Credit & Insurance for Human Capital Investments

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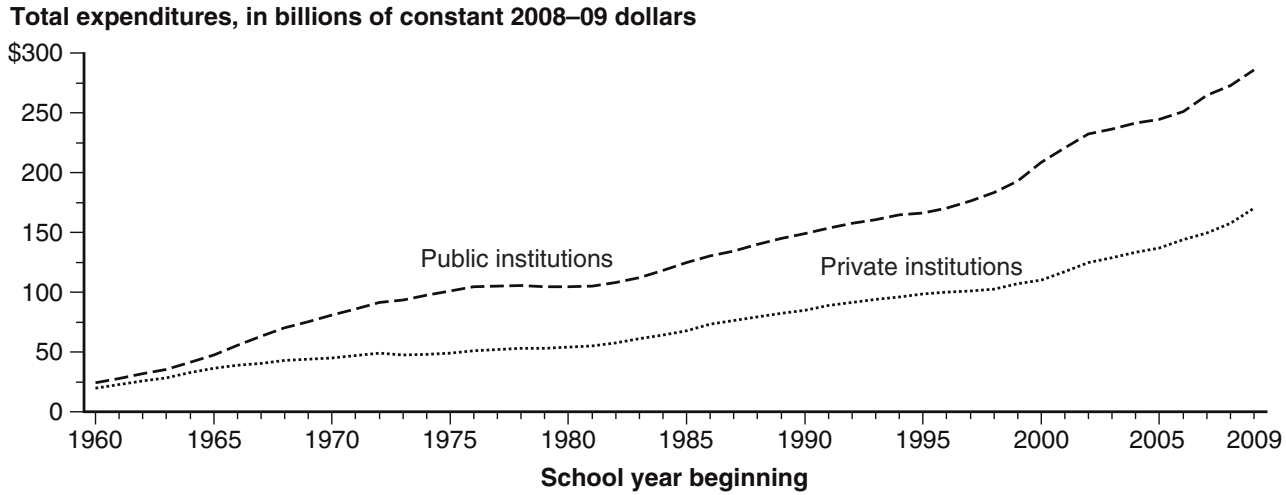
- Education and other human capital investments are central to both individual and economy-wide development
- Governments and individuals spend considerable and growing sums on education



- The way education is financed is important for both inequality and economic growth

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

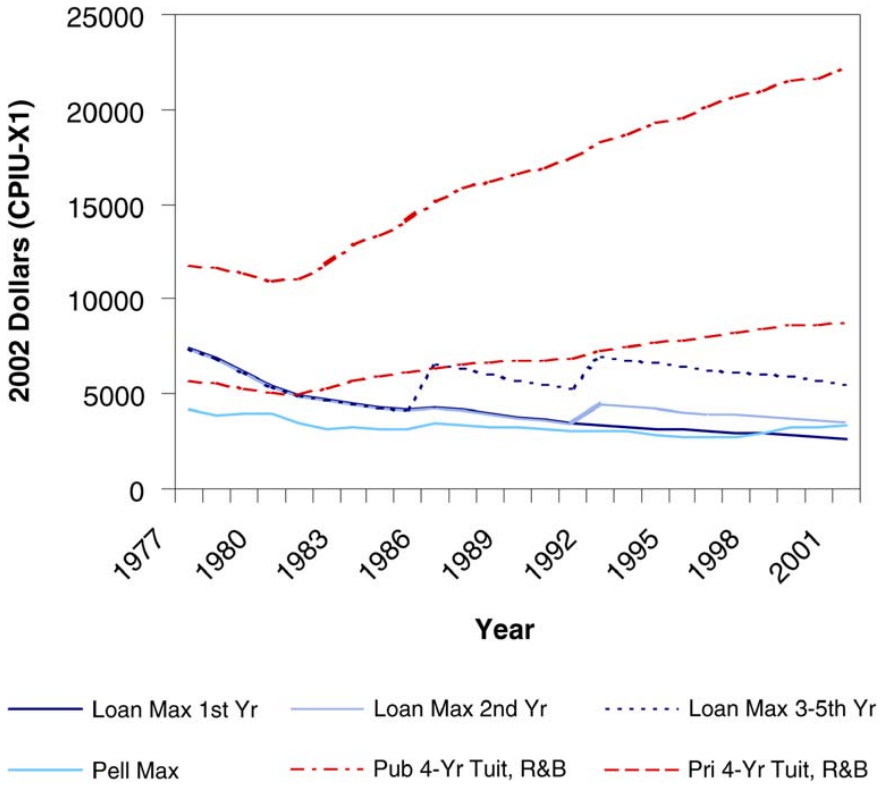


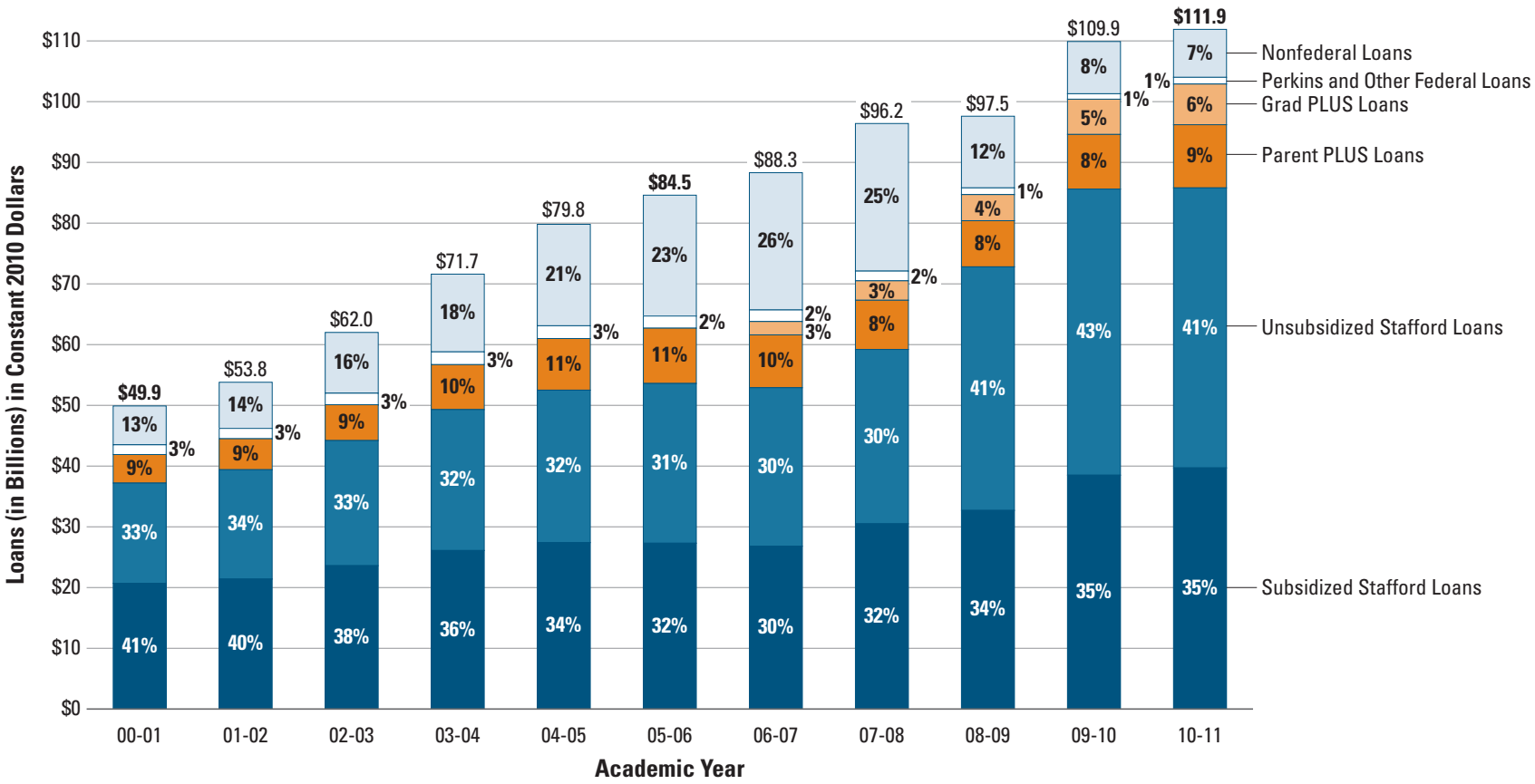
Figure 2. Federal financial aid maxima and four-year college tuition, room and board.

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
- 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)

Student Loans 2000-01 to 2010-11

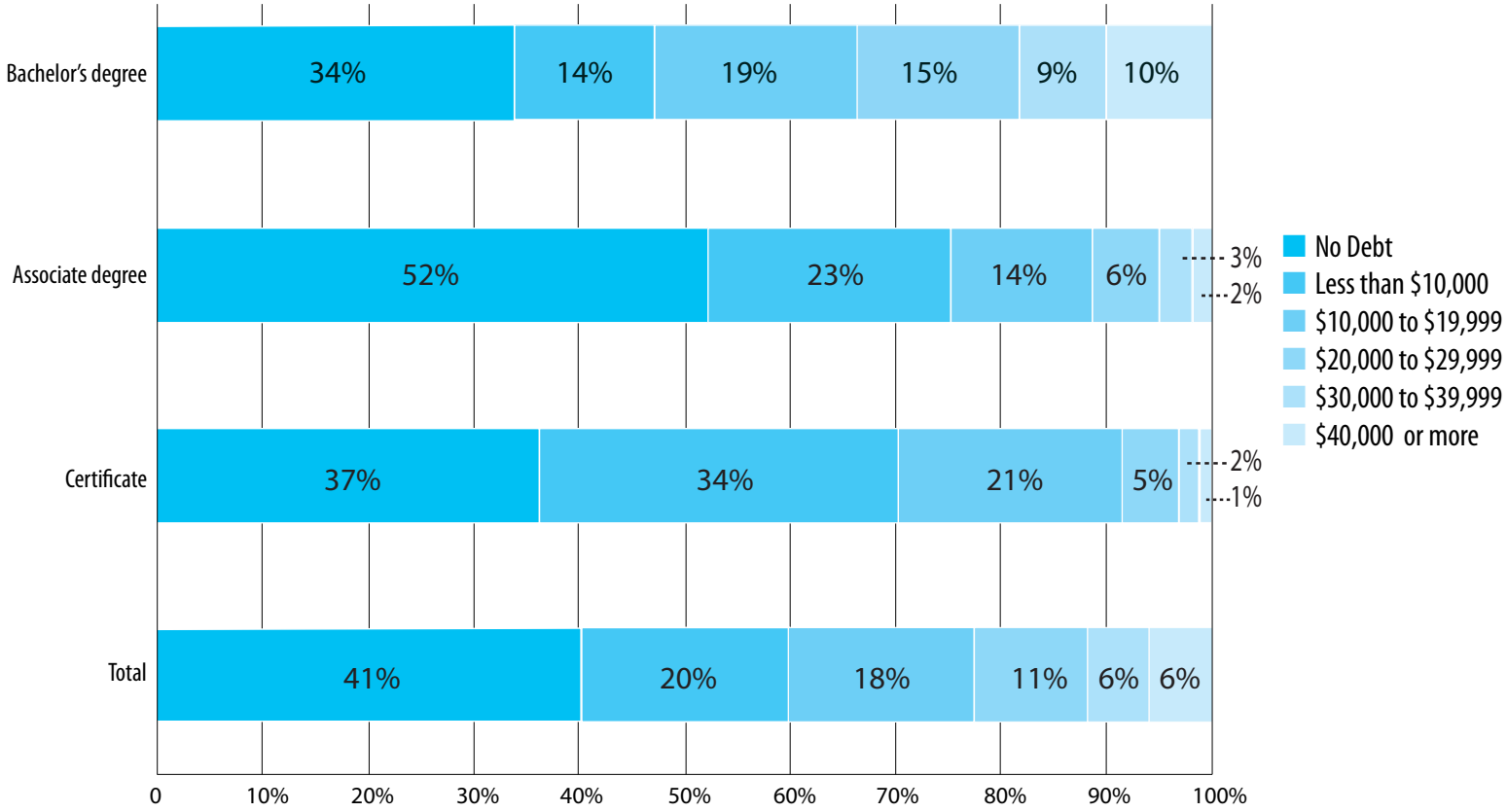
FIGURE 4 Growth of Federal and Nonfederal Loan Dollars in Constant 2010 Dollars, 2000-01 to 2010-11



Source: College Board, *Trends in Student Aid 2011.*

Total Debt Levels Among Recent Graduates

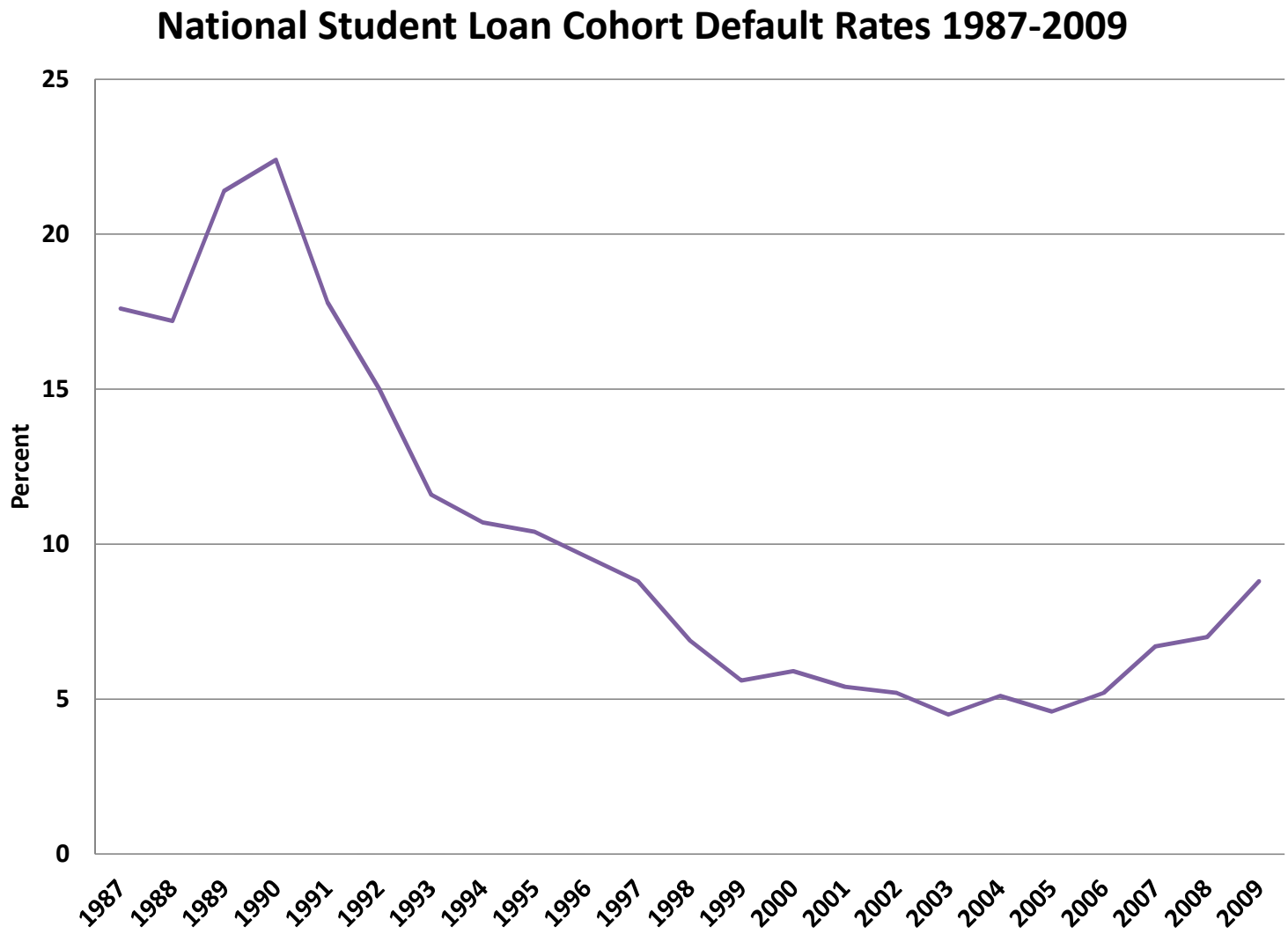
Figure 1. Percentage Distribution of Loan Debt Among Undergraduate Certificate and Degree Recipients, 2007-08



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.

Source: *College Board, "How Much Are College Students Borrowing?" Policy Brief, 2009.*

Federal Student Loan Cohort Default Rates



Objectives

- In previous work, we show that realistic assumptions about government and private lending with limited commitment is useful for understanding the behavior of human capital investments
- That work ignored uncertainty and, therefore, many interesting issues
- Here, we consider risky returns and the implications of imperfect insurance and private information for the provision of credit and human capital investment

- Uncertainty introduces
  - potential for default
  - tradeoff between enforcing repayment and providing insurance
- To think about these issues, we 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
- Work is still quite preliminary and exploratory
  - focus today on optimal contracts and implied investment, consumption, and repayment patterns in different environments

Basic Setup & Complete Markets

- 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:

$$y = w_1 a f(h)$$

  - w_1 is the *stochastic* price of human capital
  - $f(\cdot)$ is positive, strictly increasing and concave

- Assume that the post-school price of human capital 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

Complete Markets

- Individuals maximize expected utility

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

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

$$c_{1,i} = af(h) w_{1,i} - D_i, \quad i = 1, ..., N$$

- $c_{1,i}$ 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: $q_i = \beta p_i$

Complete Markets

- Human capital investments $h^*(a)$ maximize the expected net present value of lifetime income
- Investment equates expected MR with MC:

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

  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

Limited Commitment with Complete Markets

- 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':

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

  - 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 $i = 1, ..., N$
- 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

$$V^D(w_{1i}, a, h) = u\left[(1 - \tilde{\kappa}) w_{1i} a f(h)\right]$$

- Participation constraints reduce to simple 'solvency' constraints: $D_i \leq \tilde{\kappa} w_{1,i} a f(h), \ \forall i$
  - solvency constraints likely to bind for *high* realizations of $w_{1,i}$ $\Rightarrow D_i = \tilde{\kappa} w_{1i} a f'(h)$
  - 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

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

- If any 'solvency' constraint binds, there is under-investment
  - $\sum_{i=1}^{N} p_i w_{1,i}\left(\frac{1+\lambda_i\tilde{\kappa}}{1+\lambda_i}\right) < \bar{w}_1$ when $0 < \tilde{\kappa} < 1$ and $\lambda_i > 0$ 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)

Limited Commitment with Incomplete Markets

- 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

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

- Subtracts expected losses $D - \tilde{\kappa} w_{1,i} a f(h)$ from default
- Interest rates, implicitly $R(D, a, h) \equiv D/Q(D, a, h)$, contain a premium for the possibility of default
  - Higher $R(\cdot)$ covers for states in which borrowers default
- 'Hard' borrowing constraint is given by the most a lender could expect to extract from someone of ability a investing h: $\sup_D \{Q(D, a, h)\}$
- 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

- Assuming $\tilde{w}_1$ falls outside the support of $w_{1,i}$ (i.e. ignore jumps in default probabilities), optimal h satisfies:

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

  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 ($\uparrow h$)

- 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
- 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:

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

subject to BEC for the lender:

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

and ICC (assuming e_H is optimal):

$$\begin{aligned}[\mu] \;:\; & -v(e_H)+\beta\int u[w_1 af(h)-R(w_1)]\phi(w_1|e_H)dw_1 \\ & \geq -v(e_L)+\beta\int u[w_1 af(h)-R(w_1)]\phi(w_1|e_L)dw_1\end{aligned}$$

Optimal consumption satisfies:

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

- 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 ϑ 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:

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

subject to BEC for lenders:

$$-d-\beta\vartheta\Phi(\tilde{w}_1)+\beta\left\{\int_0^{\tilde{w}_1} R(w_1)d\Phi(w_1)+\tilde{R}\left[1-\Phi(\tilde{w}_1)\right]\right\}\geq 0$$

- 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 ϑ

Conclusions and Open Questions

Conclusions

- 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
- Raises questions about how to best provide credit taking into account issues with repayment enforceability and other incentive problems
- We aim to explicitly incorporate (at least, some of) these problems in models of human capital formation to aid in the design of private and public loan/insurance contracts

Types of questions we are interested in...

- How much credit should individuals get?
- How should student credit (and insurance) be structured?
- To what extent should student credit and other social insurance programs be integrated?
- What role should government vs. private lending play?