Credit Crunches, Asset Prices and Technological Change

Luis Araujo
Michigan State University

Raoul Minetti
Michigan State University

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Objective

Crisis makes clear role credit market in firms' investment

Crisis destroys value of collateral and breaks credit relationships. Consensus benefits of collateral and credit relationships for firms' investment

If entrepreneurs unable to commit contractually output or actions to lenders, collateral eases access to credit

Collateral compensates limited pledgeability, mitigates misbehavior

Credit relationships enhance collateral, compensate for shortage

Objective (cont.)

Limit this view credit market: technologically static economies

Do collateral, credit relationships ease firms' restructuring (replacement mature technologies with new ones)?

Do shocks that erode value collateral and break credit relationships depress aggregate restructuring just like investment?

Intuition

Firms adopt mature technologies or restructure. Lenders learn information for liquidating collateral if default (Diamond and Rajan, 2001)

Lenders' information on collateral eases access to credit but renders lenders conservative towards restructuring

New technologies less collateral; information mature assets specific

Therefore, lenders expect value of their information will depreciate if firms restructure; may inhibit restructuring

Intuition (cont.)

Firms can form credit relationships with lenders to convey more information and obtain cheaper credit

Yet, because conservatism induced by lenders' information, credit relationships favor technological inertia

When inertia, firms can break relationships, borrow from new lenders, restructure. However, this wastes information accumulated in relationships

Relationships, technological inertia long-lasting

Intuition (cont.)

Distribution firms across collateral values

Collateral-poor firms no credit, cannot pledge enough returns to lenders. Firms medium collateral, informed (relationship) lenders

Novelty: technology choice. Firms medium collateral restructure, collateral-rich firms with credit relationships preserve mature technology

Conservatism lenders severe: large depreciation value information if new technology adopted

Collateral Shock

Shock collateral asset quality, asset price drop. Credit relationships of collateral-poor firms break down

Collateral-rich firms: asset price drop erodes value information lenders

- Mitigates lenders' conservatism, restructuring within relationships
- Increases incentive collateral-rich firms break relationships, borrow from new lenders, restructure

Collateral Shock (cont.)

Whether restructuring occurs within relationships or through breakdown depends on credit regime

In one regime, conservatism weak and/or large benefits from relationships: collateral-rich firms restructure within relationships

In another, conservatism strong and/or small benefits relationships: collateral-rich firms restructure breaking relationships. Disintermediation, output loss

Extensions and Policy

- When new technology radically different, effects dampened. Smaller investment, asset price drop but also smaller surge in restructuring

- We incorporate government.

  Two "unconventional" policies:

- FED market maker last resort in secondary asset market
- FED finances lower margin requirements

Both policies sustain investment, asset price. But freeze restructuring activity

Related Literature

Credit frictions, credit crunches, macroeconomy (Holmstrom and Tirole, 1997; Gertler and Karadi, 2010; Gertler and Kiyotaki, 2010). Environments technologically static, no scope for firms' restructuring

Some papers (Den Haan, Ramey and Watson, 2003): breakdown credit relationships in recessions depresses investment; in our economy, fosters restructuring

Literature impact recessions on firms' restructuring (Caballero and Hammour, 2004, Barlevy, 2003). Credit frictions exacerbate in recessions, hindering restructuring

Model

Four dates, t=0,1,2,3

Unit continuum entrepreneurs, larger continuum investors

Two goods: storable final good, productive assets

Productive assets two vintages: mature and new

Agents risk neutral, consume final good at t=3

Entrepreneurs no endowment; each investor *i* final good

Technology

Each entrepreneur indivisible project

Date 2, entrepreneur can experience technological innovation. If so, adopts new technology (restructures); if not, operates mature technology

Mature (new) technology: t=3, *i* final good into one unit mature (new) assets. With prob. π mature (new) assets yield y {y(1+n)} final good; otherwise project fails, entrepreneur out of business, fraction a ($\alpha_n a$) assets liquidated. a uniformly distributed over [0,1]

Date 3, each entrepreneur still in business can reuse one unit of liquidated assets, obtaining $\eta\theta$. θ uniformly distributed over [0, θ], η reflects aggregate productivity (quality) collateral

Credit Sector

Date 1, entrepreneur applies for funding, and if accepted, enters credit contract with one investor

Two dimensions credit link, besides financing

- Lender control on production opportunities. Date 1, lender can carry out "action". If so (not), date 2 technological innovation prob. 1-σ (0)

- Lender monitors collateral. Information allows lender recover value from collateral assets (DR, 2001)

Credit Sector (cont.)

Value recovered from mature asset if action (not) taken at t=1, $\sigma\mu a$ (μa); rest lost as liquidation cost

Date 0, entrepreneur can form relationship with investor
Better information inside relationship: $\mu=M>m$

Normalize to 0 liquidation value of new asset ($\mu_n \alpha_n = 0$)

We start with $\alpha_n = 1$, then let $\alpha_n < 1$

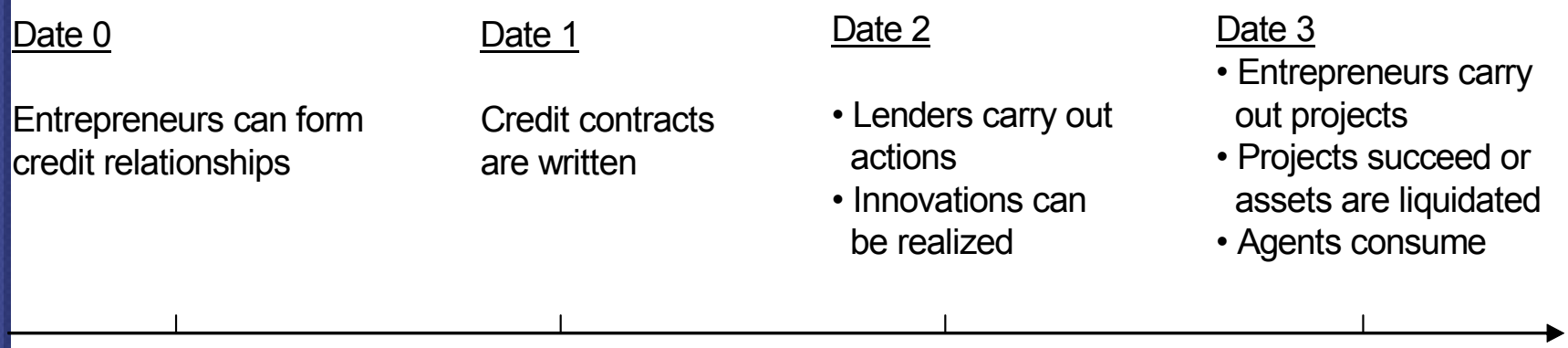
Contractual Structure

Contracts imperfectly enforceable. Lender's action neither directly nor indirectly contractible

Only fraction I of output contractible

As in DR (2001), lender cannot commit liquidation skills and, at liquidation stage, has full bargaining power in forced renegotiation

Time Line


Date 0
Entrepreneurs can form credit relationships
Date 1
Credit contracts are written
Date 2
• Lenders carry out actions
• Innovations can be realized
Date 3
• Entrepreneurs carry out projects
• Projects succeed or assets are liquidated
• Agents consume

Equilibrium

(Agents' decisions taking asset price p as given; $\alpha_n = 1 \leftrightarrow$ aggregate restructuring does not affect p)

Consider entrepreneurs who obtain credit. Lender carries out action necessary for innovation iff

$$r_n - r > \frac{(1+\sigma)(1-\pi)\,pa\,\mu}{\pi}$$

- Lemma 1: A lender carries out action necessary for innovation if and only if collateral satisfies

$$a < \bar{a}(p,\mu) = \frac{\pi l y (1+n) - i}{p\,\sigma(1-\pi)\,\mu}$$

Equilibrium (cont.)

Lender allows innovation more when no relationship, entrepreneur not rich in collateral, asset price not high

- Lemma 2: An entrepreneur chooses transactional funding if and only if

$$a \in [\bar{a}(p, M), \tilde{a}(p))$$

where

$$\tilde{a}(p) = \min \left\{ \bar{a}(p, m), \frac{\pi y n (1 - \sigma)}{(1 - \pi)(M - \sigma^2 m) p} \right\}$$

Equilibrium (cont.)

If neither type of funding allows innovation, relationship preferred. Otherwise trade-off cheaper credit-restructuring

- Lemma 3: If lender anticipated to allow innovation, credit iff

$$a > \underline{a}(p, M, A) = \frac{i - \pi \ell y (1 + n - n\sigma)}{\sigma^2 p (1 - \pi) M}$$

If lender anticipated not to allow innovation, credit iff

$$a > \underline{a}(p, M, A) = \frac{i - \pi \ell y}{p (1 - \pi) M}$$

Lemmas 1 and 3: dual role collateral and relationships

Asset Price

Collateral asset demand

$$D(p) = \max\left\{[1 - \underline{a}(p, M, A)]\pi(1 - \frac{p}{\eta\bar{\theta}}), 0\right\}$$

from entrepreneurs still in business

Collateral asset supply

$$S(p) = \max\left\{(1-\pi)[1-(a(p, M, A))^2], 0\right\}$$

from failed entrepreneurs

Firm Distribution

We characterize all possible equilibria. But assume

$$\frac{i}{\pi l y} \in \left(1+n-n\sigma, 1+n-\frac{n\sigma M}{M+\sigma m}\right)$$

and focus on two scenarios.

- Proposition 1: Firms with $a \in [0,\underline{a})$ do not obtain credit, remain inactive; firms with $a \in [\underline{a},1]$ choose funding and technology as follows. If

$$\frac{i}{\pi l y} \leq 1+n-\frac{n\sigma(1-\sigma)M}{l(M-\sigma^2 m)}$$

$a \in [\underline{a},a)$: i) relationship funding, ii) potentially restructure,
$a \in [a,1]$: i) relationship funding, ii) do not restructure,

Firm Distribution (cont.)

Proposition 1 (cont.): If

$$\frac{i}{\pi l y} > 1 + n - \frac{n\sigma(1-\sigma)M}{l(M - \sigma^2 m)}$$

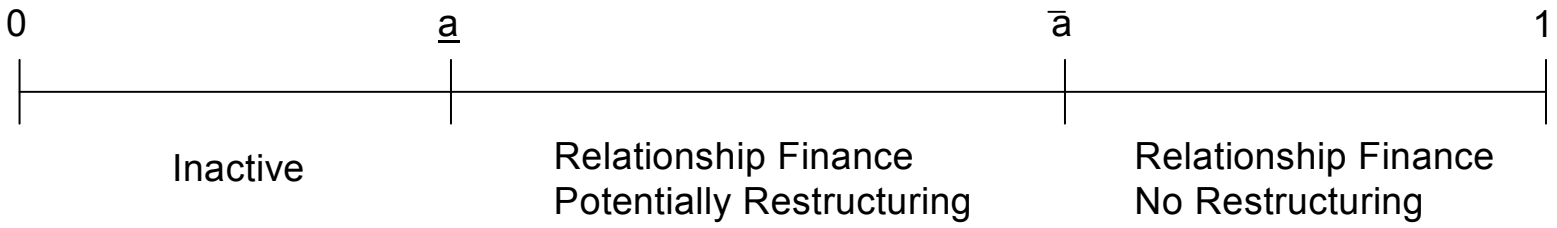
and

$$\frac{i}{\pi l y} < 1 + n - \frac{n\sigma M}{M + \sigma m)}$$

$a \in [a, a)$: i) relationship funding, ii) potentially restructure,
$a \in [a, a)$: i) transactional funding,ii) potentially restructure,
$a \in [a, 1]$: i) relationship funding, ii) do not restructure

Equilibrium (cont.)
(Firm Distribution)

FLEXIBLE CREDIT REGIME (ā=ã)



CONSERVATIVE CREDIT REGIME (ā<ã)

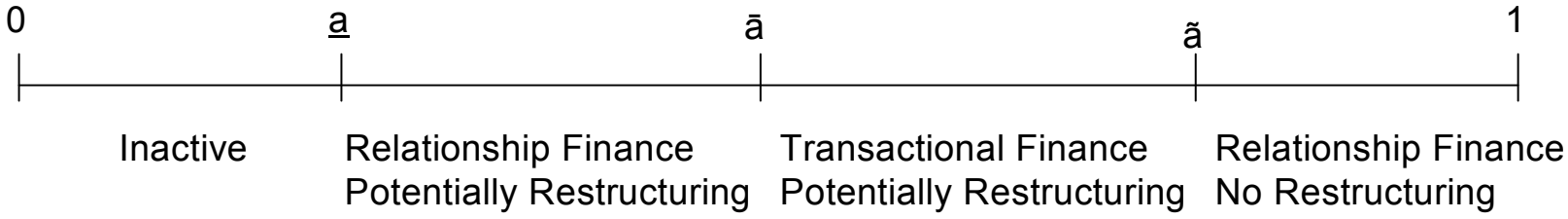


TABLE I.

Example 1: Flexible Credit Regime.

Parameters	Thresholds	Effects of 1% Collateral Shock (Uniform Distribution)		
		Public Information	*Private Information*	*Elastic Demand*
$\pi = 0.94$	$\underline{a} = 0.770$			
$y = 0.96$	$\overline{a} = 0.799$			
$i = 0.89$		$\frac{\Delta CR}{CR}$ −3.38%	−3.38%	−3.58%
$\ell = 0.94$		$\frac{\Delta I}{I}$ −3.38%	−3.38%	−3.58%
$n = 0.095$		$\frac{\Delta RF}{RF}$ 1.01%	1.01%	1.04%
$\sigma = 0.9$				
$M = 0.9$				
$m = 0.89$				

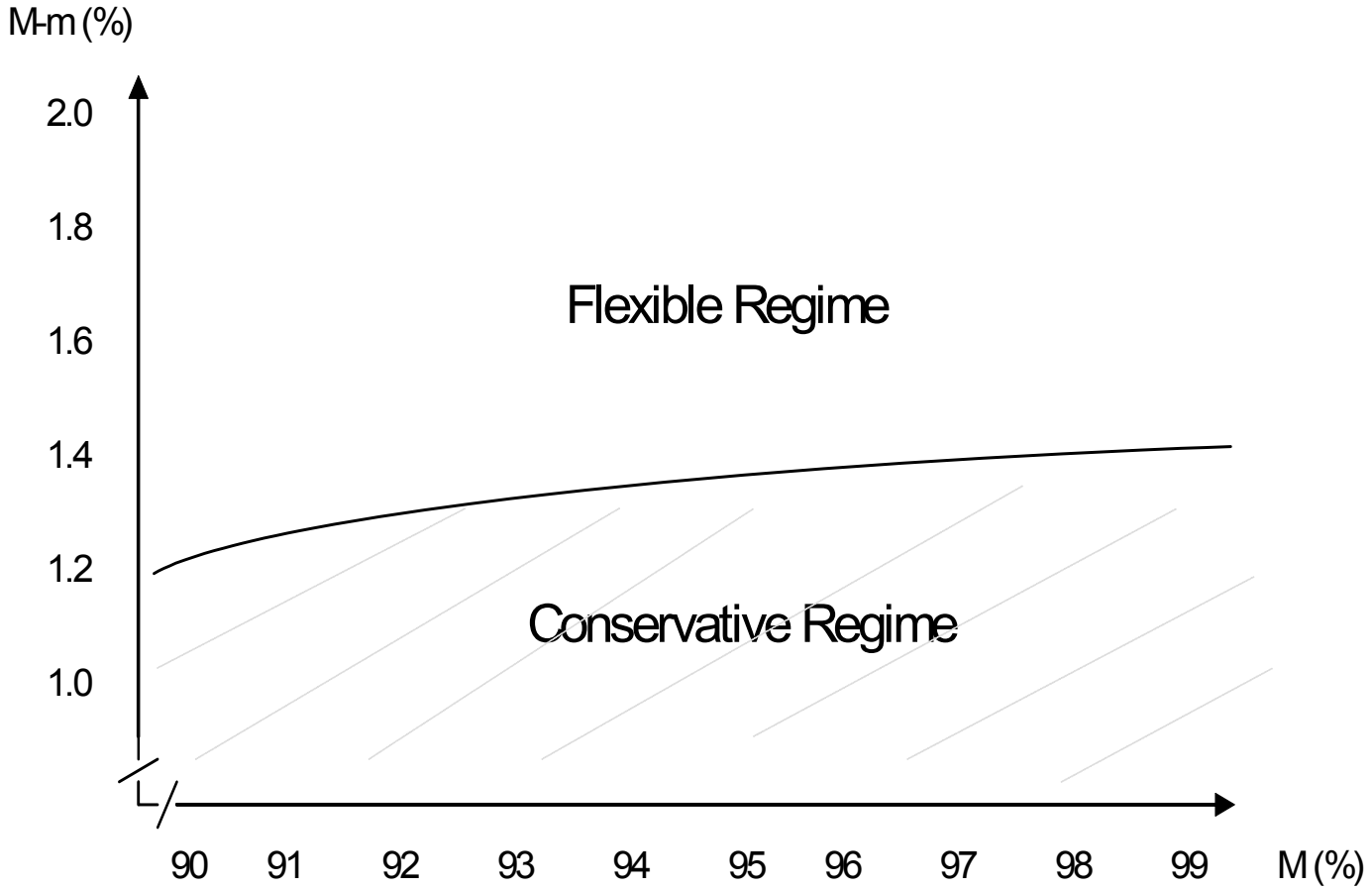
Note. The table reports a parameter selection (first column), implied collateral thresholds (second column), and the effects of a 1% drop in collateral productivity when a has a uniform distribution (fourth to sixth column).

TABLE II.

Example 2: Conservative Credit Regime.

Parameters	Thresholds	Effects of 1% Collateral Shock (Uniform Distribution)		
		Public Information	*Private Information*	*Elastic Demand*
$\pi = 0.94$	$\underline{a} = 0.73$			
$y = 0.96$	$\overline{a} = 0.757$			
$i = 0.89$	$\tilde{a} = 0.764$			
$\ell = 0.94$				
$n = 0.095$				
$\sigma = 0.9$				
$M = 0.95$				
$m = 0.942$				
		$\frac{\Delta CR}{CR}$ −5.72%	−2.79%	−7.74%
		$\frac{\Delta I}{I}$ −2.73%	−2.73%	−2.85%
		$\frac{\Delta RF}{RF}$ 1.01%	−2.79%	1.04%

Note. The table reports a parameter selection (first column), implied collateral thresholds (second column), and the effects of a 1% drop in collateral productivity when a has a uniform distribution (fourth to sixth column).


M-m (%)
2.0
1.8
1.6
1.4
1.2
1.0
Flexible Regime
Conservative Regime
90
91
92
93
94
95
96
97
98
99
M (%)

Collateral Shock

Shock to collateral quality. Contraction aggregate productivity η of assets, drop asset price

- Proposition 2: In both credit regimes, shock reduces asset price, total credit, number credit relationships, investment

  However, shock increases number restructuring firms. Effect on output ambiguous

$$\frac{\partial RF}{\partial \eta} = -\frac{2\pi}{(1-\pi)(3\pi-1)} \frac{\pi l y n}{M \eta^2 \overline{\theta}} < 0$$

- Proposition 3: In flexible regime, all firms credit relationships. In conservative regime, negative collateral shock leads to decrease of share active firms in credit relationships.

Collateral Shock (cont.)

- Flexible regime, restructuring collateral-rich firms within credit relationships → breakdown relationships due to exclusion collateral-poor firms from credit market. In conservative regime, restructuring entails breakdown credit relationships

- In conservative regime, restructuring associated with additional breakdown credit relationships. When liquidation costs real, higher liquidation costs

→ If liquidation costs real, output drops more

Asset heterogeneity

Case α_n <1, e.g., radically new technologies

- Proposition 4: In both credit regimes, collateral shock same effects in Propositions 2 and 3. But all effects, including increase in firms' restructuring activity, smaller

Robustness analysis

We consider alternative distribution of firms across collateral values

Credit, Asset Market Policy

During 2008-2009 crisis, Federal Reserve two types of unconventional policy (Krishnamurty, 2010)

- Intervened directly in asset market to sustain price of assets. Central bank as market maker last resort in secondary asset markets
- Provided loans to finance asset holdings at margin requirements lower than private sector

Model consequences of these policies

Credit, Asset Market Policy (cont.)

First policy, transfer T to each entrepreneur who purchases one unit liquidated assets. Financed via lump-sum taxes

Second policy, government lends funds to firms with a<$\underline{a}$

Policies sustain investment, freeze increase restructuring, especially the first policy

Consider, e.g., first policy. If *i* close to $\pi ly(1+n-n\sigma)$

$$\frac{\partial C(\tau)}{\partial \tau} \cong 0, \frac{\partial p(\tau)}{\partial \tau} \cong 1, \frac{\partial RF(\tau)}{\partial \tau} \cong \frac{\pi dyn}{(1-\pi)M\left[\frac{\eta\bar{\theta}}{\pi}\left(\frac{3\pi-1}{2}+\frac{\pi}{\eta\bar{\theta}}\tau\right)\right]^2} > 0$$

Conclusion

Role of credit market for aggregate restructuring

Credit relationships ease information flows between firms and lenders and, hence, firms' access to credit

However, relationships inhibit restructuring collateral-rich firms

Negative collateral shock squeezes collateral-poor firms out of credit market but fosters restructuring of collateral-rich firms, possibly through breakdown credit relationships

Unconventional credit and asset market policy can sustain investment, asset prices but freeze restructuring activity