ECON 747 – LECTURE 7:
MICROFOUNDATION OF DEBT AND DEBT CONSTRAINTS

Thomas Drechsel

University of Maryland

Spring 2025

MICROFOUNDATION: OVERVIEW

- We now turn to *rationalizing* the presence of a debt limit of the type that Kiyotaki and Moore (1997) study
- Plenty of macro papers impose borrowing constraints in an ad-hoc way
- However it is important to understand and spell out what the actual *underlying friction* is that the constraint arises from
- I want you to get a flavor of a literature that does so in great depth

MICROFOUNDATION: OVERVIEW

- The market incompleteness in Kiyotaki and Moore is endogenous
- It is thought of as arising from **agency frictions**
- Broadly speaking, two types of agency frictions
  1. Limited enforcement (moral hazard)
  2. Asymmetric information

MICROFOUNDATION: OVERVIEW

- In this part of the course we focus on enforcement problems
- We consider limited information problems later, when we study CSV models
- I want to provide you with the following
  1. A rough literature overview
  2. A presentation of the model of Hart and Moore (1994)
     (with some details omitted)

LITERATURE OVERVIEW

- Kiyotaki and Moore justify their constraint based on the inalienability of human capital, following a paper by Hart and Moore (1994)
- Hart and Moore provide a **theory of debt**:
  - An entrepreneur needs outside funds for a project
  - Entrepreneur cannot commit not to withdraw her human capital from the project
  - The threat of repudiation means that some projects cannot be financed
  - The resulting contract and its characteristics look a lot like debt contracts in practice
- Falls into the literature on **incomplete contracting** and **control rights**

LITERATURE OVERVIEW

- The literature on incomplete contracts addresses topics such as ownership rights, boundary of the firm, debt and equity, outsourcing and vertical integration, venture capital, ...
- It falls more broadly into the field of contract theory
- It addresses some classic issues in economics going back to work of Ronald Coase
- Great surveys are provided by
  - Hart (2017) (this is his Nobel speech)
  - Aghion and Holden (2011)

LITERATURE OVERVIEW

- Starting point of incomplete contracting research is probably Grossman and Hart (1986), see also Hart and Moore (1990)
- If a contract is incomplete, who has the right about the missing things (residual control rights)? Why should this matter?
- Natural application to *financial* contracts
- Aghion and Bolton (1992): tension between private benefits of managers and return of investors; state-contingent allocation of control rights as a solution
- Empirical study by Kaplan and Stromberg (2003) confirms these insights for startups and venture capital investors

LITERATURE OVERVIEW

- In Aghion and Bolton (1992) control shifts because a particular state of the world occurs, so the financial contract does not correspond to a classic debt contract
- This is where Hart and Moore (1994) falls into the literature: explain debt contracts, distinguish between human and non-human assets
- Relatedly, Bulow and Rogoff (1989) rationalize the presence of *sovereign* debt

HART AND MOORE (1994): SETTING

- Entrepreneur with project at time 0:
  - Initial cost of project K
  - Initial wealth of entrepreneur $w_0 < K$, so needs to borrow $K - w_0$
  - Project's physical assets + entrepreneur's human capital give certain stream of returns $r(t)$, $0 < t < T$
  - Physical assets can be "liqudidated" and yield stream of returns $l(t)$, $0 < t < T$
  - $r(t), l(t)$ are continuous on $[0, T]$
  - Entrepreneur's outside option is 0 and all assets collapse after time T

HART AND MOORE (1994): SETTING

- Interest rate (discount rate) normalized to 0
- This gives time-t present values

$$\begin{aligned} R(t) &\equiv \int_t^T r(\tau)d\tau \\ L(t) &\equiv \int_t^T l(\tau)d\tau \end{aligned}$$

- Note that these present values are decreasing over time, they are integrals that are getting smaller

HART AND MOORE (1994): SETTING

- Three assumptions
  1. $R(0) > K \geq L(0)$
     $\rightarrow$ project has positive NPV at time 0, capital cost exceeds alternative use
  2. $r(t) \geq l(t) \Rightarrow r(\tau) > l(\tau) \ \ \forall \tau > t$
     $\rightarrow$ once project returns exceeds liquidation returns, they exceed them in all subsequent periods
  3. $\frac{1}{2} r(t) \geq l(t) \Rightarrow \frac{1}{2} r(\tau) > l(\tau) \ \ \forall \tau > t$
     $\rightarrow$ simplifies the analysis of renegociations

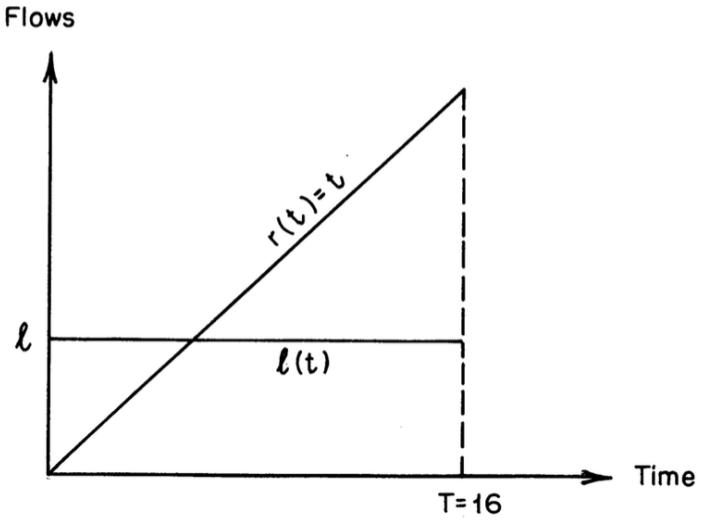
HART AND MOORE (1994): SETTING

- Assumptions 1 and 2 in combination imply that

$$R(t) > L(t) \quad \forall t$$

- Once the project is started, it is efficient to continue it
- $R(t) - L(t)$ is the surplus from continuing the relationship between the entrepreneur and the borrower

EXAMPLE



INALIENABILITY OF HUMAN CAPITAL

- Ideal world: entrepreneur raises funds from an investor, offers contract to divide up $R(0) - K$ so that both of them break even
- Problem: this ex ante division is **not enforceable**
- Why? Entrepreneur can withdraw her human capital at a future date
- Assume most extreme penalty is seizing physical assets, entrepreneur's private savings cannot be taken, and there is no criminal penalty

CONTRACT

- Creditor ('C') gives the entrepreneur (or debtor, 'D') an initial sum $I \geq K - w_0$
- D promises stream of repayment $p(t)$, $0 < t < T$ (can be positive or negative)
- D's outstanding indebtedness is

$$P(t) \equiv \int_t^T p(\tau) d\tau$$

- Assume perfect competition between creditors, so that $P(0) = I$ in equilibrium, assuming D makes agreed payments

- D earns the residual returns $r(t) - p(t)$ and puts them into private savings
- $r(t)$ could be below $p(t)$ in a given period, in which case D needs to make up the shortfall with her savings

  $\Rightarrow$ *feasibility condition* for each t

$$I - (K - w_0) + \int_0^t [r(\tau) - p(\tau)]d\tau \geq 0$$

- Given that $P(0) = I$, this is equivalent to

$$P(t) \geq K - w_0 - R(0) + R(t) \;\; \forall \, 0 \leq t \leq T$$

REPUDIATION

- At any time t, D can repudiate the contract and withdraw her human capital
- In this case, C can decide between
  1. Liquidation: realize $L(t)$
  2. Renegotiation: D continues with the project and there is a newly agreed payment stream $\tilde{p}(\tau)$, $t \leq \tau \leq T$

CONTRACT

- Given the model is deterministic, a debt contract can be written so that repudiation never occurs in equilibrium ("repudiation-proof" contract)
  - This is formally proven in the paper
- Number of optimal contracts can be written, including sequences of renegotiated short term contracts
- Therefore focus on *equilibrium repayment paths*

RENEGOTIATION

- In order to characterize repudiation-proof debt contracts, need to specify how renegotiation would work
- Simple rule: future revenues $R(t)$ are split 50:50, unless liquidation value for C would be higher than $\frac{1}{2}R(t)$ in which case she gets $L(t)$ and D gets $R(t) - L(t)$ (if payoff for C was below $L(t)$, then C would prefer to liquidate)
- C's payoff after renegotiation is $\max\left\{\frac{1}{2}R(t), L(t)\right\}$
- For debt contract to be *credible*, it must be that

$$P(t) \leq \max\left\{\frac{1}{2}R(t), L(t)\right\} \quad \forall\, 0 \leq t \leq T$$

(if this was not true, D could successfully repudiate and renegotiate the amount that it owes to C down to $\left\{\frac{1}{2}R(t), L(t)\right\}$)

RENEGOTIATION: MORE DETAILS

- A more complete characterization of the renegotiation is in the appendix of the original paper
- What complicates renegotiation is the limited wealth of D
- This means that C could choose to liquidate even if the outcome is inefficient, which makes the problem different from a conventional bargaining problem

INTUITION

- D and C need to find an equilibrium repayment path $p(t)$, $0 \leq t \leq T$, which balances two conflicting objectives:

  1. Debt repayments must not be too early, otherwise D runs out of cash

  $$P(t) \geq K - w_0 - R(0) + R(t) \;\; \forall\, 0 \leq t \leq T$$

  2. Debt repayments must not be too late, otherwise D will choose to repudiate

  $$P(t) \leq \max\left\{\frac{1}{2}R(t), L(t)\right\} \;\; \forall\, 0 \leq t \leq T$$

- These are the *feasibility* and *credibility* requirements

DOES THE PROJECT GO AHEAD?

- $P(t)$ needs to fulfill

$$\underline{P}(t) \leq P(t) \leq \overline{P}(t) \;\; \forall\, 0 \leq t \leq T$$

where

$$\underline{P}(t) \equiv K - w_0 - R(0) + R(t)$$

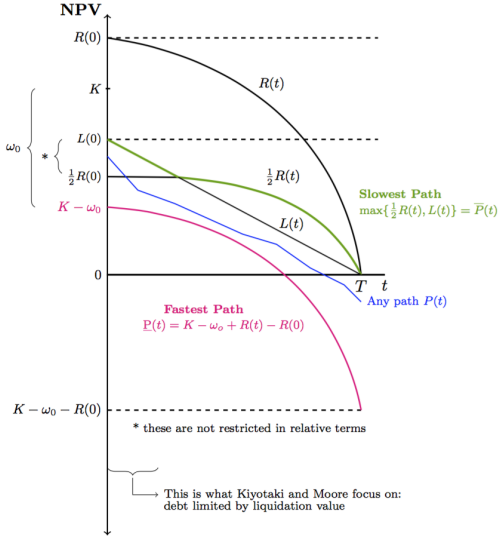
$$\overline{P}(t) \equiv \max\left\{\frac{1}{2}R(t), L(t)\right\}$$

- This is formally stated and proven as *Proposition 1* in the original paper

EQUILIBRIUM REPAYMENT PATHS

- If the condition in Proposition 1 is satisfied, there is a range of equilibrium paths that achieve the first best: C breaks even and there is no inefficient liquidation
- $\overline{P}(t)$ is the slowest repayment path
- $\underline{P}(t)$ is the fastest repayment path

EQUILIBRIUM REPAYMENT PATHS



TAKING STOCK

- Given the inalienability of human capital, a set of feasible and credible repayment schedule arises that achieve the first best
- The paper and appendix contains additional formal details: ruling out partial liquidation, reputational concerns, etc.
- Kiyotaki and Moore (1997) rely on the insights from Hart and Moore (1994): focus on the case of the slow repayment path in which liquidation value is above the share of the continuation value that creditors would obtain in the case of renegotiation (see also footnote 6 in Kiyotaki and Moore)

REST OF HART AND MOORE PAPER

- Solving the indeterminacy
  - Reinvestment opportunities for the debtor $\Rightarrow P(t) = \overline{P}(t)$
  - Reinvestment opportunities for the creditor $\Rightarrow P(t) = \underline{\mathrm{P}}(t)$
- Comparative statics
  - More durable assets
  - More front-loaded returns
  - Higher initial wealth
  - ...

OUTLOOK

WHAT'S NEXT?

- Limitations of Kiyotaki and Moore (1997):
  - Is the amplification really that strong?
  - Debt constraint vs. non-state contingency of debt
- Many applications of borrowing constraints with risk-free debt:
  - Household debt and firm debt
  - Financial shocks
  - Working capital constraints
  - Borrowing constraints of small open economies
  - Occasionally binding constraints
  - ...

Bibliography

Aghion, P. and P. Bolton (1992): "An incomplete contracts approach to financial contracting," *The review of economic Studies*, 59, 473–494.

Aghion, P. and R. Holden (2011): "Incomplete Contracts and the Theory of the Firm: What Have We Learned over the Past 25 Years?" *Journal of Economic Perspectives*, 25, 181–97.

Bulow, J. and K. Rogoff (1989): "Sovereign Debt: Is to Forgive to Forget?" *American Economic Review*, 79, 43–50, © Copyright 1989 by the American Economic Association. Posted by permission. One copy may be printed for individual use only.

Grossman, S. J. and O. D. Hart (1986): "The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration," *Journal of Political Economy*, 94, 691–719.

Hart, O. (2017): "Incomplete Contracts and Control," *American Economic Review*, 107, 1731–52.

Hart, O. and J. Moore (1990): "Property Rights and the Nature of the Firm," *Journal of Political Economy*, 98, 1119–1158.

——— (1994): "A Theory of Debt Based on the Inalienability of Human Capital," *The Quarterly Journal of Economics*, 109, 841.

Kaplan, S. N. and P. Stromberg (2003): "Financial Contracting Theory Meets the Real World: An Empirical Analysis of Venture Capital Contracts," *The Review of Economic Studies*, 70, 281–315.

Kiyotaki, N. and J. Moore (1997): "Credit Cycles," *Journal of Political Economy*, 105, 211–248.