Wolpin (2001)

Conclusions:

- Conclude that nearly all of the (sizeable) differences in educational attainment by parental education are accounted for by:
  - higher enrollment-contingent parental transfers from educated parents
  - unobserved heterogeneity

- Increases in available credit:
  - have negligible effects on schooling
  - reduces work during school
  - increases consumption during school
  - constraints have little effect on utility
Johnson (2011)

- Estimates a similar model to Keane & Wolpin
- Some key differences:
  - recent male high school graduates in the NLSY97
  - explicitly models government student loan programs and a private credit limit
  - allows for differences in tuition across states
  - incorporates need- and merit-based grants
  - allows for exogenous unemployment
  - exploits additional data on avg. tuition by state, self-reported grant aid and parental transfers
- enables him to infer consumption during and after school, helping identify who is constrained
Johnson (2011)

Key findings:

- Parental transfers (esp. that schooling-contingent transfers are greater for higher-income families) and unobserved heterogeneity are important determinants of schooling.
- Estimated borrowing limits are modest relative to college costs; substantially greater than those of Keane & Wolpin.
- Estimates a stronger, though modest, impact of increasing loan limits:
  - an additional $1,500 in credit per year in school would increase college completion rates by 4.5%.
  - allowing students to borrow up to the total costs of schooling would increase completion rates by nearly 8%.
Role of Borrowing Constraints

- Borrowing constraints have small to modest impacts on schooling choices in these two studies for very different reasons.
- Estimates from Keane & Wolpin suggest that most students are constrained but that consumption and leisure are distorted rather than schooling:
  - lack of effects on schooling consistent with other NLSY79 studies.
- Johnson estimates that few youth borrow up to their limit:
  - risk aversion, coupled with the possibility of very low income (associated with post-school unemployment), prevents individuals from taking on much debt.
  - his estimates suggest that very few would choose to borrow more than $6,000.
Interpreting Keane & Wolpin (2001) and Johnson (2011)

- Results suggest that many youth would not attend college without schooling-contingent transfers from their parents even if credit were abundant.
- Why do wealthier parents effectively subsidize so much schooling if their children are not willing to pay for it themselves?
  - Parents must value their children’s education more than their children do.
  - Why do schooling-contingent transfers increase in parental income?
- Not clear how these results explain the dramatic increase in family income – attendance gaps over the past few decades.
Navarro (2010)

- Explores importance of heterogeneity, uncertainty, and borrowing constraints as determinants of college attendance in a lifecycle framework.
- Uses schooling and earnings data from the NLSY79 and PSID.
- At each age, borrowing constraints are given by the lowest possible discounted future income (‘natural’ limit of Aiyagari (1994)).
- An important innovation is the methodology used to identify \textit{ex ante} heterogeneity in abilities (and tastes for college) separately from uncertainty about future income.
Navarro (2010)

Key findings:

- Because individuals would never choose to borrow more than the ‘natural’ limit, relaxing this constraint by itself would have no effect on behavior in his framework.

- Eliminating uncertainty would substantially change who attends college but would have little impact on the aggregate attendance rate.

- Simultaneously removing uncertainty and borrowing constraints would lead to sizeable increases in college attendance.

- Highlights an important interaction between borrowing constraints and risk/uncertainty.
General Comments on Uncertainty and Borrowing Constraints

- Assumptions about minimal income (or consumption) levels are crucial for the importance of borrowing limits in lifecycle schooling models with uncertainty.

- Demand for credit may be much higher with explicit insurance mechanisms or implicit ones (e.g. bankruptcy, default, deferment and forgiveness).

- Private credit offerings may increase in response to any reductions in risk.

- Important to think about insurance and credit together when estimating these types of models.
‘Endowments’ and Adolescent ‘Abilities’

- play a central role in determining the relationship between socioeconomic background and education (and earnings) outcomes
  - true in structural models and estimated education gaps by family income
- Most studies treat these endowments as exogenous and invariant to policy
- Some recent work endogenizes these endowments through early investments by families and schools
- constraints can have large impacts on early investments
Digression:

- This empirical literature is almost exclusively partial equilibrium.
- Heckman, Lochner & Taber (1998) and Gallipoli, Meghir & Violante (2011) show that incorporating GE effects on skill prices can considerably dampen the impacts of education policies on schooling.
Stinebrickner & Stinebrickner (2008)

- Directly ask students enrolled at Berea College whether they would like to borrow more if they could (at a ‘fair’ interest rate)
  - while Berea is ‘special’ in many ways, its college dropout rates are similar to those for other low-income students in the US
- While many Berea students live on a very tight budget, only about 20% report that they would like to borrow more
- College drop out rates (by the beginning of year two) are 11-13 percentage points higher (or roughly double) for ‘constrained’ youth
Brown, Scholz and Seshadri (2011)

- Model intergenerational relationships and derive a new way of identifying which youth may be affected by borrowing constraints.
- Assume that youth would be borrowing constrained if they did not receive help from their parents.
- Parents cannot write enforceable loan contracts with their children.
- Some parents may not want to transfer enough resources to satisfy their children’s demand for consumption and schooling.
  - Parents would provide all their transfers to their children at college ages, but children would under-invest.
- Unconstrained families transfer enough resources to their children to support optimal investment and make transfers after their children leave school.
Distinguish between ‘constrained’ and ‘unconstrained’ families based on post-school parental transfers.

In their framework, total human capital investment should be more sensitive to a tuition subsidy among constrained youth than among unconstrained youth.

Test this prediction using intergenerational data on educational attainment and family transfers from the HRS (US during 1970s, 1980s, and 1990s).

Among ‘constrained’ youth, an additional $3,600 in aid (i.e., 4 vs. 0 years of sibling overlap) increases average schooling by 0.2 years.

Negligible effects of additional aid on ‘unconstrained’ youth.
Summarizing the Evidence

- Studies analyzing the NLSY79 data find little evidence that borrowing constraints affected college-going in the early 1980s.
- Important changes over past few decades point to increased salience of constraints:
  - significant increases in the share of students ‘maxing out’ their federal student loan opportunities
  - doubling in family income – college attendance gradients for recent cohorts
  - able low-income students work much more than their high-income counterparts in NLSY97
- Changes in family income – college quality relationship mixed
- Small effects on college entry delay
- Differences in parental transfers and labor market risk are also important factors, complicating interpretation of the evidence.
Early and Late Investments and Credit Constraints
Most studies of borrowing constraints focus on college ages and take earlier investments and family transfers as given.

These studies typically find that adolescent ‘abilities’ are very important.

A few recent studies examine the role of early investments in determining these ‘abilities’ as well as later schooling choices and earnings:

- early borrowing and intergenerational transfer constraints
- family transfers/investments
- dynamics of skill production
Todd and Wolpin (2003, 2007)
Del Boca, Flinn and Wiswall (2010)
Related macro/inequality intergenerational studies typically focus on a single investment period

- Restuccia & Urrutia (2004) consider both early investment and college attendance
Importance of Early Borrowing Constraints

- Consumption studies suggest borrowing constraints more salient for younger families (e.g. Meghir and Weber 1996, Alessie, et al. 1997, Stephens 2008)
- Young parents may have large college debts and typically earn less when children are young
- No loans specifically for early investments in children
- Indirect evidence suggests early constraints may inhibit investment
  - many early interventions have large long-run impacts (e.g. Perry Preschool)
  - poor parents spend much less time and money investing in their children (e.g. Kaushal, et al. 2011)
  - early income has relatively large impacts on achievement and educational attainment
### Effects of Early and Late Family Income

- Data from Children of NLSY
- Effects measured in $10,000 in average PDV ages 0-11 and 12-23
- Controls for maternal education

<table>
<thead>
<tr>
<th>Education</th>
<th>Sample Size</th>
<th>Early Income</th>
<th>Late Income</th>
<th>Equal Effect (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete HS (ages 21-24)</td>
<td>1,483</td>
<td>0.042</td>
<td>0.001</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.007)</td>
<td>(0.008)</td>
<td></td>
</tr>
<tr>
<td>Att. College (ages 21-24)</td>
<td>1,483</td>
<td>0.044</td>
<td>0.019</td>
<td>0.096</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.008)</td>
<td>(0.009)</td>
<td></td>
</tr>
<tr>
<td>Grad. College (ages 24-27)</td>
<td>828</td>
<td>0.051</td>
<td>0.015</td>
<td>0.039</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.009)</td>
<td>(0.010)</td>
<td></td>
</tr>
</tbody>
</table>
Examine:

- The importance of borrowing constraints at different stages of development
- The extent of dynamic complementarity in investments and how it interacts with borrowing constraints
- Effects of policies at one stage of development on investments at other stages
- Intergenerational transfers and their implications for policy in the short- and long-run
Theoretical analysis

- highlights the role of ‘dynamic complementarity’ in investments
  - with
  - constraints that (might) bind at any point in the future
discourage investment in prior periods
Dynastic OLG model with ‘early’ and ‘late’ childhood human capital investment:

- Asset accumulation
  - Non-negative financial transfers from parents to children
  - Lifecycle borrowing constraints
- Heterogeneity in ability, assets, human capital/earnings
- Uncertainty in earnings
Six Life Stages

YoungParent  OldParent  PostParent  Retired

YoungChild  OldChild  YoungParent  OldParent  PostParent  Retired

YoungChild  OldChild  YoungParent  OldParent

YoungChild  OldChild  YoungParent  OldParent  PostParent  Retired

YoungChild  OldChild
Human capital upon labor market entry is:

\[ h_3 = \theta f(i_1, i_2) \]

- \( f \) is increasing and concave in \( i_1 \) and \( i_2 \)
- \( f_{12} \) represents the degree to which investments are complementary
  - strong dynamic complementarity \( \rightarrow \) optimal \( i_1 \) and \( i_2 \) move together
  - later interventions may be ineffective
- Heterogeneous ability: \( \theta \) (depends on parental ability)
- Consider free base public investment, \( p_1 \) and \( p_2 \), and investment subsidies, \( s_1 \) and \( s_2 \)
- Human capital grows exogenously for adults
Consider shocks to earnings: \( W(h_j, \epsilon_j) = wh_j + \epsilon_j \)

Allow for human capital-specific borrowing constraints:
\[ L_j(h_3) = \gamma \times (\text{min. discounted future earnings from } j \text{ on}) \]

write the entire problem from the parent’s perspective
Young Parent’s Problem

\[
V_3(h_3, \epsilon_3, A_3, \theta') = \max_{c_3, A_4, c_1', i_1'} \left\{ u(c_3) + \rho u(c_1') + \beta E_{\epsilon_4} V_4(h_4, \epsilon_4, A_4, h_2', \theta') \right\}
\]

subject to

\[
\begin{align*}
i'_1(1 - s_1) + c_1' + c_3 + A_4 &= RA_3 + W(h_3, \epsilon_3) \\
A_4 &\geq -L_3(h_3) \\
h_2' &= p_1 + i_1' \\
h_4 &= \Gamma_4 h_3
\end{align*}
\]
Old Parent’s Problem

\[ V_4(h_4, \epsilon_4, A_4, h_2', \theta') = \max_{c_4, A_5, c_2', i_2', A_3'} \left\{ u(c_4) + \beta V_5(h_5, A_5) + \rho \left[ u(c_2') + \beta E_{\theta'', \epsilon_3'}(V_3(h_3', \epsilon_3', A_3', \theta'') | \theta') \right] \right\} \]

subject to

\[ i_2'(1 - s_2) + c_2' + c_4 + A_3' + A_5 = RA_4 + W(h_4, \epsilon_4) + W_2 \]
\[ i_2'(1 - s_2) + c_2' + A_3' \geq W_2 \]
\[ A_5 \geq -L_4(h_4) \]
\[ A_3' \geq -L_2(h_3') \]
\[ h_3' = \theta' f(h_2', p_2 + i_2') \]
\[ h_5 = \Gamma_5 h_4 \]
Post-Parenthood

\[ V_5(h_5, A_5) = \max_{A_6} \{ u(RA_5 + W(h_5) - A_6) + \beta u(RA_6) \} \]

- Can easily solve for \( V_5(h_5, A_5) \) and plug into old parent's problem
Assumptions for Computation

- Human capital accumulation:
  \[ f(i_1, i_2) = (ai_1^b + (1 - a)i_2^b)^{d/b} \]

- Discrete number of early investments, \( i_1 \in I_1 \)

- Four levels of late investments, \( i_2 \in I_2 \), corresponding to HS dropout, HS graduate, some college, college graduate and beyond

- Two ability levels, \( \theta \): high and low
  - Intergenerational Markov process: \( \pi_{hh} \) and \( \pi_{ll} \)

- Distribution of earnings shocks: \( \ln(\epsilon) \sim N(m, s) \)

- Utility: \( u(c) = \frac{c^{1-\sigma}}{1-\sigma}, \ \sigma \geq 0 \)
Some Standard Parameters/Normalizations

Assume:

- Six twelve-year periods beginning at birth
- \( R = 1.8 \) implies a 5% annual return
- \( \beta = R^{-1} \)
- \( \sigma = 2 \)
- normalize \( w = 1 \) (everything in 2008 dollars deflated by the CPI-U)
Estimate $W_2$ and $i_2$ amounts based on (foregone) earnings levels in NLSY79 and direct costs from Digest of Educ. Statistics

Assume grid for $i_1$ of 7 points from 0 to $21,000$

Set $(p_1, p_2)$ and $(s_1, s_2)$ based on per capita public schooling expenditures, tuition levels, and total costs

$\Gamma_4$ and $\Gamma_5$ are set to match growth rates in earnings in NLSY79 and 2006 March CPS
Parameters ‘Calibrated’ via SMM

Simultaneously ‘calibrate’ remaining parameters using SMM:

\[ a, b, d, \theta_1, \theta_2, \pi_{hh}, \pi_{ll}, m, s, \rho, \gamma \]

Match the following moments in NLSY79/CNLSY:

- Unconditional education distribution
- Distribution of annual earnings for men ages 24-35 and 36-47: mean, variance, and skewness
- Child education conditional on mother’s education and parental income quartiles (early and late)
- Average child wages (ages 24-35) conditional on own education, mother’s education, and parental income quartile (early)
Key Calibrated Parameters

- elasticity of substitution between $i_1$ and $i_2$ is 0.4
- modest persistence in ability
- individuals can borrow about $1/2$ the minimum of their future lifetime income
## Steady State Characteristics

### Education Distribution

<table>
<thead>
<tr>
<th>Level</th>
<th>Model</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>High school dropout</td>
<td>.20</td>
<td>.18</td>
</tr>
<tr>
<td>High school graduate</td>
<td>.43</td>
<td>.40</td>
</tr>
<tr>
<td>Some college</td>
<td>.23</td>
<td>.23</td>
</tr>
<tr>
<td>College graduate and beyond</td>
<td>.14</td>
<td>.20</td>
</tr>
</tbody>
</table>
### Average Baseline Investment Amounts by Parental Education

<table>
<thead>
<tr>
<th>Parental Education</th>
<th>Average $i_1$</th>
<th>Average $i_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Levels</td>
<td>2,013</td>
<td>6,587</td>
</tr>
<tr>
<td>High School Dropout</td>
<td>685</td>
<td>2,813</td>
</tr>
<tr>
<td>High School Graduate</td>
<td>1,934</td>
<td>6,286</td>
</tr>
<tr>
<td>Some College</td>
<td>2,792</td>
<td>8,882</td>
</tr>
<tr>
<td>College Graduate</td>
<td>2,891</td>
<td>9,190</td>
</tr>
</tbody>
</table>
Borrowing constraints:

- No old children are constrained
- 41% of young parents are constrained
- 31% of old parents are constrained
General Issues for Policy Experiments

- Relax borrowing constraints
  - effects of constraints at different ages
  - short-term vs. long-term effects
- Education subsidies
  - effects of early vs. late subsidies
  - how do early investments respond to late subsidies, and what do we miss by ignoring this margin?
- Income transfers vs. loans for young parents
  - ‘current’ and ‘future’ effects of policy and one-time vs. permanent policies
% Change in Short-Run

<table>
<thead>
<tr>
<th>Parent Educ.</th>
<th>Avg. $i_1$</th>
<th>HS $+$</th>
<th>College</th>
<th>Avg. $W_3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>7.9</td>
<td>4.3</td>
<td>7.0</td>
<td>0.6</td>
</tr>
<tr>
<td>HS grad.</td>
<td>2.5</td>
<td>7.4</td>
<td>3.7</td>
<td>0.3</td>
</tr>
<tr>
<td>College grad.</td>
<td>15.2</td>
<td>0</td>
<td>18.3</td>
<td>1.5</td>
</tr>
</tbody>
</table>
Increasing Borrowing Limits for Young Parents by $2,500

- % Change in Short-Run

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<td>College grad.</td>
<td>15.2</td>
<td>0</td>
<td>18.3</td>
<td>1.5</td>
</tr>
</tbody>
</table>

- % Change in Long-Run

<table>
<thead>
<tr>
<th>Parent Educ.</th>
<th>Avg. $i_1$</th>
<th>HS +</th>
<th>College</th>
<th>Avg. $W_3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>-0.7</td>
<td>3.1</td>
<td>-3.5</td>
<td>-0.1</td>
</tr>
<tr>
<td>HS grad.</td>
<td>-6.9</td>
<td>4.5</td>
<td>-9.0</td>
<td>-0.5</td>
</tr>
<tr>
<td>College grad.</td>
<td>7.9</td>
<td>0</td>
<td>9.6</td>
<td>0.8</td>
</tr>
</tbody>
</table>
Increasing Borrowing Limits for Young Parents by $2,500

- Long-Run Changes in Fraction Constrained

<table>
<thead>
<tr>
<th>Parent Educ.</th>
<th>Young parents</th>
<th>Old parents</th>
<th>Old kids</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>-.04</td>
<td>.06</td>
<td>.05</td>
</tr>
<tr>
<td>HS grad.</td>
<td>-.02</td>
<td>.04</td>
<td>.04</td>
</tr>
<tr>
<td>College grad.</td>
<td>-.03</td>
<td>0</td>
<td>0</td>
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</table>
Increasing Borrowing Limits for Young Parents by $2,500

- Long-Run Changes in Fraction Constrained

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<td>College grad.</td>
<td>-.03</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

- Increasing borrowing limits for young parents causes those that are constrained to borrow more
  - increases investment in the short-run
  - in long-run, asset distributions shift left, constraints bind again, and there is slightly less overall human capital investment
  - initial generations capture most of the benefits
Increasing borrowing limits for old parents or old kids has little effect on human capital investment
- old children are unconstrained
Subsidizing Education

Compare increasing $s_1$ from 0 to .12 vs. increasing $s_2$ from .5 to .55

- Both policies cost about $750 per capita
- 60% of costs for early subsidy are delayed
  - increased costs associated with late subsidy
Comparing increasing $s_1$ from 0 to 0.12 vs. increasing $s_2$ from 0.5 to 0.55:

- Both policies cost about $750 per capita.
- 60% of costs for early subsidy are delayed.
  - Increased costs associated with late subsidy.

**Short-Run Effects (% Changes)**

<table>
<thead>
<tr>
<th>Increase $s_1$</th>
<th>Avg. $i_1$</th>
<th>Avg. $i_2$</th>
<th>HS+</th>
<th>Coll. Grad</th>
<th>$W_3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase $s_2$</td>
<td>2.6</td>
<td>9.7</td>
<td>9.7</td>
<td>13.0</td>
<td>0.4</td>
</tr>
<tr>
<td>$- i_1$ fixed</td>
<td>0.0</td>
<td>5.2</td>
<td>9.7</td>
<td>0.2</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Lochner

Education, Credit Constraints, Insurance and Inequality
Subsidizing Education

Compare increasing $s_1$ from 0 to .12 vs. increasing $s_2$ from .5 to .55

- Both policies cost about $750 per capita
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### Short-Run Effects (% Changes)

<table>
<thead>
<tr>
<th></th>
<th>Avg. $i_1$</th>
<th>Avg. $i_2$</th>
<th>HS+</th>
<th>Coll. Grad</th>
<th>$W_3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase $s_1$</td>
<td>21.3</td>
<td>9.3</td>
<td>0</td>
<td>23.4</td>
<td>1.5</td>
</tr>
<tr>
<td>Increase $s_2$</td>
<td>2.6</td>
<td>9.7</td>
<td>9.7</td>
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<td>5.2</td>
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<td>0.2</td>
<td>0.1</td>
</tr>
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</table>
Why are Later Subsidies Less Effective?

- Dynamic complementarity implies that early and late investments should co-move.
- Costly to increase early investment in response to later subsidies when early borrowing constraints bind.
  - Lack of early investment response makes it less valuable to make later investments (especially college).
  - Problem is dynamic complementarity coupled with early borrowing constraints.
Transfers vs. Loans for Young Parents

Compare $2,500 income transfer and loan

- Loan policy only provides liquidity, while transfer also generates wealth effects

### Effects of Permanent Policy (% Changes)

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- Why do loans increase investment more than transfers?
Transfers vs. Loans for Young Parents

Transfer policy has

- larger ‘current’ effects from increasing the child’s parental resources (one-time policy)
- more negative ‘future’ effects by increasing the child’s resources when he becomes a parent

### Effects (% Changes)

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Main Lessons

- Due to dynamic complementarity in human capital production, policies in one period affect decisions in other periods
  - difficult to make up for early investment deficits with later policies
  - dynamic complementarity + early borrowing constraints $\rightarrow$ early subsidies have a bigger impact than late subsidies
  - ignoring early investment responses underestimates impacts of later policies (by a lot!)
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- The effects of policy can be very different in the SR and the LR due to shifts in asset distributions
- One-time loans/transfers have stronger positive effects on investment than their permanent counterparts
The Nature of Borrowing Constraints for Education

(Lochner & Monge-Naranjo, AER 2011)
Standard ad hoc assumptions on borrowing limits are at odds with the actual operation of public and private sources of credit for education.

More realistic assumptions about government and private lending can be useful for understanding the behavior of human capital investments.

GSL programs explicitly link credit to educational expenditures, while private lenders extend credit to students based on their prospects of repayment and projected future earnings.
Most GSL programs have three salient features:

1. **Lending is directly tied to investment** – students (or parents) can only borrow up to the total cost of college (including tuition, room, board, books, and other expenses directly related to schooling) less any other financial aid they receive.

2. **Set upper loan limits** on the total amount of credit available for each student.

3. **Extend mechanisms to enforce repayment** compared to other unsecured private loans.
Government Student Loan Programs

- Imply that government borrowing $d_g$ must satisfy

$$d_g \leq \min \{ \tau h, \bar{d} \}$$  (3)

- Upper limit $\bar{d}$ is specified by law
- Given their strong enforcement, we begin by assuming that government loans must be repaid
Private Lending:

- The importance of private lending markets for schooling has skyrocketed from virtually zero in the early 1990s to over $15 billion in 2005-06, 20% of all student loan dollars distributed.
- Credit cards have also become an important source of funds for students.
- Useful to derive credit constraints that arise endogenously when lenders have limited mechanisms for enforcing repayment.
A rational borrower repays private loans if and only if repaying is less costly than defaulting.

Lenders limit credit to amounts that will be repaid.

Since penalties for default typically impose a larger cost on borrowers with higher earnings, credit is directly related to perceived future earnings.

Because expected earnings depend on schooling, private credit limits and investments are co-determined in equilibrium.
Assume that the cost of default on private loans equals a fraction $0 < \tilde{\kappa} < 1$ of labor earnings.

Borrowers will repay if and only if the payment $Rd_p$ is less than the punishment cost $\tilde{\kappa}af(h)$.

Private credit is limited to a fraction of post-school earnings:

$$d_p \leq \tilde{\kappa}R^{-1}af(h)$$  \hspace{1cm} (4)

Credit is increasing in both ability and investment.
Total GSL and private credit limits:

\[ d = d_g + d_p \leq \min \{ \tau h, \bar{d} \} + \tilde{\kappa} R^{-1} af(h) \]  

- Assuming GSL repayments are fully enforced, government credit does not crowd-out private credit here.
- Similar constraint holds in a lifecycle model that includes both temporary exclusion from credit markets and wage garnishments as punishments for default.
  - Partial crowd-out arises even if GSL credit is fully enforceable.
- In general, some crowd-out is expected because increases in total debt reduce incentives to repay private debt.
Empirical Implications (Lochner and Monge-Naranjo 2011):

- Framework can explain college attendance and financing patterns as equilibrium responses to the increased returns to and costs of college observed since the early 1980s, given stable GSL limits.
  - in the early 1980s, the GSL provided adequate credit to most students and only a few would have needed private funding.
  - college attendance was, therefore, largely independent of family resources.
  - rising college costs and returns have encouraged more recent cohorts to invest and borrow more, those exhausting GSL credit turning to private lenders.
  - private lenders have responded by endogenously raising their credit limits, though not enough to ensure efficient investment for everyone.
Distortionary effects of credit constraints are shifted onto consumption and away from investment due to the link of GSL and private credit to investment consistent with Keane & Wolpin (2001), Stinebrickner & Stinebrickner (2008), and Johnson (2011).

Constrained individuals may not under-invest at all, since additional investments (at the margin) can be financed with additional government or private loans.
The endogenous nature of private and GSL credit also accommodates greater investment among the most able, since total credit is increasing in both investment and ability.

Constrained investment is more likely to be increasing in ability than when credit limits are exogenous.
Private credit responses to GSL programs and other government policies
- simulations suggest that expansions of public credit have only modest crowd-out effects on private credit
- increases in GSL limits lead to higher levels of total credit and raise human capital investment among constrained youth
- human capital investment is more sensitive to government education subsidies due to a ‘credit expansion effect’

Changes in GSL credit tend to have a relatively greater impact on investment among the least able, while changes in private loan enforcement tend to impact investment more among the most able
Uncertainty, Constraints, and Insurance
Consider risky returns and the implications of imperfect insurance and private information for the provision of credit and human capital investment.

Uncertainty introduces many interesting issues for policy:
- potential for default
- tradeoff between enforcing repayment and providing insurance

Incorporate ideas from literatures on:
- optimal contracting with limited commitment
- private information

Can offer useful guidance in designing efficient policies to provide both credit and insurance for schooling in a risky environment.
Extending Basic 2-Period Framework:

- Abstract from forgone wages and normalize tuition costs to one
  - \( w_0 = 0 \) and \( \tau = 1 \)

- Assume that the post-school price of human capital is stochastic and can take on \( i = 1, ..., N \) possible realizations:
  - let \( p_i > 0 \) denote the probability of realization \( w_{1,i} \)

- Public knowledge about \( p_i, a, \) and \( W \)
Two-period-lived individuals invest in schooling in the first period and work in the second

Preferences are \( U = u(c_0) + \beta E[u(c_1)] \)

Each person is endowed with:
- financial assets \( W \geq 0 \)
- ability \( a > 0 \)

investments \( h \) increase future earnings:

\[
y = w_1af(h)
\]

\( w_1 \) is the stochastic price of human capital
\( f(\cdot) \) is positive, strictly increasing and concave
Complete Markets

- Individuals maximize expected utility

\[ U = u(c_0) + \beta \sum_{i=1}^{N} p_i u(c_{1,i}) \quad \text{s.t.} \]

\[ c_0 = W - h + \sum_{i=1}^{N} q_i D_i \]

\[ c_{1,i} = a f(h) w_{1,i} - D_i, \quad i = 1, \ldots, N \]

- \( c_{1,i} \) is second period consumption associated with realization \( i \)
- \( D_i \) reflects the (possibly neg.) quantity a person commits to repay in the second period contingent on realization \( i \)
- \( q_i \) is the (Arrow) price of a contingent claim that pays 1 if realization \( i \) takes place and zero otherwise
- Assume risk neutral arbitrage-free asset prices: \( q_i = \beta p_i \)
Human capital investments $h^* (a)$ maximize the expected net present value of lifetime income.

Investment equates expected MR with MC:

$$\bar{w}_1 a f' [h^* (a)] = \beta^{-1}$$

where $\bar{w}_1 \equiv \sum_{i=1}^{N} p_i w_{1,i}$ is the expected period 1 skill price.

Neither $u(\cdot)$ nor $W$ (nor extent of risk) affect investment.

Asset/debt holdings $D_i$ optimally smooth consumption over time and across states: $u'(c_0) = u'(c_{1,i}), \ \forall i$
Limited Commitment Problems
Assume that individuals can default on their debts in the second period.

‘Default’ utility of $V^D(w_{1,i}, a, h)$, generally increasing in $w_{1,i}$, $a$, and $h$.

‘Participation constraints’:

$$u[w_{1,i}af(h) - D_i] \geq V^D(w_{1,i}, a, h), \forall i$$

- borrowers only repay if it offers higher utility
- potential for non-payment limits the credit and insurance of borrowers
Let $\lambda_i \geq 0$ denote the (discounted) multiplier on participation constraint $i = 1, \ldots, N$

Optimal debt holdings satisfy $u'(c_0) = (1 + \lambda_i) u'(c_{1,i})$

- perfect consumption smoothing ($c_{1,i} = c_0$) for states in which the participation constraint does not bind ($\lambda_i = 0$)
- consumption growth ($c_{1,i} > c_0$) when participation constraint binds ($\lambda_i > 0$)
Consider case in which a defaulting borrower must forfeit a fraction $\tilde{\kappa} \in [0, 1]$ of his earnings

$$V^D(w_{1i}, a, h) = u ((1 - \tilde{\kappa}) w_{1i} af(h))$$

Participation constraints reduce to simple ‘solvency’ constraints: $D_i \leq \tilde{\kappa} w_{1i} af(h), \forall i$

- solvency constraints likely to bind for high realizations of $w_{1i}$
  $$\Rightarrow D_i = \tilde{\kappa} w_{1i} af'(h)$$
- individuals cannot commit to pay back enough in high earnings states to enable full consumption smoothing
- perfect smoothing across low earnings states but only limited insurance in high earnings states
Optimal human capital investment $h^{LC}(a, W)$ satisfies

$$
\bar{w}_1 a f' \left[ h^{LC}(a, W) \right] \left[ \frac{\sum_{i=1}^{N} p_i w_{1,i} \left( \frac{1+\lambda_i \kappa}{1+\lambda_i} \right)}{\bar{w}_1} \right] = \beta^{-1}
$$

If any ‘solvency’ constraint binds, there is under-investment

$$\sum_{i=1}^{N} p_i w_{1,i} \left( \frac{1+\lambda_i \kappa}{1+\lambda_i} \right) < \bar{w}_1 \text{ when } 0 < \kappa < 1 \text{ and } \lambda_i > 0 \text{ for some } i$$
Many similarities to case with full certainty:

- constraints imply under-investment
- human capital investments help relax solvency constraints
- this encourages investment and implies a ‘credit expansion’ response to education policies
- default does not occur in equilibrium, since all debt repayments are fully contingent
- optimal institutional arrangements would minimize the temptation of default by raising $\tilde{\kappa}$ as high as possible ($\tilde{\kappa} = 1$ produces unconstrained optimal allocations)
Now, suppose second period liabilities cannot depend on the state $w_{1,i}$.

Default may now occur in equilibrium.

Assume the same punishments for default with the income forfeiture recovered by lenders.

Let $D > 0$ be the amount of debt individuals ‘promise’ to repay after school.

Individuals actually repay if and only if $D \leq \tilde{\kappa} w_{1,i} a f(h)$.

- Default iff $w_{1,i} < \tilde{w}_{1} (D, a, h) \equiv \frac{D}{\tilde{\kappa} a f(h)}$.
Probability of default, \( \Pr [w_{1,i} < \tilde{w}_1 (D, a, h)] \), is weakly increasing in \( D \) and decreasing in \( a \) and \( h \)

In exchange for a ‘promise’ to pay \( D > 0 \), risk-neutral lenders extend credit

\[
Q(D, a, h) = \beta \left\{ D - \sum_{w_{1,i} < \tilde{w}_1} p_i [D - \tilde{\kappa}w_{1,i}af (h)] \right\}
\]

Subtract off expected losses \( D - \tilde{\kappa}w_{1,i}af (h) \) from default

Expected payments (and credit \( Q(\cdot) \)) are not monotonically increasing in debt, since increasing debt can more than proportionally reduce the probability of repayment

A ‘hard’ borrowing constraint is given by \( \sup_D \{ Q(D, a, h) \} < \infty \), the most a lender could possibly expect to extract from someone with ability \( a \) investing \( h \)
Assuming \( \tilde{w}_1 \) falls outside the support of \( w_{1,i} \) (i.e. ignore jumps in default probabilities), optimal \( h \) satisfies:

\[
\frac{\sum_{i=1}^{N} p_i u'(c_{1,i}) w_{1,i} - \tilde{\kappa} \sum_{w_{1,i} < \tilde{w}_1} p_i u'(c_{1,i}) w_{1,i}}{\tilde{w}_1 u'(c_0) (1 - Q_h)} = \beta^{-1},
\]

where \( 0 < Q_h < 1 \) at the optimum

Three important differences compared to full insurance:

1. riskiness of human capital discourages investment
2. some benefits of investment are lost in the event of default since \( 0 < \tilde{\kappa} < 1 \) (\( \downarrow h \))
3. additional investment increases expected payments, thereby expanding credit (\( \uparrow h \))
Interest rates, implicitly given by \( R(D, a, h) \equiv D/Q(D, a, h) \), contain a premium for the possibility of default.

Higher \( R(\cdot) \) must cover for states in which borrowers default.

Ability directly impacts interest rates and credit limits, since \( Q_a > 0 \):
- for the same investments and credit amount \( Q \), more-able individuals are required to repay less (lower \( R \))
- leads more-able persons to invest further in human capital

Higher investments coupled with higher liabilities may increase the probability of default.
Absence of repayment contingencies has a number of important consequences:

- Default can occur in equilibrium.
- If default happens, it is for low realizations of $w_{1,i}$ when earnings and consumption are low.
- The option to default serves a positive insurance role.
- Eliminating default may be inefficient and could reduce investment.
Private Information Problems
Private Information and Limited Insurance

- Conceptually, the lack of insurance assumed above is better seen as arising from imperfect information.
- As such, we consider lessons and modeling approaches from the literature on optimal contracting under private information.
- We now assume a continuous distribution for $w_1$ with cdf $\Phi(w_1)$. 
Moral Hazard in Investment

- Suppose youth must exert unobservable effort $e \in \{e_L, e_H\}$ that affects post-schooling earnings
  - Effort is costly: disutility $v(e_H) > v(e_L)$
  - Effort is productive: $\Phi(w_1|e_H) < \Phi(w_1|e_L)$ (first order dominance)
Optimal Contract solves:

$$\max_{h, e, d, \{R(w_1)\}} u[W - h + d] - v(e) + \beta \int u[w_1 af(h) - R(w_1)] \phi(w_1|e) dw_1$$

subject to BEC for the lender:

$$[\lambda] : -d + \beta \int R(w_1) \phi(w_1|e) dw_1 \geq 0$$

and ICC (assuming $e_H$ is optimal):

$$[\mu] : -v(e_H) + \beta \int u[w_1 af(h) - R(w_1)] \phi(w_1|e_H) dw_1$$

$$\geq -v(e_L) + \beta \int u[w_1 af(h) - R(w_1)] \phi(w_1|e_L) dw_1$$
Optimal consumption satisfies:

\[ u' [c_0] = \left[ 1 + \mu \left( 1 - \frac{\phi(w_1|e_L)}{\phi(w_1|e_H)} \right) \right] u' [c_1 (w_1)] \]

- Consumption is distorted when ICC binds \((e = e_H)\)
- If \(\frac{\phi(w_1|e_H)}{\phi(w_1|e_L)}\) is increasing in \(w_1\) (MLRC), then \(c_1(w_1)\) is increasing in \(w_1\)
- Full insurance and intertemporal smoothing if \(e_L\) is optimal (ICC does not bind)
Investment maximizes expected lifetime income given effort choice:

\[ \beta^{-1} = af'(h) \bar{w}_1(e) \]

where \( \bar{w}_1(e) = \int w_1 \phi(w_1|e) dw_1 \)

As long as the first best effort is implemented, then the first best level of investment is also implemented (lower \( W \) individuals)

Some middle/high \( W \) individuals may (inefficiently) choose \( e_L \) and low investment due to moral hazard
  - low effort comes with full insurance (i.e. \( c_0 = c_1(w_1), \forall w_1 \))

Very high \( W \) individuals may prefer low \( h \) and \( e_L \) even when there is no moral hazard problem (efficient allocations)
  - receive full insurance

Implies investment and effort decreasing in \( W \) conditional on a
Costly State Verification

- Now, ignore incentive problems in inducing effort
- Instead, assume a cost $\vartheta$ to verify borrowers’ labor market outcomes as in the *costly state verification* model of Townsend (1979)
There will be a verification threshold $\tilde{w}_1$:

- Verification and full consumption insurance for low earnings realizations: $w_1 < \tilde{w}_1$
  - $c_1(w_1) = c_0$
  - Repayment $R(w_1) = w_1 af(h) - [W + d - h]$

- No verification or consumption insurance for high earnings realizations: $w_1 \geq \tilde{w}_1$
  - Fixed repayment $\tilde{R} = \tilde{w}_1 af(h) - [W + d - h]$
  - Consumption increases one-for-one with income:
    $$c_1(w_1) = c_0 + (w_1 - \tilde{w}_1) af(h)$$
Optimal contract solves:

$$\max_{\{h,d,\tilde{w}_1\}} u [W - h + d] + \beta u [W - h + d] \Phi (\tilde{w}_1)$$

$$+ \beta \int_{\tilde{w}_1}^{\infty} u \left[ w_1 af (h) - \tilde{R} \right] d\Phi(w_1)$$

subject to BEC for lenders:

$$-d - \beta \vartheta \Phi(\tilde{w}_1) + \beta \left\{ \int_{0}^{\tilde{w}_1} R(w_1) d\Phi(w_1) + \tilde{R} [1 - \Phi(\tilde{w}_1)] \right\} \geq 0$$
Optimal investment is less than the first best
- no return on investment when earning realizations are low
- lack of insurance for higher realizations
Combining Moral Hazard with CSV should yield a framework with many attractive features:

- endogenous market incompleteness
- model of ‘default’ (i.e. verification) and varying interest rates
- will have imperfect insurance in presence and absence of ‘default’
- provides interesting framework for policies on $\vartheta$
Summary and Open Questions
The significant rise in the costs of and returns to college appears to have increased the demand for credit well beyond the supply available from government programs.

As such, the rapid expansion in private lending over the past 15-20 years should come as no surprise.

Providing credit for human capital requires repayment enforceability and raises other incentive problems.

It is important to explicitly incorporate (at least, some of) these incentive problems in models of human capital formation to aid in design of private and public loan/insurance contracts.

Also, important to recognize that constraints at early investment ages may be more of a problem than constraints at college-going ages.
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  - Do some students receive too little credit?
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- To what extent should student credit and other social insurance programs be integrated?

- What role should government vs. private lending play?
Figure 2a: College Attendance by AFQT and Family Income Quartiles (NLSY79)
Figure 2b: College Attendance by AFQT and Family Income Quartiles (NLSY97)
“Sufficient Complementaritity”

Condition 1: \[ \frac{f_{12}}{f_1 f_2} > -\frac{v''(-RL_2 + wh_3 \chi)}{v'(-RL_2 + wh_3 \chi)} w \chi \]

Assuming:
- CES human capital production function:
  \[ f(i_1, i_2, \theta) = \theta(a i_1^b + (1 - a) i_2^b)^{c/b} \]
- CIES utility:
  \[ u(c) = \frac{c^{1-\sigma}}{1-\sigma}, \quad \sigma \geq 0. \]

Then, if \( c > b \), Condition 1 simplifies to:

\[
\frac{1}{1-b} \quad < \quad \frac{1}{\sigma} \quad \left( 1 - \frac{RL_2}{w \chi h_3} \right) \quad \left( \frac{c - b}{c(1-b)} \right) \quad \text{e. of sub.} \quad \text{CIES} \quad 1 - \text{maximum debt lifetime income}
\]
Effects of Early and Late Family Income

Controlling for child/family background and maternal education

<table>
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<tr>
<th>Education</th>
<th>Sample Size</th>
<th>Early Income</th>
<th>Late Income</th>
<th>Equal Effect (p-value)</th>
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<td>1,422</td>
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<td>(0.008)</td>
<td>(0.009)</td>
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