Aggregate Restructuring and the Credit Market

Raoul Minetti*

Abstract

We investigate the role of the credit market in an economy where firms can preserve a mature technology or restructure and adopt a new technology. As in previous studies, firms’ collateral and credit relationships ease firms’ access to credit and investment; however, they may also inhibit firms’ restructuring. A negative collateral shock squeezes collateral-poor firms out of the credit market but fosters the restructuring of collateral-rich firms, possibly through the breakdown of their credit relationships. We characterize conditions under which the credit rationing of collateral-poor firms and the restructuring of collateral-rich firms reinforce or conflict with each other.

Keywords: Aggregate Restructuring, Collateral, Credit Relationships.

JEL Codes: E44.

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1 Introduction

In the last two decades or so, a rich literature has investigated the role of the credit market for firms’ investment decisions. In particular, a consensus has formed around the benefits that two key features of the credit market, firms’ collateral and credit relationships, may have for firms’ investment. When entrepreneurs have limited ability to commit contractually output or skills to lenders, the availability of pledgeable assets eases their access to credit. Lenders can repossess collateral and this may compensate for the limited pledgeability of output. Lenders can also mitigate entrepreneurs’ misconduct by threatening to repossess collateral. In this view, credit relationships enhance the benefits of collateral and compensate for its possible shortage. For example, lenders who have formed relationships with entrepreneurs can obtain better information on collateral and more value from its repossessing. An aggregate implication of this view is that shocks that erode the value of collateral or break credit relationships can depress investment by hindering entrepreneurs’ access to credit.

A limit of this view of the credit market is that it is centered on technologically static economies. If one allows for technological progress, two questions arise naturally: do collateral and credit relationships ease firms’ restructuring, meant as the replacement of mature technologies with new ones? And therefore, in an aggregate perspective, do shocks that erode the value of collateral and break credit relationships depress aggregate restructuring as they allegedly do with investment? In this paper, we address these questions. To ease comparisons with the above view, we borrow features of the analysis from Holmstrom and Tirole (1997), which constitutes an influential study on the benefits of collateral and information-intensive (relationship) finance in a technologically static economy.

The intuition can be summarized as follows. Firms adopt mature technologies or restructure and adopt new technologies. Lenders, in turn, learn information which is crucial for liquidating collateral when firms default (as in Diamond and Rajan, 2001, for example). Lenders’ information on collateral eases firms’ access to credit. However, information renders lenders conservative towards restructuring. In fact, new technologies have less pledgeable collateral. Furthermore, the information on the assets of mature technologies is (partially) specific and non-transferable to the assets of new technologies. Therefore, lenders expect that the value of their information will depreciate if firms restructure and may impede restructuring to avoid this.

In this economy, firms can form credit relationships with lenders in order to convey them more information and obtain cheaper credit. Yet, because of the technological conservatism induced by lenders’ information, credit relationships favor technological inertia. When technological inertia arises, firms can break credit relationships, borrow from new lenders and restructure. However, this wastes the information accumulated within the relationships. Hence, these relationships and technological inertia can be long-lasting.

The distribution of firms across collateral values replicates important features of that in Holmstrom
Collateral-poor firms have no access to the credit market because they cannot pledge enough returns to lenders, even when these obtain high quality information. Furthermore, firms with medium collateral obtain credit from informed (relationship) lenders. The novelty regards firms’ technology choice. While firms with medium collateral potentially restructure, collateral-rich firms with credit relationships preserve the mature technology. In fact, the conservatism of their lenders is severe because these expect a large depreciation in the value of their information if a new technology is adopted.

We perturb this economy with a contraction in the value of collateral. As in Holmstrom and Tirole (1997), the credit relationships of collateral-poor firms break down because these firms can no longer pledge enough returns to lenders. Consider next collateral-rich firms. The collateral shock erodes the value of the information of their lenders. This mitigates lenders’ conservatism, allowing restructuring to occur within the relationships. This also increases the incentive of collateral-rich firms to break credit relationships, borrow from new lenders and restructure. Whether the restructuring occurs within relationships or through their breakdown depends on the credit regime. There is a credit regime in which lenders’ conservatism is weak and/or firms derive large benefits from credit relationships: in this regime, collateral-rich firms restructure within relationships. There is however a credit regime in which lenders’ conservatism is strong and/or firms derive small benefits from credit relationships: in this regime, collateral-rich firms restructure by breaking relationships and borrowing from new lenders. Thus, the restructuring induced by the shock can entail a moderate or a substantial breakdown of credit relationships.

In the first part of the paper we treat collateral values as de facto exogenous. In the second, we allow for their general equilibrium determination in the market for collateral and obtain further insights into the interaction between collateral-poor firms and collateral-rich firms after the shock. First, we relax the assumption of public information on collateral values and find that the credit rationing of collateral-poor firms may inhibit the restructuring of collateral-rich ones. In fact, consider the credit regime in which collateral-rich firms restructure by borrowing from new lenders. If the latter lack information on collateral, collateral-rich firms face adverse selection because in the credit market they are pooled together with the collateral-poor firms whose relationships break down after the shock. This can discourage collateral-rich firms from restructuring. Second, we relax the assumption of a perfectly elastic demand for collateral. We find that in this variant the credit rationing of collateral-poor firms may foster the restructuring of collateral-rich firms by pushing down collateral demand and, hence, collateral values. However, the results of numerical experiments suggest that the latter effect is quantitatively small.

This paper relates to two strands of literature. The first investigates the impact of recessions on the financial structure and the consequences for aggregate investment. We have discussed the key elements we share with Holmstrom and Tirole (1997). We also borrow critical properties of the modelling strategy
from their paper, such as the focus on a highly tractable finite horizon economy. Den Haan, Ramey and Watson (2003) and dell’Ariccia and Garibaldi (2001) are other close papers in this strand of literature. Employing a search environment, these papers analyze the breakdown of credit relationships that can be induced by a recession. In these studies, the breakdown of credit relationships depresses investment. In our economy, this breakdown depresses investment but may also foster aggregate restructuring. The second strand of literature analyzes the impact of recessions on firms’ restructuring (e.g. Caballero and Hammour, 1994; Hall, 2000). Caballero and Hammour (1994), for example, examine the impact of cyclical variations in demand on the creation of innovative production units and on the destruction of outdated ones. Most of this literature neglects the role of financial factors for aggregate restructuring. Caballero and Hammour (2004), Ramey (2004) and Barlevy (2003) are exceptions. These studies show that credit frictions can exacerbate during recessions, hindering aggregate restructuring.1 This paper endorses an opposite view: the breakdown of information-intensive credit relationships mitigates the conservatism of lenders that inhibits restructuring. Finally, the microeconomic foundation for lenders’ conservatism builds on previous work of the author but also shares critical features with the analysis on technological inertia developed in other fields. For example, Jovanovich and Nyarko (1996) build a growth model in which myopic agents “learn by doing” and do not adopt new technologies in order to preserve their knowledge on mature ones.

The remainder of the paper is structured as follows. In section 2, we outline the setup and solve for the equilibrium. In section 3, we investigate the effects of a collateral shock. In section 4, we discuss robustness issues and the extant empirical evidence. Lengthy proofs are in the Appendix.

## 2 The Model

### 2.1 Setup

The economy lasts four dates \((t = 0, 1, 2, 3)\). There is a unit continuum of entrepreneurs (firms) and a continuum of investors of measure greater than unity. There is a final consumption good, which can be produced and stored, and productive assets of two vintages, mature and new. Entrepreneurs have no endowment while each investor starts out with an amount \(i\) of final good at least. All agents are risk neutral and consume at date 3. In what follows, we describe the real sector, the credit sector and the contractual structure. We then discuss our assumptions. In figure 1, we display the timing of events.

**The Real Sector.** Each entrepreneur can run one project of fixed size. At date 2, the entrepreneur can experience a technological innovation. If the innovation occurs, the entrepreneur adopts a new technology (restructures); otherwise, she adopts a mature, less productive one. Under the mature (new) technology at date 3 the entrepreneur transforms an amount \(i\) of final good into one unit of mature (new) assets. With probability \(\pi\) the project succeeds and the assets yield an amount \(y\ (y(1 + n))\)
 Entrepreneurs can form credit relationships

Credit contracts are written

• Lenders carry out actions
• Innovations can be realized

• Entrepreneurs carry out projects
• Projects succeed or assets are liquidated
• Agents consume

Figure 1: Timing of Events.

of final good; otherwise the assets yield zero but a fraction $a$ can be liquidated outside the firm. $a$ is distributed across entrepreneurs according to the cumulative function $F(a)$ with domain $[0,1]$.

At date 3, each entrepreneur can reuse one unit of liquidated assets. When reused, each unit of mature (new) assets yield one unit (an amount $\alpha_n \leq 1$) of final good, where $\alpha_n$ measures the redeployability of new assets relative to mature. This specification implies that liquidation values are de facto exogenous. We will later add structure to the asset market and allow for their general equilibrium determination.

We introduce a first restriction on the parameters that guarantees that both technologies are economically viable and that the new technology strictly dominates the mature for any value of $\alpha_n$:

$$n\pi y > \max\{ni, 1 - \pi\}.$$  \hspace{1cm} (1)

**The Credit Sector.** At date 1, each entrepreneur can enter a credit contract with one investor. A lender interacts with an entrepreneur in two dimensions besides credit provision: control and information. Borrowing from an established literature (e.g. Aghion and Bolton, 1992; Rajan, 1992), we allow the lender to exert control over production opportunities. Precisely, at date 2 the lender can carry out a costless action that affects the probability of the innovation: if she carries out this action, the innovation will occur with probability $1 - \sigma$ ($0 < \sigma < 1$); otherwise, the innovation cannot occur.

The lender also learns information as a by-product of her financing. As in Diamond and Rajan (2001) and Habib and Jonsen (1999), information enables her to obtain more value than other agents from the liquidation of the entrepreneur’s assets. Precisely, the share of liquidation value that the lender obtains equals the amount of her information on the assets; the rest is lost in the form of a transaction cost. In contrast, we normalize to zero the net amount of final good that any other agent obtains from liquidation.

Having characterized the nature of information, we have to specify its amount. We allow the entrepreneur to affect it by choosing the type of funding - relationship or transactional. Precisely, at date 0 each entrepreneur can form a credit relationship with one investor. Consider first mature assets: we let $\mu (\sigma \mu)$ be the amount of information of a lender if she does (not) carry out the action for the innovation; furthermore, for a relationship (transactional) lender $\mu = M (\mu = m < M)$. This
specification has two features. First, because a credit relationship entails a long-run tie with the entrepreneur since date 0, a relationship lender learns more information ($M > m$). Second, when a lender allows the innovation, she learns less information on mature assets ($\sigma < 1$). This reflects the idea that the lender has less opportunities - and with endogenous information acquisition, less incentives - to learn information on a technology if the entrepreneur is working to abandon it. Consider then new assets: denoting $\mu_n$ the amount of information, we let $\mu_n \alpha_n = 0$. Thus, a lender obtains less value from liquidating new assets than mature ones - the normalization to zero is for simplicity. We discuss this specification momentarily.

The Contractual Structure. The control of a lender matters as long as her actions are non-contractible directly or through monetary incentives (Aghion and Bolton, 1992). We then assume that a lender cannot contractually commit to carry out her action because this is non-verifiable. Imperfect enforceability also limits agents’ commitment to monetary transfers. As for the output in case of success, only a fraction $\ell$ is verifiable while the rest privately accrues to the entrepreneur. As for the asset liquidation proceeds in case of failure, we follow Diamond and Rajan (2001). The lender cannot pre-commit the specific liquidation skills tied to her information. Thus, she can threaten to withhold her skills during the liquidation and force a renegotiation of the allocation of the proceeds. Furthermore, for simplicity, the lender has all the bargaining power in this renegotiation.

We conclude the description of the setup by introducing a second restriction on the parameters:

$$\frac{i}{\pi \ell y} \in \left[ 1 + n - n\sigma, \frac{1 + n - n\sigma - \sigma^2}{1 - \sigma^2} \right].$$

The lower bound on $i$ in (2) implies that, as in Holmstrom and Tirole (1997), collateral-poor firms (low $a$) are denied credit. The upper bound implies that the marginal firms can pledge enough returns and obtain credit only when the innovation can occur. This way we avoid that an entrepreneur adopts the mature technology merely because it allows her to obtain credit, rendering our message transparent.

2.2 Discussion of the Setup

The specification of the real and the credit sector follows related studies. Starting by the real sector, the difference between the two technologies is that the new technology yields more output ($y(1+n) > y$) but its assets have lower liquidation value ($\mu_n \alpha_n a < \mu a$). We put forward two interpretations. First, new technologies typically have less pledgeable collateral, i.e. $\alpha_n < 1$ (Hall, 2001; Carpenter and Petersen, 2002; Berlin and Butler, 2002; Rajan and Zingales, 2001). Carpenter and Petersen (2002) argue that “high-tech investments have limited collateral value. R&D investment, which is predominantly salary payments, has little salvage value in the event of failure. Furthermore, physical investments designed to embody R&D results are likely to be firm specific, and therefore may have little collateral value”. Analogously, Berlin and Butler (2002) distinguish between posting collateral and investing in growth
opportunities (e.g. R&D). Second, for a given liquidation value, lenders typically have less experience in liquidating new vintages of assets than mature ones, i.e. $\mu_n < \mu$.

Turning to the credit sector, we have to discuss three features: the control of a lender; the characterization of information as liquidation skills; the amount of information of a lender. We share, for example, with Aghion and Bolton (1992) and Rajan (1992) the assumption that a lender carries out an interim action that affects production opportunities. The action has several real world counterparts. It can consist of providing the entrepreneur with advice or information for expanding the firm’s technological frontier; in an R & D race, it can consist of concealing the findings of the firm’s internal research from its competitors (Bhattacharya and Chiesa, 1995; Yosha, 1995); if the lender has representatives on the board of the firm, as in the case of German and Japanese banks, it can consist of voting for an innovative strategy. In other circumstances, the action can consist of a refinancing (Rajan, 1992): the need for refinancing is likely for a new technology which typically offers little interim cash flows, especially at the R&D stage (Goodakre and Tonks, 1995). Aghion and Bolton (1992) provide examples of other actions of lenders which may affect innovation opportunities, such as supporting firms’ mergers and spin-offs.

We borrow the characterization of information as liquidation skills from Diamond and Rajan (2001) and Habib and Jonsen (1999). The critical feature is that the lender learns more information than the entrepreneur and the other investors. As for latter, following Diamond and Rajan (2001), our assumption matches the idea that the lender acquires more information on assets through her financing activity. As for the former, “Because he [the entrepreneur] is a specialist at maximizing the value of the asset in its primary use [...] it is reasonable to assume that he lacks the skill even to identify the asset’s next best use or to recognize clearly the occurrence of the bad states, in which case he risks maintaining it in a suboptimal use” (Habib and Johnsen, 1999, p. 145).

The second feature of our information structure is the amount of information. In many models, the distinctive characteristic of a relationship lender is her information advantage over a transactional (Berger and Udell, 1998). Berger and Udell argue that “banks may acquire private information over the course of a relationship” (1995, p. 352) and “under relationship lending, banks acquire information over time through contact with the firm, its owner, and its local community” (2002, p. 32).

Turning finally to the contractual structure, we follow Aghion and Bolton (1992), Diamond and Rajan (2001) and Rajan (1992) in specifying the limited contract enforceability. As in their studies, the lender’s interim action is non-contractible directly. Moreover, monetary returns are imperfectly contractible and this limits the design of monetary incentives for the lender.
2.3 Equilibrium

In solving for the equilibrium we start by agents’ decisions. We then characterize firms’ distribution across collateral values \( a \) according to the type of funding chosen - relationship or transactional - and the technology adopted - mature or new.

2.3.1 Agents’ Decisions

We focus first on the entrepreneurs who obtain credit and proceed by backward induction. First, we solve for the lender’s action. Then, we solve for the entrepreneur’s funding choice. Note that the type of funding affects the amount of pledgeable returns and, hence, the access to credit. This occurs because the value that the lender expects from collateral liquidation depends on whether she has a credit relationship. In order to render our message transparent, we concentrate on the case in which their possible exclusion from the credit market does not distort entrepreneurs’ funding choice. Later in the analysis (see 3.3.2) we introduce a restriction on the parameters (see (16)) that guarantees this and we justify our modelling restriction in detail.

Consider the lender’s decision whether to carry out the action at date 2. The contractual structure implies that the contract only determines the loan and the repayments to the lender in case of success, contingent on the technology adopted. Denote \( r \) (\( r_n \)) the repayment contractually due to the lender if the mature (new) technology is successfully adopted. The lender compares her expected return if the innovation can occur with her expected return if it cannot. Using simple algebra and assuming that she breaks a tie in favour of inaction, the lender will carry out the action if and only if

\[
 r_n - r > \frac{(1 + \sigma)(1 - \pi)a \mu}{\pi}. 
\]  

(3)

Inequality (3) is the lender’s incentive compatibility constraint. The left hand side of (3) is the spread between the repayments in case of successful adoption of the new and the mature technology, respectively. The right hand side of (3) is a monotonic transformation of the reduction in her liquidation proceeds that the lender experiences if the entrepreneur restructures and the project fails. This reduction, which stems from the lower redeployability of new assets \( (\alpha_n = 0) \) and/or the lender’s worse ability to liquidate them \( (\mu_n = 0) \), is positively related to the lender’s information \( \mu \) and to the liquidation value \( a \) of mature assets.

The lender will allow the innovation only if, as in (3), the contract guarantees her a sufficiently higher repayment if the new technology is successfully adopted, compensating her for the reduction in her expected liquidation proceeds. Lemma 1 solves for the lender’s action.

LEMMA 1: A lender will carry out the action necessary for the innovation if and only if the entrepreneurs’s collateral satisfies \( a < a(\mu) \), where

\[
a(\mu) = \frac{\pi k y (1 + n) - i}{\sigma (1 - \pi) \mu}. 
\]  

(4)
Proof. The spread \( r_n - r \) is maximum when \( r_n \) is set at its uppest limit. The maximum level of \( r_n \) that can be set in the contract is \( \ell y(1 + n) \). Given this choice of \( r_n \), the minimum level of \( r \) that guarantees non-negative expected profits to the lender if the innovation can occur satisfies

\[
\pi r = \frac{i - \pi (1 - \sigma) \ell y(1 + n)}{\sigma} - (1 - \pi) \sigma \mu a. \tag{5}
\]

By substituting the values of \( r_n \) and \( r \) into the left hand side of (3), and operating algebraic manipulations, we obtain the condition \( a < \pi(\mu) \). ■

The intuition behind lemma 1 is as follows. The spread \( r_n - r \) that can be specified in the contract is bound above. On the one hand, the repayment \( r_n \) for the new technology is constrained above by the entrepreneur’s limited liability constraint \( r_n \leq \ell y(1 + n) \). On the other hand, for a given \( r_n \), the repayment \( r \) for the mature technology is constrained below by the lender’s participation constraint. Hence, in some region of the parameter space, in (3) the left hand side falls short of the right hand side for any feasible pair \( (r_n, r) \). In this region, the lender impedes restructuring.

Lemma 1 yields two insights. First, the technological conservatism of the lender is more likely within a credit relationship, i.e.

\[
\pi(M) < \pi(m). \tag{6}
\]

In fact, because of her better information \( (M > m) \), a relationship lender has more ability to liquidate mature assets than a transactional, that is in (3) the right hand side is higher. Second, the conservatism of the lender is more likely for collateral-rich entrepreneurs. Intuitively, a lender loses more from the depreciation of her liquidation skills when these skills are better developed \( (M > m) \) and the value \( a \) of the collateral is higher.

We can now solve for an entrepreneur’s funding choice. Henceforth, we assume that an entrepreneur breaks a tie in favour of relationship funding.

**Lemma 2:** An entrepreneur will choose transactional funding if and only if \( a \in [\pi(M), \tilde{a}] \), where

\[
\tilde{a} = \min \left\{ \pi(m), \frac{\pi y n (1 - \sigma)}{(1 - \pi)(M - \sigma^2 m)} \right\}. \tag{7}
\]

Proof. We here focus on the formal part of the proof; the rest is in the text that follows. As we argue in the text, the non-obvious case is when only a transactional lender allows the entrepreneur to restructure, i.e. \( a \in [\pi(M), \pi(m)] \). In this case, it is easy to see that the condition under which an entrepreneur chooses transactional funding is

\[
\pi[(1 - \sigma)[y(1 + n) - r_n] + \sigma(y - r)] > \pi(y - r). \tag{8}
\]

The repayments \( r \) and \( r_n \) that guarantee zero profits to a relationship lender satisfy

\[
\pi [(1 - \sigma)r_n + \sigma r] = i - (1 - \pi) \sigma^2 ma, \tag{9}
\]
while the repayment $r$ that guarantees zero profits to a transactional lender satisfies

$$\pi r = i - (1 - \pi)Ma. \tag{10}$$

Using (10) and (9) to substitute into (8), we obtain

$$a = \pi yn(1 - \sigma)/(1 - \pi)(M - \sigma^2m), \tag{11}$$

i.e. the second term in braces in (7).

The intuition behind lemma 2 is as follows. It is straightforward that the entrepreneurs who can restructure under both relationship and transactional funding ($a < \pi(M)$) and those who cannot restructure under either type of funding ($a \geq \pi(m)$) choose relationship funding. In fact, for given innovation opportunities, a relationship lender offers cheaper credit because she is more efficient in liquidating mature assets. The entrepreneurs with $a \in [\pi(M), \pi(m)]$ face instead a trade-off: on the one hand, only transactional funding allows them to restructure; on the other hand, relationship funding offers them cheaper credit. The extra cost of transactional funding increases with the value of collateral $a$ and equals the cost of the technological inertia induced by relationship funding when

$$a = \pi yn(1 - \sigma)/(1 - \pi)(M - \sigma^2m).$$

Henceforth, we impose the following third restriction:

$$\bar{a} < 1. \tag{12}$$

Restriction (12) guarantees that the upper bound on firms’ collateral values does not distort our results. We also simplify the notation setting $\pi(M) = \pi$.

Thus far, we have focused on the entrepreneurs who obtain credit at date 1. In lemma 3, we establish the condition under which an entrepreneur has access to credit.

**LEMMA 3:** Denote

$$a(\mu) = \frac{i - \pi \ell y(1 + n - n\sigma)}{\sigma^2(1 - \pi)\mu}. \tag{13}$$

Only the entrepreneurs with $a \geq a(M) \equiv \underline{a}$ obtain credit at date 1.

**Proof.** We first prove that, when the lender allows the innovation, the minimum value of collateral at which the entrepreneur can guarantee zero profits to the lender is lower than when the lender does not allow the innovation. In order for this to be true it must be that

$$\frac{i - \pi \ell y(1 + n - n\sigma)}{\sigma^2(1 - \pi)\mu} < \frac{i - \pi \ell y}{(1 - \pi)\mu}. \tag{14}$$

Operating algebraic manipulations, (14) can be rewritten as

$$\sigma(i - \pi \ell y) < \pi \ell y(1 + n) - i, \tag{15}$$

which always holds given the upper bound on $i$ in (2). Furthermore, because of the better information of a relationship lender ($M > m$), it is immediate that relationship funding entails a higher amount of
pledgeable returns than transactional funding. All this implies that the minimum value of collateral such that a firm obtains credit is \( a(M) \), where \( a(M) > 0 \) because of the lower bound on \( i \) in (2).

The intuition behind lemma 3 is straightforward. The limited verifiability of their output and the low value of their collateral imply that some entrepreneurs cannot pledge enough expected returns to a lender, even when the lender obtains high quality information on collateral \( (\mu = M) \). This leads to their exclusion from the credit market.

**Discussion: the Dual Role of Collateral and Relationships.** Lemmas 1 and 3 illustrate the dual role of collateral and credit relationships. Lemma 3 shows that they both ease firms’ access to credit: this role has been investigated in previous studies (e.g. Holmstrom and Tirole, 1997). However, lemma 1 shows that collateral and credit relationships may inhibit restructuring: relationship lenders learn high quality information on collateral and they can impede restructuring to preserve the value of their information. The idea that collateral and credit relationships can distort the decisions of firms and financiers is hardly new. Manove, Padilla and Pagano (2003) review the distortions associated with an “excess of collateral”. For example, lenders protected by collateral may have the incentive to strip a company of key assets and force liquidation (Bolton and Sharfstein, 1996). Moreover, if entrepreneurs are overoptimistic, pledging collateral can increase their ability to obtain funds for inefficient projects by insulating banks from downside risk (Manove and Padilla, 1999). Here, we stress the technological inertia potentially associated with an excess of collateral. As for credit relationships, Rajan (1992) shows that relationship lenders may hold up entrepreneurs during projects and extract rents. In turn, this can depress entrepreneurial effort. Rajan (1992) does not investigate entrepreneurs’ technology choice.

### 2.3.2 Firms’ Distribution

The credit rationing that firms potentially face may distort their funding choice. Suppose that a firm wants to choose transactional funding and restructure. As shown in lemma 2, this happens if \( a \in [\tilde{\pi}, \bar{a}] \). It could be that, because of the poor ability to liquidate collateral of a transactional lender, this choice does not guarantee non-negative expected profits to the lender. Hence, this firm could be forced to choose relationship funding and adopt the mature technology. In order to render our message transparent, we rule this case out (see section 4 for a further discussion). Precisely, we restrict ourselves to a region of the parameter space such that

\[
a(m) < \min \{ \tilde{\pi}, \bar{a} \}.
\]  

We can now characterize firms’ distribution across collateral values (refer also to figure 2).
PROPOSITION 1: The firms with \(a \in [0, \bar{a})\) do not obtain credit and remain inactive. The firms with \(a \in [\bar{a}, 1]\) choose funding and technology as follows.

I. \(\bar{a} \geq \bar{a}\): Flexible credit regime.
   \(a \in [\bar{a}, \bar{a})\): i) relationship funding, ii) potentially restructure,
   \(a \in [\bar{a}, 1]\): i) relationship funding, ii) do not restructure,

II. \(\bar{a} < \bar{a}\): Conservative credit regime.
   \(a \in [\bar{a}, \bar{a})\): i) relationship funding, ii) potentially restructure,
   \(a \in [\bar{a}, \bar{a})\): i) transactional funding, ii) potentially restructure,
   \(a \in [\bar{a}, 1]\): i) relationship funding, ii) do not restructure.

Proof. Operating algebraic manipulations, it is easy to show that there exists a non-empty region of the parameter space such that restrictions (1),(2),(12) and (16) hold and \(\bar{a}\) can be greater or smaller than \(\bar{a}\). Below, we provide two numerical examples while algebraic details are available from the author.

The rest of the proposition follows from combining the results in lemmas 2 and 3. 

Proposition 1 identifies two credit regimes. In the first (\(\bar{a} \geq \bar{a}\)), lenders’ technological conservatism within credit relationships is weak or, put differently, only firms with large collateral face the conservatism of a relationship lender. Alternatively, entrepreneurs derive a large benefit from credit relationships or, put differently, they are reluctant to forego the cheap credit of a relationship lender. In this credit regime, which we call “flexible”, all firms form credit relationships and firms only differ in their technology choice. In particular, firms with medium collateral (\(\bar{a} \leq a < \bar{a}\)) potentially restructure while firms with large collateral (\(a \geq \bar{a}\)) adopt the mature technology.
TABLE I.
Example 1: Flexible Credit Regime.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Thresholds</th>
<th>Effects of 1% Collateral Shock</th>
<th>( \Delta CR )</th>
<th>( \Delta I )</th>
<th>( \Delta RF )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \pi = 0.93 )</td>
<td>( a = 0.412 )</td>
<td>Public Information</td>
<td>-0.71%</td>
<td>-0.71%</td>
<td>-0.72%</td>
</tr>
<tr>
<td>( y = 0.96 )</td>
<td>( \pi = 0.963 )</td>
<td>Private Information</td>
<td>-0.71%</td>
<td>-0.71%</td>
<td>-0.72%</td>
</tr>
<tr>
<td>( i = 0.89 )</td>
<td></td>
<td>Elastic Demand</td>
<td>1.01%</td>
<td>1.01%</td>
<td>1.03%</td>
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<tr>
<td>( \ell = 0.96 )</td>
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<td>( n = 0.095 )</td>
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<td>( \sigma = 0.8 )</td>
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<td>( M = 0.9 )</td>
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<td>( m = 0.8 )</td>
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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).

EXAMPLE 1: Consider the parameters in table I, first column. These parameters imply that, when the innovation can occur, the expected return from a project net of the investment cost equals 2.2%; 4% of the output is non-verifiable; in case of success, the return of the new technology exceeds that of the mature by roughly 10%; the share of value lost in liquidation by a relationship (transactional) lender amounts to 10% (20%). With this parameter choice the economy is in the flexible credit regime.

In the second regime \((\pi < \bar{a})\), lenders’ conservatism within credit relationships is strong. Alternatively, entrepreneurs derive a small benefit from relationships. In this regime, which we call “conservative”, firms with medium collateral \((\pi \leq a < \bar{a})\) overcome the technological conservatism of relationship lenders by choosing transactional funding. As in the flexible regime, firms with medium collateral \((a \leq a < \bar{a})\) potentially restructure while firms with large collateral \((a \geq \bar{a})\) adopt the mature technology.

EXAMPLE 2: Consider the parameters in table II, first column. These parameters imply that, when the innovation can occur, the expected return from a project net of the investment cost equals 2.4%; the share of value lost in liquidation by a relationship (transactional) lender amounts to 5% (roughly 6%). With this parameter choice the economy is in the conservative credit regime.

In sum, the critical difference between the two credit regimes consists of the role of transactional finance. In the flexible regime, transactional finance is inactive; in the conservative, it is active and...
it specializes in the financing of potentially restructuring firms. In both regimes, collateral-rich firms (i.e. the firms with \( a \in [\pi, 1] \) in the flexible regime and with \( a \in [\bar{a}, 1] \) in the conservative regime) form credit relationships with lenders in which they preserve the mature technology. Finally, note that which credit regime features more restructuring firms depends on the preferred parameters.

### 3 Impact of a Collateral Shock

Following Holmstrom and Tirole (1997), we now assume that at date 1, before contracts are written, an unexpected collateral shock occurs: the productivity of liquidated assets drops by a share \( \eta \). In the real sector, we focus on the effects on total investment (\( I \)) and on the measure of restructuring firms (\( RF \)). In the credit sector, we focus on the effect on the measure of credit relationships (\( CR \)). Henceforth, when we refer to these effects, we implicitly compare the equilibrium that is realized after the shock with the one that would be realized in the absence of the shock. For example, when we say that a credit relationship breaks down, we mean that in the absence of the shock the firm would have borrowed from a relationship lender, while after the shock it either borrows from a transactional lender or it is inactive.

### 3.1 Exogenous Collateral Values

Proposition 2 summarizes the effects of the collateral shock in the flexible credit regime.

PROPOSITION 2: In the flexible credit regime, a proportional contraction of firms’ collateral by...
η reduces the measure of credit relationships by

$$\Delta CR = F\left(\frac{a}{1 - \eta}\right) - F(a)$$

(17)

and investment by

$$\Delta I = i[F\left(\frac{a}{1 - \eta}\right) - F(a)]$$

(18)

If firms’ distribution is not too skewed to the left, the collateral shock will increase the measure of restructuring firms. Precisely, the change in the measure of restructuring firms equals

$$\Delta RF = (1 - \sigma) \left[ F\left(\frac{\bar{a}}{1 - \eta}\right) - F(\bar{a}) - F\left(\frac{a}{1 - \eta}\right) + F(a) \right].$$

(19)

**Proof.** Most of the proof is provided in the text that follows. Here, it is sufficient to consider that, in order to compute the change in the measure of restructuring firms and in the measure of credit relationships, one has to compare the inflows and outflows of firms from each region of the domain of a identified in proposition 1. As for the change in investment, this is computed by multiplying $i$ by the change in the measure of active firms. ■

In the flexible regime, after the shock, the firms with initial collateral $a \in [a, \frac{\bar{a}}{1 - \eta})$ are denied credit because they cannot pledge enough returns to a lender. Hence, these firms drop out, their investment is lost and their credit relationships break down. This effect of the collateral shock replicates that obtained by Holmstrom and Tirole (1997). The new prediction is the impact of the shock on collateral-rich firms. The firms with initial collateral $a \in [\bar{a}, \frac{\bar{a}}{1 - \eta})$ are now allowed to restructure by their relationship lenders. These firms potentially switch to the new technology within their credit relationships. Whether the measure of restructuring firms increases or decreases depends on the measure of this group of firms relative to those squeezed out by the shock. If firms’ distribution is not too skewed to the left, the former will outweigh the latter and the measure of restructuring firms will increase. Of course, there are left-skewed distributions such that the measure of restructuring firms declines. However, even in this case, the ratio “(restructuring firms)/(active firms)” may increase. Finally, if this ratio declines too, the model predictions will resemble those of the studies on the negative effects of financial imperfections on restructuring during recessions (e.g. Caballero and Hammour, 2004; Barlevy, 2003).

**EXAMPLE 1 (continued):** Let $F(a)$ be a uniform and consider the parameters in table I. Furthermore, let the drop in collateral productivity $\eta$ equal 1%. Then, $\Delta CR/CR = \Delta I/I \approx -0.71\%$ and $\Delta RF/RF \approx 1.01\%$.

We now investigate the effects of the collateral shock in the conservative credit regime.

**PROPOSITION 3:** In the conservative credit regime, a proportional contraction of firms’ collateral by $\eta$ reduces the measure of credit relationships by

$$\Delta CR = F\left(\frac{\bar{a}}{1 - \eta}\right) - F(\bar{a}) - F\left(\frac{a}{1 - \eta}\right) + F(a).$$

(20)
Investment declines as it would in the flexible regime, i.e.

\[ \Delta I = i[F\left(\frac{\bar{a}}{1-\eta}\right) - F(a)]. \]  

The change in the measure of restructuring firms equals

\[ \Delta RF = (1-\sigma) \left[ F\left(\frac{\bar{a}}{1-\eta}\right) - F(\bar{a}) - F\left(\frac{\bar{a}}{1-\eta}\right) + F(a) \right]. \]  

**Proof.** The proof is analogous to that of proposition 2 and is therefore omitted. □

As in the flexible regime, the collateral shock breaks the credit relationships of collateral-poor firms \( (a \in [\bar{a}, \frac{\bar{a}}{1-\eta}) ) \), whose investment is lost. The firms initially with \( a \in [\bar{a}, \frac{\bar{a}}{1-\eta}) \) would now be allowed to restructure by relationship lenders and would prefer relationship funding. However, they can no longer form credit relationships. Hence, they borrow from transactional lenders. Finally, the firms with initial collateral \( a \in [\bar{a}, \frac{\bar{a}}{1-\eta}) \) prefer now borrowing from transactional lenders and possibly restructuring. These firms deliberately break their credit relationships and borrow from new investors.

EXAMPLE 2 (continued): Let \( F(a) \) be a uniform and consider the parameters in table II. Furthermore, let \( \eta = 1\% \). Then, \( \Delta CR/CR \approx -5.72\% \), \( \Delta I/I \approx -2.73\% \) and \( \Delta RF/RF \approx 1.03\% \).

Propositions 2 and 3 imply that the qualitative effects of the collateral shock on restructuring and investment in the real sector are the same in the two credit regimes. What differs is the way firms’ restructuring occurs and, hence, the effect in the credit sector. In the flexible regime, the restructuring of collateral-rich firms occurs within their credit relationships and the breakdown of relationships caused by the shock stems solely from the exclusion of collateral-poor firms from the credit market. In the conservative regime, instead, the restructuring of collateral-rich firms entails the breakdown of their credit relationships. In the conservative regime, firms’ restructuring is then associated with an additional breakdown of credit relationships besides that induced by the exclusion of collateral-poor firms from the credit market. This can be further grasped with the help of the two numerical examples (see tables I and II). While a 1% shock produces very similar effects on the measure of restructuring firms in the two credit regimes, in the conservative regime the shock induces a 5.72% decline of the measure of credit relationships versus 0.71% in the flexible regime.

### 3.2 Endogenous Collateral Values

The framework employed so far is admittedly primitive because it features exogenous collateral values. We now add structure to the market for collateral and allow for the general equilibrium determination of collateral values. This yields further insights into the interaction between the exclusion of collateral-poor firms from the credit market and the restructuring of collateral-rich firms after the shock. First, we relax the assumption of public information on collateral values. In this variant, the market value of
A firm’s collateral reflects the average collateral value of defaulted firms, i.e., the quality composition of collateral. Second, we relax the assumption of a perfectly elastic demand for collateral and consider the interaction between the quantity of collateral demanded and the quantity of collateral supplied.

### 3.2.1 The Quality of Collateral

We relax the assumption of public information on collateral values. There is a continuum of locations of measure one and in each location there is one entrepreneur and one investor. An investor has private information on the value \( a \) of the collateral of the firm in her location. Since we are not interested in issues of informational monopoly and lenders’ rent extraction, at the contractual stage we let an entrepreneur have full bargaining power vis-à-vis the investor in her location (aka insider). It is immediate that proposition 1 carries over, with all entrepreneurs borrowing from insiders in the absence of the shock. Proposition 4 reworks the effects of the shock.

**PROPOSITION 4:** A proportional contraction by \( \eta \) of firms’ collateral:

i) In the flexible credit regime, has the same effects as with public information.

ii) In the conservative credit regime, reduces the measure of credit relationships less than with public information. Precisely, let

\[
\begin{align*}
    a^* &= \frac{(1 - \pi)\sigma^2 ma_{AV} + \pi y n(1 - \sigma)}{(1 - \pi) M}, \quad (23) \\
    a_{AV} &= (1 - \eta) \left[ \int_{a}^{a^*} ada + \int_{a^*}^{\infty} ada \right]. \quad (24)
\end{align*}
\]

If \( a_{AV} < a(m) \), the decline in the measure of credit relationships will equal

\[
\Delta CR = F\left(\frac{a}{1 - \eta}\right) - F\left(a\right); \quad (25)
\]

if \( a_{AV} \geq a(m) \), the decline in the measure of credit relationships will equal

\[
\Delta CR = F\left(\frac{a^*}{1 - \eta}\right) - F\left(\tilde{a}\right) + F\left(\frac{a}{1 - \Delta}\right) - F\left(a\right). \quad (26)
\]

Furthermore, as long as \( \eta \) is large enough, investment and the measure of restructuring firms will decline more than with public information.

**Proof.** As for propositions 2 and 3, in order to compute the change in the measure of restructuring firms and in the measure of credit relationships, one has to compare the inflows and outflows of firms from each relevant region of the domain of \( a \). Consider now the values of \( a^* \) and \( a_{AV} \). The value of \( a_{AV} \) is obtained as the average value of \( a \) across all the firms that are willing to borrow from outsiders after the shock (see the text below for more). The value of \( a^* \) is obtained by taking equations (8), (9) and (10) for the choice between relationship and transactional funding and considering that now for an outsider (9) is replaced by

\[
(1 - \sigma)r_n + \sigma r = \frac{i - (1 - \pi)\sigma^2 ma_{AV}}{\pi}. \quad (27)
\]
Substituting (10) and (27) into (8), we obtain that a firm is willing to borrow from an outsider if and only if $a < a^*$. ■

The intuition behind proposition 4 is the following. In the flexible regime, no collateral-rich firm wants to break a credit relationship. Hence, the only firms that want to borrow from uninformed outsiders are the collateral-poor firms whose relationships break down after the shock, which no outsider wants to finance regardless of the actual value of their collateral. In contrast, in the conservative regime a group of collateral-rich firms ($a \in [\bar{a}, \frac{\bar{a}}{1-\eta}]$) want to break their relationships with informed insiders, borrow from outsiders and restructure. This adds to the group of collateral-poor firms ($a \in [a, 1-\eta]$, $a < a^*$) that also turn to outsiders to replace their broken relationships with insiders. Since outsiders lack information on collateral, they cannot discern whether an applicant belongs to the first or the second group. Hence, their evaluation of the collateral of an applicant reflects the average collateral value of the pool of applicants. This reasoning implies that in the conservative regime the firms that deliberately turn to outsiders see their collateral undervalued and must pay an additional cost to obtain credit from them. This extra cost, which adds to that associated with transactional funding, depresses their incentive to restructure: after the shock, the only firms that want to break their relationships are those initially with $a \in [\bar{a}, \frac{\bar{a}}{1-\eta}]$. Formally, (23)-(24) constitutes a system that jointly determines the average collateral value $a_{AV}$ of the firms borrowing from outsiders and the maximum collateral value $a^*$ at which a firm deliberately breaks its relationship.

We can now comment proposition 4. As for the real effects of the collateral shock, one of the following cases is realized. If, despite adverse selection, $a_{AV}$ is (weakly) higher than $a(m)$, the shock will foster restructuring and will leave investment unchanged. In fact, on average outsiders will expect to obtain enough value from collateral liquidation to break even and will finance all new applicants. In this case, the collateral-poor firms ($a \in [a, 1-\eta]$) will adopt the new technology. Furthermore, the collateral-rich firms not discouraged by the extra financing cost ($a \in [\bar{a}, \frac{\bar{a}}{1-\eta}]$) will switch from the mature to the new technology, raising the measure of restructuring firms. If, instead, $a_{AV}$ is lower than $a(m)$, outsiders will deny credit to all new applicants. Hence, the collateral-poor firms will lose access to credit as with public information. Furthermore, no collateral-rich firm will be able to borrow from outsiders and restructure. Hence, investment and restructuring will decline. By direct inspection of (24), which case is realized depends on a range of factors, including the magnitude of the shock: the higher $\eta$, the lower $a_{AV}$ and the more likely the second case.  

EXAMPLE 2 (continued): Let $F(a)$ be a uniform and consider the parameters in table II. Furthermore, let $\eta = 1\%$. Then, $\Delta RF/RF \approx -2.79\%$ and $\Delta I/I \approx -2.73\%$.

The example shows that with private information after a 1% shock restructuring exhibits a sharp drop in the conservative regime, with the measure of restructuring firms falling by 2.79%. The reader
should contrast this with the increase of the measure of restructuring firms by 1.03% that occurs with public information (see table II). As for investment, it declines as with public information (−2.73%).

Turning to the effect of the collateral shock in the credit sector, the measure of credit relationships that break down is always lower than with public information. When \( a_{AV} \geq a(m) \), because of the extra financing cost, fewer firms deliberately break credit relationships. Furthermore, collateral-poor firms preserve their relationships because they are pooled together with collateral-rich firms. When \( a_{AV} < a(m) \), the only credit relationships that break down are those of collateral-poor firms, while collateral-rich firms continue to borrow from relationship lenders.

EXAMPLE 2 (continued): Let \( F(a) \) be a uniform and consider the parameters in table II. Furthermore, let \( \eta = 1\% \). Then, \( \Delta CR/CR \approx -2.79\% \).

The example makes evident that in the conservative credit regime private information shields credit relationships from the shock: their percentage drop is 2.79% versus 5.72% with public information.

3.2.2 The Quantity of Collateral

We now set aside informational asymmetries and relax the assumption that the demand for collateral is infinitely elastic. Borrowing from the analysis of the market for collateral in Shleifer and Vishny (1992), we generate a downward sloping demand for collateral by allowing for heterogeneity in entrepreneurs’ ability to reuse assets. If an entrepreneur reuses one unit of liquidated assets, she will obtain an amount \( \theta \) of final good with \( \theta \) uniformly distributed across entrepreneurs over the domain \([\theta - 1, \theta]\). Furthermore, following Shleifer and Vishny (1992), only the entrepreneurs who succeed in production at date 3 have the technology to reuse liquidated assets.

Let \( p \) denote the asset liquidation price. The demand of liquidated assets is given by

\[
D(p) = \pi(\bar{\theta} - p) \left[ 1 - F\left(\frac{\theta}{p}\right)\right].
\]

Intuitively, a measure \( 1 - F\left(\frac{\theta}{p}\right) \) of entrepreneurs obtain credit and become active. In fact, the threshold value of collateral below which an entrepreneur cannot obtain credit is now \( a/p \). A share \( \pi \) of active entrepreneurs is successful; finally, a share \( \bar{\theta} - p \) of successful entrepreneurs obtain an output no lower than \( p \) from reusing assets. The supply \( S \) of assets is self-explanatory and is given by

\[
S(p) = (1 - \pi) \int_{\theta}^{1} ada.
\]

An equilibrium where neither demand nor supply is rationed obtains when

\[
D(p) = S(p).
\]
We rework the effects of the collateral shock for the case of a uniform distribution of $a$ considered thus far. Note that in the examples that follow i) the excess collateral demand $D(p) - S(p)$ is monotonically decreasing in $p$ and, hence, ii) there is a unique price that clears the market for collateral.

EXAMPLE 1 (continued): Let $F(a)$ be a uniform and consider the parameters in table I. Furthermore, let $\overline{\theta} = 1.05$ and $\eta = 1\%$. Then, $\Delta CR/CR = \Delta I/I \approx -0.72\%$, $\Delta RF/RF \approx 1.03\%$.

EXAMPLE 2 (continued): Let $F(a)$ be a uniform and consider the parameters in table II. Furthermore, let $\overline{\theta} = 1.05$ and $\eta = 1\%$. Then, $\Delta CR/CR = -7.74\%$, $\Delta I/I \approx -2.85\%$, $\Delta RF/RF \approx 1.04\%$.

The two examples show that in both credit regimes the collateral shock induces a larger decline of investment and the measure of credit relationships than in the baseline economy with exogenous collateral values. The most significant differences occur in the conservative regime, where, in absolute value, $\Delta CR/CR$ and $\Delta I/I$ are respectively 2.02% and 0.12% larger than in the baseline economy. In contrast, the measure of restructuring firms increases more than in the baseline economy: however, in both scenarios the difference is tiny (less than 0.1%).

The intuition for these results is easy to grasp. The shock induces a fall of the asset price $p$ because the demand for liquidated assets tends to drop more than the supply. The measure of firms that have access to credit is positively related to $p$. Hence, the fall of $p$ leads to the exclusion of a larger measure of firms and to a larger drop in investment than in the baseline economy with $p$ fixed at one. In contrast, the measure of collateral-rich firms that face conservatism within relationships (in the flexible regime) or want to preserve inertial credit relationships (in the conservative regime) is negatively related to $p$. Hence, in both credit regimes, when $p$ drops, more firms restructure. Yet, the fall in $p$ is too small to affect restructuring significantly, amounting to less than 0.1% in both credit regimes. This conclusion is quite robust: we experimented with several parameter choices and in all cases we found that relaxing the assumption of a perfectly elastic demand for collateral has modest implications for firms’ restructuring.

4 Concluding Remarks

We have investigated the role of the credit market in a restructuring economy. Credit relationships ease information flows between firms and lenders and, hence, firms’ access to credit. However, relationship lenders hinder the restructuring of collateral-rich firms to preserve the value of their information on mature technologies. A negative collateral shock squeezes collateral-poor firms out of the credit market but fosters the restructuring of collateral-rich firms, possibly through the breakdown of their credit relationships. We have also investigated the general equilibrium interaction between the credit rationing of collateral-poor firms and the restructuring of collateral-rich firms after the shock.
Before assessing the model implications in the light of the empirical evidence, it is important to discuss some assumption of the model.

**Asset Liquidation Value.** A first assumption is the normalization to zero of the value that a lender obtains from the liquidation of a new asset. We could consider a variation in which a new asset has positive liquidation value, though lower than that of a mature \((0 < \mu_n a_n < 1)\). In this variation, what would matter for the decision of a lender whether to carry out her action and for the funding choice of an entrepreneur would be the difference between the values of a mature and a new asset \((a(1 - \mu_n a_n))\). What would matter, instead, for the access of a firm to credit would be the lender’s total expected liquidation proceeds \((a(\sigma + (1 - \sigma)\mu_n a_n))\). The qualitative results would carry over but the model would be less tractable.

**Credit Rationing and Firms’ Choices.** A second assumption is that their possible exclusion from credit does not distort firms’ technology and funding choices (restrictions (2) and (16)). We have made this assumption to highlight the technological inertia associated with credit relationships. In fact, other studies have investigated the impact of limited output verifiability on technology adoption and this is not our focus. Furthermore, this enables us to isolate the negative impact that the pooling of collateral-poor and collateral-rich firms has on aggregate restructuring when there is private information in the credit market. If we allowed the mature technology to offer more pledgeable expected returns, this effect would be harder to disentangle. That said, we could relax restrictions (2) and (16). For example, we could relax restriction (2) and allow the mature technology to offer a higher pledgeable expected return. This would imply that the marginal firms that obtain credit would choose the mature technology but would not change our qualitative results.

**Turn-over and Destruction of Credit Relationships.** After the collateral shock the firms initially with \(a \in [\overline{a}, \overline{\overline{a}}]\) are unable to form credit relationships (see 3.1). This is not essential. In fact, we could reason in terms of turn-over of credit relationships rather than net changes and the results would be unaltered. However, we believe that this feature is realistic. As stressed by den Haan, Ramey and Watson (2003), credit relationships can easily break down but take time to be formed. Analyzing gross flows of bank credit in the United States between 1979 and 1999 with data from banks’ Call Report Files, Dell’Ariccia and Garibaldi (2004) find evidence in support of the argument that banks expand credit slower than they contract it and argue that the extension of new loans is a time consuming process.

Although an empirical analysis is outside the scope of this paper, it is important to assess the consistency of the model implications with key stylized facts. The model predicts that firms’ restructuring can occur within credit relationships or through a process of credit reallocation, meant as the replacement by firms of existing lenders with new ones. Assessing the relevance of the first scenario requires to identify flows of credit within a firm: we are not aware of studies that can shed light on this. As for the restructuring outside credit relationships, evidence comes from the studies on credit reallocation. Dell’
Ariccia and Garibaldi (2004) find that in the United States during recessions the reduction in net bank credit is mainly attributable to a higher contraction of credit and, to a lower extent, to a slowdown in the expansion of credit. This implies that aggregate credit reallocation is countercyclical. While Dell’ Ariccia and Garibaldi (2004) especially focus on supply-side explanations based on banks’ behavior, their findings are consistent with the predictions of this analysis. The objective of our current research is indeed to test whether a link exists between credit reallocation and firms’ restructuring activity.
References


Notes

1 Caballero and Hammour (2004) show that, because of financial frictions, production units can be destroyed at an excessive rate during a recession. Furthermore, during the following recovery, the creation of new production units can be too slow and most of the recovery can occur via a slowdown of destruction. Ramey (2004) endogenizes the project screening and selection of financial managers. He shows that, when financial managers have empire-building incentives, during recessions they can discard efficient projects in order to preserve the number of projects in their portfolios. Barlevy (2003) shows that credit frictions can reverse the cleansing effect of recessions by leading to the disruption of high-surplus production units rather than of low-surplus ones.

2 Setting the amount of information learnt by the lender on the mature technology equal to the probability that the mature technology is adopted simplifies the expressions but is not relevant for the results.

3 As in Diamond and Rajan (2001), the lender can commit not to engage her skills in the liquidation if a standstill is reached in the renegotiation.

4 Note that we do not impose a limited liability constraint for the lender. Implicitly, we are assuming that the lender has more than enough funds to operate transfers to the entrepreneur at date 3, if needed. Incorporating a limited liability constraint would not alter the results.

5 Hence, the region of the parameter space in which the maximum feasible \( r_n - r \) falls short of the liquidation advantage of a transactional lender is a subset of the corresponding one for a relationship lender.

6 Notice that the minimum collateral that is necessary to borrow from outsiders is \( a(m) \) and not \( a(M) \).

7 Which case is realized depends also on the distribution of \( a \).