

Credit and Efficiency in Centralized and Decentralized Economies

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We study a credit model where, because of adverse selection, unprofitable projects may nevertheless be financed. Indeed they may continue to be financed even when shown to be low-quality if sunk costs have already been incurred. We show that credit decentralization offers a way for creditors to commit *not* to refinance such projects, thereby discouraging entrepreneurs from undertaking them initially. Thus, decentralization provides financial discipline. Nevertheless, we argue that it puts too high a premium on short-term returns.

The model seems pertinent to two issues: “soft budget constraint” problems in centralized economies, and differences between “Anglo-Saxon” and “German–Japanese” financing practices.

1. INTRODUCTION

We investigate how the degree to which credit markets are centralized affects efficiency when there is asymmetric information. Specifically, we argue that decentralization of credit may promote efficient project selection when creditors are not fully informed *ex ante* about project quality.

Our starting point is the idea that, although an entrepreneur (project manager) may have a relatively good idea of her project’s quality from the outset, creditors acquire this information only later on, by which time the criteria for profitability may have changed. Thus, a poor project (one whose completion time is too long to be profitable *ex ante*) may nevertheless be financed, since a creditor cannot distinguish it at the time from a good (quick) project. Moreover, the project may not be terminated even after the creditor has discovered its quality, if significant sunk costs have already been incurred. If the threat of termination deterred entrepreneurs from undertaking poor projects in the first place, creditors would wish to commit *ex ante* not to refinance them. But, sunk costs may well render this threat incredible: *ex post*, both creditor and entrepreneur could be better off carrying on with the project, *i.e.* refinancing it.

How can decentralization help in such circumstances? We conceive of a decentralized credit market as one in which ownership of capital is diffuse, so that the capital needed to refinance a poor project may be available but not in the hands of the initial creditor. This creditor, we assume, can monitor the project and thereby enhance its value. However, monitoring is not observable to subsequent creditors. Consequently, the initial creditor’s

incentive to monitor is blunted (relative to a centralized market where he owned all the capital) because he cannot fully appropriate the marginal return from doing so. With incentives reduced, he will monitor less than under centralization, which in turn reduces the value of the project and therefore the profitability of refinancing. That is, refinancing is less likely than in a centralized market; the threat to terminate a project is more credible.¹ Entrepreneurs are thereby induced not to undertake poor projects in the first place, and this enhances efficiency.²

Decentralization tends to deter projects that drag on too long, but for similar reasons may also discourage profitable projects that are slow to pay off. That is, the same features that strengthen commitments to terminate poor projects foster an over-emphasis on short-term profit opportunities.

To see this, suppose that the slow-and-quick-project model we have sketched is enriched so that not only poor projects but also highly profitable projects require long-term financing. Poor (i.e. inept) entrepreneurs are stuck with poor projects, but good (i.e. capable) entrepreneurs have a choice about whether their project is to be long-term and highly profitable or short-term and only moderately profitable. Finally, suppose that the degree of decentralization in the credit market is determined *endogenously*. That is, owners of capital can come together and *choose* whether to form a few big “banks” or a lot of small banks.

In such a model *multiple equilibria* (and, hence *coordination problems*) may well arise. If, in equilibrium, banks are small, even good entrepreneurs will have trouble getting continued financing for long-term projects for the reasons mentioned above. Thus they will choose the short-term option. But given that they do so, it will pay banks to be small (a single big bank would be overrun with unprofitable long-term projects from poor entrepreneurs). Thus, an equilibrium with only short-term projects and small banks exists.

But another equilibrium is also possible, one in which all banks are big. With a profusion of big banks, good entrepreneurs can get long-term financing and so choose highly lucrative projects. The profits from these projects outweigh the losses that banks incur from poor projects (which because of adverse selection are also financed). Such a “long-term” equilibrium can, in fact, be shown to Pareto-dominate the “short-term” equilibrium.

We believe that our framework may be relevant for two widely-discussed issues: the “soft budget constraint” problem of centrally-planned economies and the contrast in financing practices and investment horizons between economies of the “Anglo-Saxon” and “Japanese–German” modes.

Kornai (1979, 1980) has emphasized that the absence of bankruptcy threats in socialist economies resulted in the proliferation of inefficient enterprises. Firms realized that their losses would be covered by the state, and so operated quite independently of profit considerations. The pervasiveness of these soft budget constraints under socialism is widely acknowledged, and attempts to harden them are central features of several recent proposals for reform in eastern Europe.

But although the consequences of soft budget constraints have been intensively investigated, the same is not true of their causes. Most explanations have focused on political

1. Lack of commitment in centralized settings has been the focus of the *ratchet effect* literature. (See, for example, Freixas *et al.* (1985), Laffont and Tirole (1988), and Schaffer (1989)). What remains unsettled in this particular literature, however, is why lack of commitment should pertain particularly to centralization. Our paper attempts an answer to that question.

2. As in Stiglitz and Weiss (1981), creditors face an adverse selection problem. In the Stiglitz–Weiss model, credit rationing is a way to deal with this problem and improve the mix of projects being financed. In our setting, by contrast, it is the threat of termination that serves as the device for screening out poor projects.

constraints, such as the need to avoid unemployment or socially costly relocation. While not denying the importance of such constraints, we wish to suggest that *economic* factors may also be relevant. Specifically, the slow-and-quick-project model outlined above (and presented in detail in Sections 2 and 3) offers an explanation of soft budget constraints in which “softness” arises from the profitability of refinancing poor projects. Indeed, in our framework, softness is the “normal” state of affairs; the pertinent question is how, in some circumstances (e.g. a decentralized credit market), budget constraints can be hardened.³

We can also apply the framework to explain differences between Anglo-Saxon (U.S. and U.K.) and German–Japanese corporate finance. Several economists have noted that large German or Japanese firms have been more likely to obtain financing from banks than their American or British counterparts (which have relied more on equity or bonds for external finance). Moreover, these banking relationships have typically had a long-term structure in which banks assumed an active monitoring role. (See Aoki (1990), Baliga and Polak (1994), Corbett (1987), Edwards and Fischer (1994),⁴ Mayer and Alexander (1989) and Hoshi, Kashyap and Scharfstein (1988, 1989).) Most important from our standpoint, the Anglo-Saxon/German–Japanese financial contrast seems to be marked by differences in project length. Specifically, German and Japanese corporations have seemed less prone to “short-termism” (see for example Corbett (1987) and *The Economist* (1990)).

Although highly stylized, the enriched model sketched above, is consistent with these differences. The “long-term” equilibrium accords with German–Japanese experience, and the “short-term” equilibrium with that of the U.S. and U.K.

We proceed as follows. In Section 2, we present a very simple (in some respects, oversimplified) model and show how credit decentralization can improve efficiency. We then discuss several alternative specifications that lead to the same conclusions. In particular, we argue that the contrast between centralization and decentralization is only heightened if we suppose, following one tradition, that the central financing authority maximizes social surplus rather than profit.

Section 2 distinguishes decentralization from centralization rather crudely by identifying the former with two creditors and the latter with one. In Sections 3 and 4 we turn to a richer model in which the market structure is determined endogenously. Section 3 establishes that the main qualitative conclusions of Section 2 carry over to a framework in which market structure is determined endogenously. Finally, Section 4 introduces profitable long-run projects as an additional option for good entrepreneurs and shows that there can be two (Pareto-ranked) equilibria marked by different average project lengths.

2. DECENTRALIZATION AS A COMMITMENT DEVICE

a. The Model

There are three periods, one entrepreneur, and either one or two creditors (banks). Contracting between the entrepreneur and a bank occurs in period 0, and projects are carried out in periods 1 and 2. If a project remains incomplete at the end of period 1, the entrepreneur and bank can renegotiate the terms of the contract to their mutual advantage.

3. Qian and Xu (1991) and Qian (1994) have used this approach to show how soft budget constraints both interfere with innovation and can contribute to the endemic shortages that plague socialism.

4. Edwards and Fischer (1994) note, however, that the reliance on external finance among German banks has not been so great as commonly supposed.

The entrepreneur's project can be either good (g) or poor (p). A good project is completed after one period; a poor project requires two periods for completion. (We identify the quality of a project with that of its entrepreneur; thus, we shall refer to good and poor entrepreneurs). The project generates an observable (and verifiable) monetary return only at its completion. Whether good or poor, it requires one unit of capital per period (all returns, capital inputs, and payoffs are denominated in money).

The entrepreneur has no capital herself and so has to obtain financing from the bank(s). Banks have capital but cannot initially distinguish between good and poor projects. Let α be the prior probability that the project is good. All parties are risk neutral, i.e. they maximize expected profit.

For the time being we will assign no bargaining power to the entrepreneur (we will relax this assumption in Section 3). Thus, in negotiating financial terms, a bank can make a take-it-or-leave-it offer to the entrepreneur and thereby extract the entire observable return. The entrepreneur is limited to unobservable private benefits such as the perquisites she can command, the enhancement of her human capital and reputation, or what she can divert from the project into her own pocket.

Let E_g be a good entrepreneur's private benefit. E_t is a poor entrepreneur's benefit when her project is terminated after the first period, whereas E_p is her benefit from a completed project. We assume that $E_p \geq E_t$. This inequality makes sense if we imagine that the entrepreneur can extract more from a project the longer it continues. It would also follow from a more elaborate model in which her reputation is enhanced if the project is completed. In any case, it must hold in any model in which poor projects are ever refinanced (provided that the entrepreneur always has the option of quitting after the first period).⁵ We allow for the possibility that any of E_g , E_t , and E_p may be negative,⁶ which could occur, for example, if private benefits include the cost of effort that the entrepreneur must incur to set the project up.

Consider centralization first. In this case, there is a single bank B endowed with two units of capital. In period 0, the entrepreneur E (whose type is private information) turns up and requests financing (i.e. a loan of one unit of capital). B makes a take-it-or-leave-it contract offer in which the repayment terms depend on the observable return and when it is realized (because E has no endowment, the repayment cannot exceed the observable return⁷). Assume that a good project generates observable return $R_g > 1$, which, given its bargaining power, B can fully extract (provided that $E_g \geq 0$; if $E_g < 0$, B can extract only $R_g + E_g$ because E will require an inducement $-E_g$ to undertake the project).

If the project is poor, B obtains nothing unless he agrees to refinancing at the beginning of period 2, i.e. agrees to loan another unit of capital⁸ (since the observable return is zero at the end of the first period). Moreover, we assume that regardless of the first period agreement, B cannot commit himself not to refinance (or, rather, that any such commitment can be renegotiated). If refinanced, the poor project's observable return at the end of the second period is a random variable \bar{R}_p , whose realization is either 0 or \bar{R}_p , where $0 < \bar{R}_p$. (We could allow R_g to be a random variable as well, but this would not matter in view of the parties' risk neutrality.) One can interpret \bar{R}_p as the liquidation or resale value of the completed project. We suppose that, in addition to its role as lender, B serves to

5. And it is precisely the problem created by refinancing poor projects that is of interest to us.

6. As we shall see, in fact, the major case of interest for our purposes is where $E_t < 0$ and $E_p > 0$.

7. This is not necessarily true if the private return is known to be positive and bounded away from zero. But as long as B is uncertain about the value of this private return, he will not be able to extract it fully.

8. Here we are assuming for convenience that E cannot contribute any of what she may have saved from the first loan to reduce the size of the second.

TABLE I
Payoffs under centralization

	Good project (assuming $E_g > 0$)	Poor project without refinancing	Poor project with refinancing
Entrepreneur	E_g	E_l	E_p
Bank	$R_g - 1$	-1	$\Pi_p^* - 2$

monitor the project.⁹ This is modeled by assuming that, through his efforts, B can influence the distribution of \tilde{R}_p .¹⁰ Assume that B learns E 's type at the beginning of period 1. If E is poor, B can expend *monitoring effort* $a \in [0, 1]$ to raise the expectation of \tilde{R}_p . Specifically, let a be the probability of \bar{R}_p . As a rises, so does the cost of B 's efforts. Let $\psi(a)$ denote this cost, with $\psi' > 0$, $\psi'' > 0$, $\psi(0) = \psi'(0) = 0$, and $\psi'(1) = \infty$. These assumptions ensure an optimal effort level $a^* \in (0, 1)$ such that $\bar{R}_p = \psi'(a^*)$ and, given its bargaining power, an expected return for B (gross of its capital investment) of $\Pi_p^* \equiv a^* \bar{R}_p - \psi(a^*)$.

To summarize, the payoffs (net of the cost of capital) of the entrepreneur and bank under centralization are displayed in Table 1.

Under decentralization, the model is much the same as above, but now assume that there are two banks, B_1 and B_2 , each with only one unit of capital. The entrepreneur presents herself to B_1 in at the beginning of period 1 (we will postpone the issue of competition between banks until Section 3). If she turns out to be good, the analysis is as above. The same is true if she is poor but not refinanced. If, however, she is to be refinanced, she must turn to B_2 , since by then B_1 has no capital left.¹¹ Suppose that any monitoring that B_1 has done in period 1 is unobservable to B_2 .

For the sake of comparability, we assign B_2 no bargaining power so that, as in the case of centralization, B_1 can make take-it-or-leave-it offers. The problem for B_1 is to convince B_2 to loan a second unit of capital in exchange of a share of \tilde{R}_p . The higher B_2 's expectation of B_1 's monitoring effort in period 1, the smaller this share can be. We claim that equilibrium monitoring effort is less than a^* (the effort level under centralization), despite the fact that endowing B_1 with all the bargaining power maximizes his incentive to monitor. To see this, let \hat{a} be B_2 's assessment of the expected level of B_1 's monitoring activity. Then, to induce B_2 to participate, the repayment he receives must be $1/\hat{a}$ if $\tilde{R}_p = \bar{R}_p$. This means that B_1 chooses a to maximize

$$a(\bar{R}_p - 1/\hat{a}) - \psi(a),$$

i.e. to satisfy $\bar{R}_p - 1/\hat{a} = \psi'(a)$.¹² Now, in equilibrium, \hat{a} must be correct, so that if a^{**} is the equilibrium effort level, a^{**} satisfies $\bar{R}_p = \psi'(a^{**}) + 1/a^{**}$.¹³ Clearly, a^{**} is less than a^* (because B_1 concedes part of the marginal return from monitoring to B_2). Therefore, $\Pi_p^{**} \equiv a^{**} \bar{R}_p - \psi(a^{**})$ is less than Π_p^* .

9. In the 1990 version of this paper, we assumed that, instead of monitoring, B acquires information about the project that it can use to affect the distribution of \tilde{R}_p .

10. We could also assume that monitoring affects the realization of R_x . Because such monitoring would play no role in our analysis, however, we do not consider it.

11. Actually, all that is needed for our purposes is that B_1 should not be willing or able to undertake all the refinancing itself. Indeed, even if B_1 had more than 1 unit of capital left, B_2 would still have to be brought in if B_1 were sufficiently risk averse.

12. This first-order condition is valid provided that $\bar{R}_p \geq 1/\hat{a}$. Otherwise, the maximizing choice of a is $a = 0$.

13. If there is no solution to this equation, then $a^{**} = 0$ (see footnote 12). If there are several solutions, choose the one that maximizes $a(\bar{R}_p - 1/a) - \psi(a)$, in order to rule out inefficiencies due simply to coordination failure.

TABLE 2

Payoffs under decentralization

	Good project (if $E_g > 0$)	Poor project with no refinancing	Poor project with refinancing
E	E_g	E_r	E_p
B_1	$R_g - 1$	-1	$\Pi_p^{**} - 2$
B_2	0	0	0

Recapping we exhibit the (net) equilibrium payoffs under decentralization in Table 2.

We are interested in comparing the (perfect Bayesian) equilibria under centralization and decentralization, and, especially, in investigating how these two alternatives fare in deterring poor entrepreneurs. For these purposes, it makes sense to suppose that poor projects generate negative "social surplus" ($\Pi_p^* + E_p < 2$),¹⁴ that good projects have positive surplus ($R_g + E_g > 1$), and that poor entrepreneurs are deterred only by termination¹⁵ ($E_r < 0 < E_p$). We shall (briefly) consider the other cases after Proposition 1 and in Section 3. (Not surprisingly, centralization and decentralization perform very similarly in most of those other cases.)

Proposition 1. *Assume that $E_p > 0 > E_r$. Under either centralization or decentralization, there exists a unique equilibrium. For parameter values such that some financing is undertaken in equilibrium, a necessary and sufficient condition for project selection to differ in the two equilibria is $\Pi_p^* > 1 > \Pi_p^{**}$. If this condition holds, only a good project is financed under decentralization (the socially efficient outcome); both good and poor projects are financed (and the latter refinanced) under centralization.¹⁶*

Sketch of Proof. If $\Pi_p^* < 1$, then it is inefficient to refinance a poor project under centralization (and *a fortiori* under decentralization). Thus, a poor entrepreneur will not seek financing (since $E_r < 0$), and so only a good project is financed under both centralization and decentralization. If $\Pi_p^{**} > 1$, then once even a poor project is started, parties will end up refinancing it under decentralization (and *a fortiori* under centralization). Because $E_p > 0$, we conclude that a poor entrepreneur will gain by getting funded and so, under

14. Even if $\Pi_p^* + E_p > 2$, a poor project may not necessarily be desirable. In view of the unobservability of the entrepreneur's private return, she cannot be made to compensate the centralized creditor for its negative profit $\Pi_p^* - 2$. Thus the project's desirability will depend on the creditor's and entrepreneur's relative weights in the social welfare function. However, if $\Pi_p^* + E_p < 2$, then a slow project is unambiguously inefficient.

15. Poor entrepreneurs might be threatened by legal sanctions (e.g. the threat of being thrown in jail), which could have a deterrent effect. However, if these entrepreneurs are needed for the completion of the project in the second period, such threats may not be very credible.

16. As modelled, negotiation between the entrepreneur and the bank can occur only after period 1 has elapsed, i.e., after one unit of capital has already been sunk. Let us consider what would happen if regeneration were also permitted *before* the capital is sunk (but after the initial financing contract has been signed). In that case, the bank could propose returning the first period's capital unused in exchange for a fee of $E_p + \varepsilon$. A poor entrepreneur would accept this deal, whereas a good entrepreneur would not (provided that $E_p + \varepsilon < E_g$). Moreover, given our assumption that $\Pi_p^* + E_p - 2 < 0$, the bank would be better off. To rule out such a peculiar outcome, we can suppose that, in addition to good and poor projects, there is a third type that is so dreadful that refinancing is never desirable but for which the entrepreneur's payoff is positive if financed for even one period. Let us suppose that, with high probability, the quality of such a project is detected by the bank before the capital is sunk. Nevertheless if the probability is less one, dreadful entrepreneurs will still seek financing. Therefore, the bank will thwart its detection mechanism and seriously interfere with efficiency if it offers the above deal.

both decentralization and centralization, both types of projects will be financed.¹⁷ Finally, if $\Pi_p^{**} < 1 < \Pi_p^*$, refinancing is efficient under centralization but not under decentralization. Hence, a poor project will be funded in the former case but not the latter. ||

Hence, either centralization and decentralization lead to the same project selection in equilibrium,¹⁸ or else decentralization is strictly better, i.e. it selects efficiently whereas centralization is subject to a soft budget constraint.

We have been assuming that $E_t < 0 < E_p$. If $E_t > 0$, then termination does not deter a poor entrepreneur from seeking financing, and both poor and good projects are financed under either centralization or decentralization (although that is not to say that the two systems are equally efficient; see footnote 17). If $E_p < 0$, then only good projects are financed under either system.

b. Alternative Specifications

We have modeled the initial project selection as a problem of adverse selection and refinancing as one of moral hazard, but these imperfections can readily be switched around. Specifically, suppose that instead of project length being given exogenously, E can affect it through (unobservable) effort. Under centralization, B could reward the entrepreneur for early completion, but such a reward might make financing unattractive from B 's perspective. The advantage of decentralization would be to induce E to complete early without having to reward her; the threat of termination would be inducement enough. Such an alternative model should yield qualitatively very similar results. Undoubtedly, both specifications are relevant in reality.

By the same token, B_2 's informational disadvantage has been formally expressed as a problem of moral hazard but could alternatively be derived from adverse selection and collusion between E and B_1 . Let us, for example, drop B_1 's effort from the model (so that \tilde{R}_p 's distribution becomes exogenous) but also abandon the assumption that \tilde{R}_p 's realization is verifiable. Interpret B_1 's informational advantage as the ability to prove to a court that $\tilde{R}_p = \bar{R}_p$, if that equality holds. As in models of hierarchies (Tirole (1986), Kofman and Lawarrée (1993)), collusion between two parties who share some information may prevent a third party without access to that information from sharing the benefits. Here it would be in B_1 's and E 's joint interest to agree to conceal the evidence that $\tilde{R}_p = \bar{R}_p$ (putting aside the unresolved theoretical issue of how such an agreement would be enforced) in order to prevent B_2 from extracting some of the return. Hence decentralization, by giving rise to collusion, reduces the incentive to refinance poor projects, as in subsection *a*.

In our model, it is the non-transferability of information that makes multi-creditor financial arrangements problematic. But there is a related (yet informal)¹⁹ idea from the finance literature that would serve our purposes just as well: the principle that renegotiation

17. This relies on our assumption that some financing is undertaken in equilibrium. If this assumption is violated, then it is possible that no projects are financed under either system, or even that both are financed under centralization and neither under decentralization. The latter possibility is an artefact, however, of the crude way we have modelled decentralization. If the market structure is determined endogenously (as in the model of Section 3), this particular discrepancy between centralization and decentralization disappears.

18. But not necessarily the same degree of efficiency. If $\Pi_p^{**} > 1$, both centralization and decentralization select the same projects, but the former is more efficient, since $\Pi_p^* > \Pi_p^{**}$. However, this discrepancy derives from our over-simplified model of decentralization (see footnote 16). In the more satisfactory model of Section 3, centralization and decentralization are equally efficient in the case where they make the same project selection.

19. See Bolton and Scharfstein (1994) and Hart and Moore (1995) for two recent contributions that build upon this insight.

becomes more difficult to coordinate the more parties are involved. From this standpoint, having two creditors reduces the chances of refinancing because getting them to agree to it is harder.

We have endowed the creditors in both the centralized and decentralized models with the same objective: expected profit maximization. But ever since Lange and Lerner it has been common practice to have the centre in planned economy models maximize expected *social surplus*. To do so here would, in fact, only aggravate the inefficiency of centralization. To see this, recall that centralization's shortcoming is that it promotes "too much" refinancing. Now if, at the beginning of period 2, the creditor takes into account total social surplus rather than just its own profit (see footnote 14, however, for why social surplus is not unambiguously the best measure of efficiency in this model), the criterion for refinancing would become $E_p + \Pi_p^* > 1$, i.e. it would be more relaxed than before and so refinancing would occur even more readily.

3. EQUILIBRIUM IN A DECENTRALIZED CREDIT MARKET

The contracting model of the previous section is rather "microeconomic" in nature, involving a single entrepreneur and at most two creditors. For the case of centralization, assuming only a single creditor seems quite reasonable; in many centralized economies, the state has been the only significant lender. However, to equate decentralization with the existence of two banks is fairly heroic (or foolhardy). Moreover, our model leaves out two ingredients that are important features of decentralized credit markets, namely, competition among creditors and the endogenous determination of the market structure.

Thus in this section, we enrich the previous model of decentralization by assuming that there is an indefinitely large population of (identical) investors, each endowed with a small amount of capital. Thus, as in the introduction, a decentralized market is one with *diffuse ownership*, in the sense that there are many small investors. Investors, however, are allowed to *join forces* at the beginning of period 1, to form banks. Each bank has capital equal to the sum of its investors' endowments and should be viewed as a *cooperative*, i.e. as managed jointly with all members having access to the information acquired when monitoring a project. (Actually, given our risk-neutrality assumption, we could alternatively assume that joining forces entails setting up a lottery that gives each participant a chance to receive *all* the capital). But the transfer of information across banks is assumed to be impossible.

We assume that there is a population n of entrepreneurs, each drawn independently from a distribution in which there is a probability a of being good. Although n should be thought of as large, the indefinite supply of capital (which we may suppose takes the form of a liquid asset with interest rate normalized to zero) ensures that every project can in principle be financed. Operationally, this will have the effect of driving creditors' profits to zero through competition (i.e. the entrepreneur will now retain some of the observable return herself).

As for centralization, we modify the model of subsection 2a only by adopting the above assumption of n entrepreneurs and by supposing that the single creditor has enough capital to accommodate them all. The earlier analysis of equilibrium in the centralized case clearly carries over completely.

As modelled, centralization differs from decentralization in two respects: ownership of capital and transferability of information. It is this combination of attributes that generates our results. Of course, we are idealizing the quality of the flow of information within a centralized hierarchy, and our perspective is quite "un-Hayekian" in that respect.

Still this flow, however imperfect, is likely to be better than the transferability of information between separate (and competing) hierarchies (e.g. rival banks).

The timing of our modified decentralization model is as follows. At the beginning of period 1, investors can join forces to form banks (in equilibrium, not all investors need do so). An investor can contribute his capital to a bank of any "size" he chooses (because all creditors are identical and there are indefinitely many of them, he will be able to find sufficiently many other like-minded investors in equilibrium to actually form the bank). At the same time, each bank/creditor offers a set of contracts (a contract is the same as in Section 2). Entrepreneurs then choose among contracts. If more than one entrepreneur chooses the same contract, then there has to be rationing (see below). If after period 1 some projects are not yet complete, existing or new creditors can offer refinancing contracts. The affected entrepreneurs then choose among these contracts (again, possibly with some rationing).

Because everyone is risk neutral, there is no advantage to diversification *per se*, and so in equilibrium the largest creditor that need form is one with two units of capital. We shall refer to creditors with one and two units of capital²⁰ as small and large creditors, respectively.

Notice that what we are referring to as a bank's "size" is more accurately thought of as the bank's *liquidity*—how much of its assets are available to be loaned out—which may bear little relation to its literal size, i.e. *total* assets. Thus, the terms "small" and "large" creditor might more properly be relabelled "illiquid" and "liquid" creditor. (From this perspective, soft budget constraints arise in a centralized economy because the centre is too liquid, e.g. it can print money to refinance projects.)

A small creditor must invest all its capital in a single project if it is to do any financing in period 1. In this case the refinancing problem is the same as in subsection 2a.

A big creditor has two choices: it can fund a single project and keep its second unit of capital liquid, or it can finance two projects, thus sinking all its capital. Such a creditor is, respectively, denoted *diversified* or *undiversified* (the usage here is not quite standard because, as noted, ordinary diversification plays no role). A poor entrepreneur financed by a diversified creditor knows that its chance of being refinanced is the same as in the centralized model of subsection 2a. When the creditor is undiversified, however, refinancing possibilities depend on its *mix* of projects. Indeed, a poor entrepreneur financed by such a creditor is in the same situation, if the creditor's other project is also slow, as though financed by a small creditor. In this sense, lack of diversification is a *substitute* for being small. However, it is not a perfect substitute because the poor entrepreneur *can* obtain refinancing if the other project is good. (The creditor can use the return on the good project either to refinance the poor one directly or—if this return is realized too late—as collateral against a loan from another bank.)

As we have mentioned, entrepreneurs have to be rationed if more than one chooses the same financing contract. By a *rationing scheme* we mean a rule that, for any set of contracts that could be offered, specifies, for each contract in the set and each entrepreneur, the probability that the contract is assigned this entrepreneur. For our purposes, many different schemes would do. For concreteness, we concentrate on the following simple scheme:

20. Notice that it is of no value and possibly actually harmful to have strictly between one and two units of capital. To prevent refinancing from occurring, it is better to have one unit. And if refinancing *does* occur, it is better to have two.

*The Rationing Scheme:*²¹ All entrepreneurs of a given type are first allocated uniformly over the set of their favourite contracts (this reflects the attempt by an entrepreneur to choose the best contract for herself); if there are fewer entrepreneurs of a given type than favourite contracts, the entrepreneurs are allocated at random to these contracts. If only one entrepreneur is allocated to a given contract, she is *assigned* to that contract with probability one. If more than one is allocated, each has an equal chance of being assigned. At the end of this round, the procedure is repeated with all entrepreneurs and contracts not yet assigned. The process continues iteratively until either the supply of unassigned entrepreneurs or that of desirable contracts (those that are preferred to no contract at all) is exhausted.

Instead of modelling entrepreneurs' behaviour explicitly, we shall subsume it within the rationing scheme (which is applied both after the period 1 and period 2 contracts are offered). We can thus define equilibrium in terms of creditors' behaviour alone.²²

Equilibrium. An equilibrium is a configuration of creditors, each creditor's set of period 1 contracts (possibly empty), and each creditor's refinancing strategy (the period 2 contracts it offers as a function of what happened in the first period) such that, given the rationing scheme,

- (i) each creditor earns non-negative expected profit on each of its contracts (whether first or second period) given other creditors' contracts and their refinancing strategies;
- (ii) there is no other set of contracts that a creditor could offer and no other refinancing strategy that, given others' behaviour, would earn higher expected profit;
- (iii) there is no group of inactive investors (i.e. investors who do not already form a bank) who could come together to become a creditor with a set of contracts and a refinancing strategy that, given the behaviour of the already existing creditors, makes strictly positive expected profit.

We will focus on pure-strategy equilibria (where, moreover, all creditors of a given size offer the same contracts).

As in Section 2, we are interested in comparing equilibria under centralization and decentralization. Once again, the interesting case (i.e. the case where there is a significant difference) is $E_p > 0 > E_r$, and so we shall stick to this assumption. We shall also continue to assume that $E_g + R_g > 1$ (good projects are efficient), and, that $E_p + \Pi_p^* < 2$, i.e. poor projects are inefficient (but see the discussion of equilibrium efficiency after Proposition 3, where this is relaxed).

When $\Pi_p^* > 1 > \Pi_p^{**}$, we have seen that the centralized outcome entails inefficient project selection: both good and poor projects are financed. According to the simple model of Section 2, decentralization hardens the budget constraint and induces an efficient outcome in which only good projects are funded. We now observe that the same conclusion

21. We ignore the issue of strategic behaviour on the part of entrepreneurs, i.e. the possibility that an entrepreneur will choose a less favoured contract because she has a better chance of being assigned it. However, with enough uncertainty about who the other entrepreneurs are, etc., such behaviour would not be optimal in any case.

22. Actually, it is investors, rather than creditors, who are the basic decision-making units. We find it too cumbersome, however, to define equilibrium in terms of investor behaviour. Whichever way one does it, the "natural" notion of equilibrium is not entirely clear. This is because if an investor contemplates joining a bank of a given size he must compare the corresponding payoff with what he would get if he joined some other bank. But what is he to suppose happens to the first bank if he does not join it? (The answer may well be relevant to his payoff.) That it finds a replacement for him? That it does not form at all? Implicitly, our definition of equilibrium adopts the former hypothesis.

obtains for our more elaborate model (Proposition 2 shows that an equilibrium with this hardening feature exists, and Proposition 3 demonstrates that it is essentially unique). Basically, this is because creditors would like to avoid financing poor projects. Hence, whether or not there is competition among them, they will extract all the observable surplus from such projects. And so, even in this more elaborate model, the condition $\Pi_p^* > 1 > \Pi_p^{**}$ continues to imply that refinancing will occur with big creditors but not small.

Proposition 2. *Suppose $\Pi_p^* > 1 > \Pi_p^{**}$. There exists an equilibrium in which each of $n+1$ or more small (one-unit) creditors offers a first-period contract that just breaks even on good entrepreneurs. No big creditors (two or more units) offer first-period contracts.*

Proof. Each of these small creditors earns zero profit because it breaks even on good entrepreneurs and does not attract poor entrepreneurs (since they cannot be refinanced). Moreover, none of these creditors could make positive profit by deviating because any contract that earned positive profit on good entrepreneurs would not (in view of the rationing scheme) be allocated any of them since there are enough other small creditors (that is, at least n) offering more favourable terms to accommodate all good entrepreneurs. Finally, no new creditor can enter and make positive profit: it cannot make money on good entrepreneurs for the reason just given, and if it attracted poor entrepreneurs (which would require that it consist of two or more units since $\Pi_p^* > 1 > \Pi_p^{**}$), it would lose money on them since $\Pi_p^* < 2$. \parallel

Proposition 3. *If $\Pi_p^* > 1 > \Pi_p^{**}$, then the only equilibrium is that described in Proposition 2.²³*

Proof. We first show that there cannot be an equilibrium in which a big creditor offers any first-period contracts. If there were such contracts in equilibrium, then there would be one to which a poor entrepreneur is assigned with positive probability. (A poor entrepreneur can earn a positive return only from big creditors, contracts because, since $\Pi_p^* > 1 > \Pi_p^{**}$, only these are refinanced. Indeed, if such a contract is refinanced, the entrepreneur's return is certainly positive. This will be the case when the big creditor is diversified, but also when undiversified provided that the other project financed is good. Thus, it cannot be the case that every big creditor contract is assigned only good entrepreneurs.) Of the contracts that are assigned poor entrepreneurs with positive probability, let c^0 be the one that gives poor entrepreneurs the best terms. Contract c^0 earns a negative return on poor entrepreneurs (since $\Pi_p^* < 2$), and so, in order to earn a non-negative return over all, it must earn a strictly positive return on good entrepreneurs and be assigned them with positive probability. Suppose that a group of investors who are inactive in equilibrium come together as a small creditor and offer a contract c^{00} with slightly more favourable terms for good entrepreneurs than c^0 (i.e. the contract c^{00} slightly "undercuts" c^0). This contract c^{00} must be assigned good entrepreneurs. But because it is not refinanced (since $\Pi_p^{**} < 1$) it will not be assigned poor entrepreneurs. Therefore, it makes positive profit overall, a contradiction. We conclude that big creditors cannot offer first-period contracts in equilibrium.

23. Actually, Proposition 2 describes a *multiplicity* of equilibria in which the number of active creditors can vary as long as it exceeds $n+1$. However, this sort of non-uniqueness is clearly not essential.

We next observe that the only contract that is accepted with positive probability in equilibrium is the break-even contract for good entrepreneurs. A contract that offered more favourable terms to good entrepreneurs would lose money, and a less favourable contract would make positive profit and so induce entry and slight undercutting as above.

Finally, there must be at least $n+1$ small creditors offering the break-even contract in equilibrium. Otherwise, a small creditor could enter and offer a contract that, if assigned to a good entrepreneur, would make a profit (and also would be preferred by the entrepreneur to no contract at all). Because there are fewer than n other small creditors, there would be a positive probability that not all good entrepreneurs could find financing elsewhere and therefore would be assigned this contract. ||

The proof of Proposition 3 is somewhat involved, but the idea that underlies it is very simple: If $\Pi_p^* > 1 > \Pi_p^{**}$, then small creditors have the advantage over their big counterparts of not attracting poor entrepreneurs. Thus they are more efficient and so, in equilibrium with free entry, drive the big creditors out of the market.

We have been considering the case in which $E_p + \Pi_p^* < 2$. If instead this inequality goes the other way (but all other inequalities remain the same, in particular $\Pi_p^* < 2$), then, according to the criterion of social surplus, slow projects are efficient (see footnote 14, however, for why social surplus may not be the right criterion). Nonetheless, Propositions 2 and 3 continue to hold. That is, only good projects are financed under decentralization. This follows because creditors ignore the entrepreneurs' private benefits in deciding whether or not to fund a project, and suggests that there may be an excessive tendency in decentralized credit markets to focus on short-term (i.e. one-period) projects (because banks are too illiquid to make efficient loans). For a less ambiguous illustration of this tendency (one that does not rely on this questionable measure of efficiency), see the next section.

In the case $\Pi_p^* > 1 > \Pi_p^{**}$, the market outcome reproduces the features of the decentralized model of subsection 2a. When $\Pi_p^{**} > 1$, matters are more complicated because both types of entrepreneurs will be financed regardless of the size of creditors. A potential problem of non-existence of equilibrium may arise if a creditor is able to affect its mix of entrepreneurs (the relative probabilities of good and poor entrepreneurs choosing its contracts) sharply by slightly changing the terms it offers. Such a problem is similar to those arising in insurance models à la Rothschild–Stiglitz (1976) and Wilson (1977). To avoid all this, we introduce the following mild assumption:

Assumption A. Slow entrepreneurs have an (arbitrarily) small probability of completing their projects in one period.

This assumption limits the effect that improving the terms offered to good entrepreneurs has on a creditor's mix of entrepreneurs; any improvement will be attractive to poor as well as to good entrepreneurs. Assumption A enables us to derive the following result:

Proposition 4. *Let $\Pi_p^{**} > 1$, Under Assumption A, there is a unique equilibrium (where uniqueness is qualified the same way as in Proposition 3) in which (i) only big creditors are active in the market, and (ii) at least $n+1$ of them offer contracts that break even on average across good and poor projects and that extract the entire observable return from poor projects.*

Proof. We will show that the behaviour described constitutes an equilibrium. Uniqueness can be established as in the proof of Proposition 3. Clearly, it is not optimal

to leave any observable return to poor entrepreneurs: a creditor would only improve its mix of entrepreneurs by lowering the return offered to poor ones. Under Assumption A, however, a creditor cannot improve its mix by offering better terms to good entrepreneurs, since such improvement would attract all the poor entrepreneurs as well. Therefore, if at least n other big creditors offer break-even contracts as described in the proposition, a big creditor can do no better than to follow suit.

As for small creditors, they cannot avoid attracting poor as well as good entrepreneurs since $\Pi_p^{**} > 1$. However, they are less efficient in monitoring poor projects than are big creditors. Thus if the latter creditors break even, the former lose money. ||

Thus, in this model, a decentralized market leads to efficient creditor liquidity. When neither large nor small creditors can commit not to refinance poor entrepreneurs, large creditors are more efficient because they have the incentive to provide better monitoring. Therefore, they drive small creditors out of the market.

4. DECENTRALIZATION AND SHORT-TERMISM

We now introduce a third project: a two-period but *very profitable* undertaking denoted by the subscript v . This project requires one unit of capital per period and generates a return $R_v > 2$ after two periods. For simplicity, we suppose that R_v is deterministic and does not require monitoring. A good entrepreneur can choose between a good or very profitable project (poor entrepreneurs are stuck with poor projects), but her choice is unobservable.²⁴ Moreover, poor and very profitable projects are indistinguishable to creditors at the end of period 1.²⁵ A good entrepreneur's private benefit from a very profitable project is E_r (if the project is terminated after one period) or E_v (if the project is completed). We adopt the natural assumption that $E_v \geq E_p$.

The timing is much the same as that of Section 3. But we now must insert the choice between good and very profitable contracts, which we assume is made at the same time as creditors offer contracts. A creditor's monitoring intensity depends on its beliefs in period 1 about project quality. Specifically, a large creditor will expend effort $a^*(\alpha')$ such that $(1 - \alpha')\bar{R}_p = \psi'(a^*(\alpha'))$ if it believes that α' is the probability, the project is very profitable and $1 - \alpha'$ is the probability it is poor. Note that if $\alpha' = 0$, the model reduces to that of Section 3. Hence $a^*(0) = a^*$, and the financial return (gross of capital) is Π_p^* . Similarly, for a small creditor, we define $a^{**}(\alpha')$, and obtain $a^{**}(0) = a^{**}$, which generates gross financial return Π_p^{**} . Refinancing decisions clearly also depend on α' . Pessimistic beliefs (i.e. low values of α') lead to *short-termism*—i.e. the choice of good over very profitable projects—because good entrepreneurs forecast that long-term projects will not be refinanced:

Proposition 5. *If $\Pi_p^{**} < 1$ there exists an equilibrium in which only small creditors are active and only good projects are chosen.*²⁶

24. We thank Ian Jewitt for suggesting that we replace our earlier adverse selection treatment of very profitable long-run projects with the current moral hazard formulation.

25. To simplify analysis, however, we suppose that these projects are distinguishable at the end of period 2.

26. As the model stands, this result depends to some extent on the timing. If good entrepreneurs choose projects before creditors move, nothing is changed since the entrepreneurs' decisions are unobservable anyway. But if the creditors move first, then a group of investors might form a bank so big that good entrepreneurs are encouraged to choose very profitable projects. Still, the bank may have to be very big indeed—big enough to accommodate a large fraction of all entrepreneurs—otherwise, a good entrepreneur may face too high a risk of not being assigned to one of this bank's contracts if she chooses the very good project. Thus, if there are reasonable limits on creditor size/liquidity, our results should not be very sensitive to timing after all.

Proof. Suppose that $n+1$ or more small creditors are active (and no other creditors are) and offer the contract that breaks even on good projects. Suppose, furthermore, that creditors believe that, if a project has to be refinanced, then with high probability it is poor. Under these circumstances, all good entrepreneurs will choose good projects, since $\Pi_p^{**} < 1$ and the creditors' pessimistic beliefs together imply that two-period projects will not be refinanced. Hence the creditors' beliefs are justified. Now, a small creditor clearly cannot do better than break even. Suppose then that a big creditor enters. It will attract *all* the poor entrepreneurs and only its share of good projects. But since the former are unprofitable ($\Pi_p^* < 2$), the creditor will lose money on average. ||

The equilibrium of Proposition 5 can be highly inefficient. As in Section 2, let α be the fraction of entrepreneurs who are good. Notice that the Proposition 5 equilibrium exists no matter how close α is to 1. However if R_v is big, then, for α near 1, it is clearly better from a social standpoint to put up with poor projects for the sake of the very good ones. Indeed, for big enough R_v , there exists another and more efficient equilibrium, provided that α is sufficiently near 1. If $E_v = E_g$, the precise condition we require for existence of this other equilibrium is

$$\alpha R_v + (1 - \alpha)a^*(\alpha)\bar{R}_p - \psi(a^*(\alpha)) - 2 > \alpha(R_g - 1). \quad (*)$$

Condition (*) implies that if all good entrepreneurs choose very profitable projects, big creditors can offer them better terms than on good projects, while still breaking even. In such a case, creditors' *optimistic* expectations are self-fulfilling.

Proposition 6. *Suppose that $\Pi_p^{**} < 1$, $E_v = E_g$, and (*) is satisfied. Then there exists an equilibrium in which only big creditors form and all good entrepreneurs select very profitable projects.*

Proof. Suppose that there are at least $n+1$ big creditors and each offers the contract \hat{c} , which gives the entrepreneur nothing (except her private return) if the project turns out to be poor, T_v if the project is very profitable, and T_g if the project is good where

$$\alpha(R_v - T_v) + (1 - \alpha)a^*(\alpha)\bar{R}_p - \psi(a^*(\alpha)) - 2 = 0 \quad (1)$$

and

$$R_g - 1 - T_g = 0. \quad (2)$$

From (1), \hat{c} just breaks even if creditors' beliefs that all good entrepreneurs choose very profitable projects are correct. Now, good entrepreneurs will choose these projects provided that

$$E_v + T_v > E_g + T_g. \quad (3)$$

From (1) and (2) and because $E_v = E_g$, (3) can be rewritten as

$$\alpha R_v + (1 - \alpha)\Pi_p^* - 2 > \alpha(R_g - 1),$$

which is just (*). Hence, good entrepreneurs will select very profitable projects as claimed. The arguments that no big creditor can do better by deviating and that any creditor can profit from entering are the same as in the proof of Proposition 4. ||

Propositions 5 and 6 imply that the same economy may end up in two quite different equilibria. In the equilibrium of Proposition 5, creditors are small and projects are short-term. In that of Proposition 6, creditors are big and projects are long-term. Note that,

even ignoring entrepreneurs' private benefits, (*) implies that the latter equilibrium is more efficient. Including the private benefits only aggravates the discrepancy (it would entail adding $(1 - \alpha)E_p$ to the left-hand side of (*)). Indeed, the equilibrium of Proposition 6 Pareto-dominates that of Proposition 5.

To conclude, let us note that Propositions 5 and 6 have some connection with those of von Thadden (1995). Von Thadden argues that a commitment not to refinance projects may be an optimal screening device for creditors facing an adverse selection problem, even though it can induce short-termism on the part of good entrepreneurs. Although the set of technological opportunities available to entrepreneurs and the initial asymmetry of information in his paper are similar to those in our model, von Thadden takes a different perspective, since he does not explicitly address ex post incentives to refinance or the role of creditor liquidity. Rather, he concentrates on a one-creditor problem. In his model, bank finance can reduce short-termism thanks to economies of scale (à la Diamond (1984)), which make direct inspection of project types profitable.

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