Informal Finance: A Theory of Moneylenders

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Abstract

This paper argues that weak legal institutions, in particular poor creditor protection, explain the coexistence of formal and informal financial sectors in developing credit markets. Informal finance emerges as a response to the formal sector's inability to perfectly enforce its claims. Within this framework, the theory rationalizes why entrepreneurs employ multiple lenders, why entrepreneurial and informal sector assets are either complements or substitutes, and suggests that an unequal wealth distribution promotes investment in poor societies.

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1 Introduction

A common characteristic of developing credit markets–credit markets with weak legal institutions–is the coexistence of formal and informal financial sectors. Informal sector transactions, such as loans made by professional moneylenders, traders, neighbors and family, exceed their formal counterpart in many of the world's developing financial markets and entrepreneurs often obtain finance from both sectors. The informal sector accounts for between one third and three quarters of total credit in parts of Asia (Germidis et al., 1991, Ghate et al., 1992, and Montiel et al., 1993), and it also provides more credit and attracts larger volumes of savings than the formal sector in sub-Saharan Africa (Nissanke and Aryeetey, 1998).[1]

The observed diversity raises a number of issues. First, why do entrepreneurs resort to multiple lenders in developing credit markets? Second, is there a causal link between institutional development and informal lending? If so, precisely what is the connection? A third important question concerns the relation between investment and the distribution of income. Should assets be allocated equally across credit markets participants, as proposed in recent growth models (Banerjee and Newman, 1993, and Galor and Zeira, 1993), or is wealth concentration more efficient, in the tradition of Kuznets (1955)?

Following recent work on the effect of institutions on economic performance (La Porta et al., 1997, 1998), I view legal protection of creditors as essential in ensuring availability of credit.[2] In what follows, decreased creditor vulnerability is thus synonymous with institutional development. To address my questions in a systematic fashion, I construct a model in which credit rationing is a result of creditor vulnerability in the formal sector. In contrast, the informal sector is assumed able to prevent borrowers from behaving opportunistically. Informal lenders offer credit to a group of known clients within a small community, where strong social ties and social sanctions prevent borrowers from deliberately misusing their loan.[3] However, informal lenders themselves have limited resources and often face the same kind of credit rationing in the formal sector, as do their customers. The challenge is thus to model how the interplay between these constraints define the pattern of lending from formal lenders to final borrowers

[1] For example, in rural Thailand the percentage share of informal to total lending was about 30 percent, Giné (2001), in Pakistan 78 percent, Irfan et al. (1999), in Malawi 75 percent, and in Ghana 55 percent, Nissanke and Aryeetey (1998).

[2] By legal protection of creditors I mean legal rules, functioning law enforcement bodies, and supportive political institutions, not merely "law on the books".

[3] For evidence of the highly personal character of informal lending, see e.g. for Africa: La Ferrara (2003), Nissanke and Aryeetey (2000), Steel et al. (1997), and Udry (1990); for Asia: Aleem (1993), Bell (1993), and Ghate et al. (1992). See also Banerjee, Besley and Guinnane (1994) and Besley, Coate and Loury (1993) for theoretical work on rotating savings and credit associations stressing the importance of social sanctions, similarly, Anderson, Baland and Moene (2003) and Karlan (2004) for empirical evidence. Note that my aim is not to explain informal lenders superior ability to prevent opportunistic behavior, but to understand its implications as Besley and Coate (1995).

(entrepreneurs), from formal to informal lenders, and from informal lenders to entrepreneurs.

For a given level of institutional development the theory rationalizes why entrepreneurs borrow from multiple lenders. In the model, each entrepreneur will utilize the maximum amount of formal funds extended to her since the supply of formal credit gives her a stronger bargaining position with the informal lender.[4] As wealth declines, the moral hazard problem with the formal lender accentuates and she will gradually increase the borrowing from the informal lender, despite a deteriorating bargaining position. Hence, in this framework all but the wealthiest entrepreneurs resort to both the formal and informal financial sector. These predictions are consistent with empirical evidence provided by Bell, Srinivasan and Udry (1997), Conning (2001), Ghate et al. (1992) and Giné (2001).

The theory also establishes that entrepreneurial and informal lender assets are complements for low levels of wealth and substitutes when informal assets increase. Intuitively, when neither the informal lender nor the entrepreneur is affluent enough such that first-best investment is realized, the two complement each other in drawing on formal sector funds. If the informal lender's debt capacity does not constrain investment, the entrepreneur's preference for formal funds implies that she substitutes away from informal to formal funds. Equivalently, formal and informal lenders complement each other in providing external finance for low levels of wealth, while acting as substitutes when the informal sector is wealthier.

With sufficiently improved institutions, the model further predicts that informal finance will become obsolete. For low levels of creditor vulnerability, entrepreneurs borrow exclusively from the formal sector. Indeed, the share of informal to total intermediation decreases as the legal protection of creditors improves. These predictions, unique to the present model, would explain why informal lending is virtually non-existent in developed credit markets with well functioning creditor protection, while prominent in developing markets.

The paper also contributes to the ongoing debate of how to allocate wealth across credit market participants. For low levels of wealth I show that resource allocation improves when the informal sector holds relatively more assets. If one entrepreneur and one lender interact it does not matter whether the entrepreneur or the informal lender holds the wealth–the same level of investment will be achieved. However, the main difference between lenders and entrepreneurs stems from the difference in technology endowments; while entrepreneurs' production technology applies to one project,

[4] This differs from other theories of multiple lending. For example, in Bolton and Scharfstein (1996), Dewatripont and Tirole (1994), and Berglöf and von Thadden (1994), the optimal contract distributes the project claims in such a way as to avoid strategic default, while also preventing costly liquidation of the firm (the latter two, like the present paper, study multiple lending with different claims, while Bolton and Scharfstein focus on multiple lending with similar claims).

lenders' enforcement technology is applicable to many entrepreneurs. This has two implications. Reallocating wealth from entrepreneurs to lenders facilitates higher investment as lenders interact with multiple entrepreneurs. In addition, if lending to multiple entrepreneurs entails repeated interactions with the formal sector, the informal sector has more to lose from default. This potential loss reduces the informal lenders incentive to behave opportunistically, enabling the formal sector to extend funds more generously. The significance of the informal sector's assets underscores the importance of wealth concentration over an equal distribution of income when markets are underdeveloped, an idea that dates back to Kaldor (1956), Kuznets (1955), and Lewis (1954). My conclusion differs from recent dynamic growth models that emphasize the negative effects of inequality on growth (see Banerjee and Newman, 1993, and Galor and Zeira, 1993).[5] Whereas this literature emphasizes the effects of formal sector credit rationing on entrepreneurs, it does not consider the importance of informal sector assets.

Increasing the informal sector's share of total intermediation further improves investment. Intuitively, when entrepreneurs are poor, more assets in the formal sector does not increase the external financing available to entrepreneurs as this induces opportunistic behavior. Increasing the assets of the informal sector however leaves more financing available, given the informal sector's ability to prevent entrepreneurs from misusing the funds.

The model's findings offer two important policy conclusions. First of all, better functioning institutions improves efficiency and eases access to formal sector financing. Given that institutional deficiency is difficult to affect in the short-run however, the removal of restrictions prohibiting lending for interest, or preventing too high interest rates, will allow the informal sector to accumulate wealth to be used in multiple projects and in attracting more formal capital. Secondly, more liquidity in the financial system is not a good thing per se. If the bottleneck is the scarce resources of the informal sector, a mobilization of domestic savings for example will not necessarily translate into more funds invested.

Finally, previous theoretical work modeling formal and informal financial sector linkages has either seen the informal lender as a formal sector competitor (Bell et al., 1997; Conning, 2001; Jain, 1999) or as a channel of formal funds (Bose, 1998; Floro and Ray, 1997; Hoff and Stiglitz, 1998).[6] While each contribution captures important aspects of how the two sectors interact, they do not address the potential agency problem between the informal lender and the formal sector, indeed an important short-coming

[5] See also Aghion and Bolton (1997), Mookherjee and Ray (2002), and Piketty (1997).

[6] Given Jain's focus on multiple lending, his contribution is perhaps closest in spirit to mine. Although he recognizes the importance of legal protection of creditors, he assumes perfect enforcement. Also, his formal sector is able to condition its lending on the informal sector's contract with the entrepreneurs to benefit from their (in his paper assumed) informational advantage. Giné (2001) empirically invalidates this assumption in his study on informal and formal lenders in Thailand.

given the observation of the informal sector itself being a formal borrower.[7] I attempt to accommodate for this limitation by providing a more unified framework, allowing for lending and competition between the two sectors to arise endogenously, taking into account that there exist enforcement problems between the formal and the informal lender, as well as the formal lender and the entrepreneur.

The model builds on Burkart and Ellingsen's (2004) analysis of trade credit in a perfectly competitive banking and input supplier market.[8] The bank and the entrepreneur in their model are analogous to the formal lender and the entrepreneur in my setting. However, their input supplier and my informal lender differ substantially. While the input supplier (and the bank) offers a simple debt contract, the informal lender offers a more sophisticated project-specific contract, where the investment and the subsequent repayment are determined using the Nash Bargaining Solution. More importantly, the informal lender is assumed able to ensure that investment is guaranteed, something that the trade creditor is unable to.

In the section that follows I introduce the model. Section 3 discusses equilibrium outcomes. Section 4 examines the link between institutions and informal lending. Section 5 analyzes the effect of different wealth distributions on investment. Section 6 considers extensions of the model and concludes.

2 Model

Consider a credit market consisting of entrepreneurs, banks (formal finance) and moneylenders (informal finance). The entrepreneur is risk neutral and endowed with an observable wealth $\omega_E \geq 0$. She has access to a deterministic production function $Q(I)$, where I is the investment volume. The production function is assumed concave and twice continuously differentiable. While investments are unverifiable to the banks–the source of the potential agency problem–the outcome of the project may be verified. To ensure the existence of an interior solution it is assumed that $Q(0) = 0$ and $Q'(0) = \infty$. In a perfect credit market with interest rate r, the entrepreneur would like to invest enough to attain the first-best level of investments given by $Q'(I^*) = 1 + r$.[9] The entrepreneur lacks sufficient capital to realize this level, $\omega_E < I^*(r)$, and is thus forced to resort to the bank and/or the moneylender for the remaining funds.

The moneylender is risk neutral and endowed with an observable wealth $\omega_M \geq 0$. To capture the moneylender's superior ability in ensuring investments, the lender is

[7] See Aleem (1993), Ghate et al. (1992), Hoff and Stiglitz (1993), and Siamwalla et al. (1993).

[8] Burkart and Ellingsen's theory is based on the notion that it is less profitable for the borrower to divert inputs than to divert cash. Thus, input suppliers may lend when banks are limited due to potential agency problems.

[9] The output price, p, is normalized to one.

assumed to be a monopolist.[10] For simplicity her occupational choice is restricted to lending.[11] A contract between the moneylender and the entrepreneur is given by a pair $(B, R) \in \mathbb{R}^2_+$, where B is the amount borrowed by the entrepreneur and R is the repayment obligation. The contract terms are settled in a bilateral bargain, given by the generalized Nash Bargaining Solution. Assume for now that $R(B)$ is a primitive that shares the same properties as the production function.[12] In line with the reasoning outlined above the moneylender ensures that the entrepreneur invests the loan extended to her.[13] Finally, if the moneylender requires additional funding she turns to the bank for extra funds.

The bank is perfectly competitive and has access to unlimited funds at a constant unit cost ρ. I assume that borrowers cannot commit to investing bank funds, and that diversion of funds yields private benefits. With diversion I denote any activity that is less productive than investment or lending, for example, using the loan for consumption or financial saving. The actual diversion activity yields $\phi < 1$ of benefit for every unit diverted. The entrepreneur's trade-off may be depicted as follows:[14] either she invests, in which case she realizes the net benefit of production after repaying the bank (and possibly the moneylender), or she profits directly from diverting the bank's funds (the entrepreneur will still have to pay the moneylender if she has borrowed from her). If the entrepreneur decides to divert partially, the remaining amount will have to be repaid in full. The bank is assumed not derive any benefit from assets that are diverted. When ϕ is equal to zero, the legal protection of creditors is perfect and there is no agency problem. To make the problem interesting, assume that

$$\phi > \underline{\phi} \equiv \frac{Q\left(I^*\left(r\right)\right) - \left(1+r\right)\left(I^*\left(r\right) - \omega_E\right)}{I^*\left(r\right)}. \tag{1}$$

In words, the marginal benefit of diversion yields higher utility than the average rate of return to a first-best investment. Finally, the bank offers the contract (L, D), where L is the loan, and D the amount to be repaid. Without loss of generality I focus on contracts of the form $\{(L, (1+r)L)\}_{L \leq \bar{L}}$, where $\bar{L}$ specifies the credit limit of funds extended by the bank at a constant interest rate r.[15] The contract implies that a borrower may withdraw any amount of funds until the bank credit limit binds. To keep things simple

[10] The assumption of exclusivity is also in line with empirical evidence, see Aleem, 1993, and Siamwalla et al., 1993.

[11] Additional sources of income would not alter the main insights of the model, see Section 6 for a discussion.

[12] Any simple sharing rule would do as long as the payment is increasing (decreasing) in the moneylender's (entrepreneur's) outside option.

[13] The results continue to hold when introducing a monitoring cost k to ensure investments, see Section 6 for a discussion.

[14] The moneylender's trade-off is similar with the investment activity replaced by lending her own and the bank's funds to the entrepreneur.

[15] Burkart and Ellingsen (2004) shows that $\{(L, (1+r)L)\}_{L \leq \bar{L}}$ constitutes an optimal contract.

the borrowers only borrow from one bank at a time. Competitive pressures drive the bank's rents down to zero and she earns a value equal to the constant opportunity cost of funds, ρ. Hence, the lenders differ on two accounts: While the bank cannot ensure that investments actually take place, the moneylender is able to control the entrepreneur's use of the funds. Importantly, the bank has access to unlimited funds while the moneylender may be credit constrained.

As a bank loan is the entrepreneur's outside option in her bargaining with the moneylender, it is optimal for the entrepreneur to visit the bank before turning to the moneylender.[16] After viewing both contract offers the entrepreneur decides how much to borrow and from whom. Likewise, the moneylender also considers the bank contract (if wealth constrained) before bargaining with the entrepreneur. The timing may be depicted as follows.[17]

1. The bank offers a contract to the entrepreneur and the moneylender, specifying the credit limits, $\bar{L}_E$ and $\bar{L}_M$, respectively.
2. The entrepreneur decides how much she wants to borrow from the moneylender, B, and they bargain over the repayment, R.
3. The moneylender makes her lending/diversion decision.
4. The entrepreneur makes her investment/diversion decision.
5. Repayments are made.

3 Equilibrium Outcomes

I solve for the subgame perfect equilibrium outcome and begin with the entrepreneur. If wealth constrained, she chooses the amount of bank funds to invest, I_B, and the amount of credit, L_E, to maximize

$$U_E = \max\left\{0, Q\left(I_B + B\right) - \left(1 + r\right) L_E - R\right\} + \phi(\omega_E + L_E - I_B), \tag{2}$$

subject to

$$\begin{aligned} \omega_E + L_E &\geq I_B, \\ \bar{L}_E &\geq L_E. \end{aligned}$$

The first part of expression (2) shows the profit from investing. The second part denotes the profit from diversion. The full expression is maximised subject to available funds

[16] The timing is also empirically supported by Bell, Srinivasan and Udry (1997).

[17] In line with empirical findings provided by Giné (2001), it is assumed that the bank is unable to condition the loan on the moneylender's contract offer to the entrepreneur.

and the credit limit posted by the bank. Note that B, the amount borrowed from the moneylender, is free from potential opportunistic behavior on part of the entrepreneur. It can be shown that the choice is essentially binary; either the entrepreneur chooses to invest all the money or she diverts the maximum possible. Partial lending or diversion is not optimal, since if the entrepreneur chooses to invest some money this yields at least $1+r$ on every dollar invested, while diversion only leaves her with ϕ. The entrepreneur will not be tempted to behave opportunistically if the contract satisfies the incentive constraint

$$Q\left(\omega_E + L_E^u + B\right) - \left(1+r\right) L_E^u - R \geq \phi\left(\omega_E + \bar{L}_E\right), \tag{3}$$

where $L_E^u = \min\left\{\left(I^*\left(r\right) - \omega_E - B, \bar{L}_E\right)\right\}$. In other words, either the entrepreneur borrows and invests such that the first-best level of investments is achieved or she exhausts the maximum credit line extended by the bank.

Similarly, the moneylender chooses the amount to lend to the entrepreneur, B, and the amount of credit, L_M, to maximize

$$U_M = \max\left\{0, R(B) - \left(1+r\right) L_M\right\} + \phi(\omega_M + L_M - B),$$

subject to

$$\begin{aligned} \omega_M + L_M &\geq B, \\ \bar{L}_M &\geq L_M. \end{aligned}$$

The outcome is analogous to the one of the entrepreneur, yielding the critical incentive constraint

$$R(B) - \left(1+r\right) L_M^u \geq \phi\left(\omega_M + \bar{L}_M\right), \tag{4}$$

where $L_M^u = \min\left\{\left(I^*\left(r\right) - \omega_M - \omega_E - L_E^u, \bar{L}_M\right)\right\}$.

So far the repayment function has been considered a primitive; it remains to determine its actual form, as shaped by Nash Bargaining. The entrepreneur's inside option is given by the net benefit of investing the funds extended from the bank and the moneylender, while her outside option is the residual return from investing the bank funds alone. The moneylender's inside option is the repayment less the cost of borrowing the money from the bank, while the outside option is the utility from diverting all the funds. The entrepreneur's bargaining power $\alpha \in (0,1)$ is assumed to be an exogenous representation of the market power of moneylenders.[18] The equilibrium repayment is given by

$$\begin{aligned} \max_{\{R\}} &\left[Q\left(I\right) - \left(1+r\right) L_E^u - R - \left(Q\left(\omega_E + L_E^u\right) - \left(1+r\right) L_E^u\right)\right]^{\alpha} \\ &\times \left[R - \left(1+r\right) L_M^u - \phi\left(\omega_M + \bar{L}_M\right)\right]^{1-\alpha}. \end{aligned} \tag{5}$$

[18] The outside option of the entrepreneur is given by borrowing from the bank alone. The reason is that the relationship with the moneylender builds on exclusivity. See Binmore, Shaked and Sutton (1989), and Sutton (1986), for work where the outside option implies breaking up the current relationship.

The investment level with credit extended by the bank and the moneylender equals $I = \omega_E + L_E^u + B = \omega_E + L_E^u + \omega_M + L_M^u$, while the stand-alone investment level utilizing bank funds is given by $\omega_E + L_E^u$. The bargaining outcome solving (5) is

$$R^* = (1-\alpha)\left(Q\left(I\right) - Q\left(\omega_E + L_E^u\right)\right) + \alpha\left(\left(1+r\right)L_M^u + \phi\left(\omega_M + \bar{L}_M\right)\right).^{19} \qquad (6)$$

Finally, the perfectly competitive bank market yields the equilibrium zero profit interest rate of ρ.

Proposition 1 *There are wealth thresholds, $\hat{\omega}_E\left(r,\phi\right) > 0$ and $\hat{\omega}_M\left(\omega_E, r, \phi\right) > 0$, such that:*

(i) If $\omega_E < \hat{\omega}_E$ and $\omega_M < \hat{\omega}_M$: Then investment is credit constrained ($I < I^*\left(r\right)$); the entrepreneur borrows from both a bank and a moneylender, and this moneylender borrows from a bank.

(ii) If $\omega_E < \hat{\omega}_E$, $\omega_M \geq \hat{\omega}_M$, and $\omega_E + \omega_M < I^*\left(r\right)$: Then the first-best level is invested ($I = I^*\left(r\right)$); the entrepreneur borrows from both a bank and a moneylender, and this moneylender borrows from a bank.

(iii) If $\omega_E < \hat{\omega}_E$, $\omega_M \geq \hat{\omega}_M$, and $\omega_E + \omega_M < I^*\left(r\right)$ or $\omega_E + \omega_M \geq I^*\left(r\right)$: Then the first-best level is invested ($I = I^*\left(r\right)$); the entrepreneur borrows from both a bank and a moneylender, and this moneylender does not borrow from a bank.

(iv) If $\omega_E \geq \hat{\omega}_E$: Then the first-best level is invested ($I = I^*\left(r\right)$); and the entrepreneur borrows from a bank exclusively.

The intuition for Proposition 1 runs as follows (for a complete proof, see Appendix). When the entrepreneur borrows from both lenders, she prefers utilizing the maximum amount of bank funding. This choice increases the entrepreneur's outside option, thus keeping the repayment to the moneylender at a minimum. Consequently, the entrepreneur will always exhaust her bank credit line as long as she interacts with both lenders (Figure 1 depicts the different outcomes). Specifically, for low levels of wealth, $\omega_E < \hat{\omega}_E$ and $\omega_M < \hat{\omega}_M$, the entrepreneur and the moneylender will be credit rationed by the bank. Here the temptation to divert for each of them is too strong to permit a first-best investment. In this situation the entrepreneur borrows the maximum amount available to her from both the formal and informal sector. This option dominates borrowing from the bank or moneylender alone as this would yield lower investments.[20] Hence,

[19] R^* always satisfies the incentive constraints of the entrepreneur and the moneylender.

[20] I assume that the entrepreneur prefers higher investment for the same level of utility, and one lender over two lenders for the same level of utility and investment.

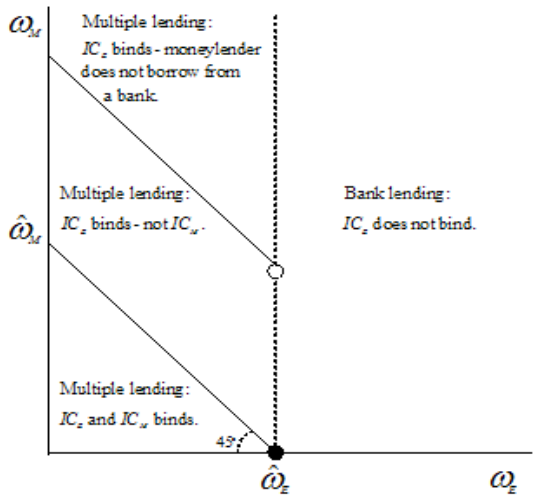

Figure 1: Lender Constellations and Wealth Thresholds.

the credit limits will be given by the following binding constraints of the entrepreneur and the moneylender (accounting for the outcome of the bargaining):

$$\begin{aligned} \alpha Q\left(I\right)+\left(1-\alpha\right)Q\left(\omega_E+\bar{L}_E\right)-\left(1+r\right)\bar{L}_E-\alpha\left(1+r\right)\bar{L}_M- \\ -\alpha\phi\left(\omega_M+\bar{L}_M\right)-\phi\left(\omega_E+\bar{L}_E\right)=0, \end{aligned} \tag{7}$$

and

$$Q\left(I\right)-Q\left(\omega_E+\bar{L}_E\right)-\left(1+r\right)\bar{L}_M-\phi\left(\omega_M+\bar{L}_M\right)=0, \tag{8}$$

with $I=\omega_E+\bar{L}_E+\omega_M+\bar{L}_M$. For higher levels of moneylender wealth, $\omega_M\geq\hat{\omega}_M$ and $\omega_E+\omega_M<I^*\left(r\right)$, the informal lender's credit limit no longer binds and she is able to borrow and lend enough such that the first-best level of investment is achieved. In this equilibrium, the entrepreneur's credit limit is still given by equation (7), while the moneylender's credit line is determined by

$$Q'\left(I\right)-\left(1+r\right)=0. \tag{9}$$

That is, the equation $I^*\left(r\right)=\omega_E+\bar{L}_E+\omega_M+L_M$ determines L_M.

When the moneylender is wealthy enough for first-best investment to be attainable without the moneylender borrowing from the bank, $\omega_M\geq\hat{\omega}_M$, $\omega_E+\omega_M<I^*\left(r\right)$ or $\omega_E+\omega_M\geq I^*\left(r\right)$, the entrepreneur's incentive constraint yields

$$\alpha Q\left(I^*\left(r\right)\right)+\left(1-\alpha\right)Q\left(\omega_E+\bar{L}_E\right)-\left(1+r\right)\bar{L}_E-\alpha\left(1+r\right)B=\phi\left(\omega_E+\bar{L}_E\right), \tag{10}$$

with $I^*\left(r\right)=\omega_E+\bar{L}_E+B$, and $B\leq\omega_M$. Note that the moneylender's outside option has changed from $\phi\left(\omega_M+\bar{L}_M\right)$ to $\left(1+r\right)B$.[21] Finally, a sufficiently wealthy entrepreneur, $\omega_E\geq\hat{\omega}_E$, will achieve the first-best level by borrowing exclusively from the bank.

[21] The moneylender's outside option is given by the equivalent of depositing the funds in the bank, instead of lending them to the entrepreneur.

Proposition 1 is consistent with a series of empirical studies on formal-informal sector interactions (Bell, Srinivasan and Udry, 1997, Conning, 2001, and Giné, 2001).[22] For example, in Giné's study of 2880 households and 606 small businesses in rural Thailand, the wealthiest borrowers (measured both by wealth and income) resort exclusively to the formal sector. As wealth declines, borrowers take credit from both sectors.[23] Conning provides similar evidence from his study on rural Chile.

The result rests on the assumption that the moneylender is able to ensure investments ex-ante. An alternative would be to model the informal sector's advantage as one of ensuring repayments ex-post, where the moneylender prevents strategic default.[24] However, in the one-period set-up above this reasoning excludes bank lending, as the entrepreneur would default on her formal loan and simply repay the moneylender. Introducing a second period potentially alleviates the problem as the bank could threaten to liquidate a successful entrepreneur in the first period to force repayment. However, this assumes that bankruptcy law actually functions properly so that assets may be seized. Indeed, Claessens, Djankov and Klapper (2003) show that creditors in East Asia only resort to bankruptcy as a means of securing debt ex-post if creditor vulnerability is low. By viewing the problem as one of ex-ante moral hazard, I arrive at multiple lending not having to worry about the problems of seizing assets.[25]

With the lender constellations established, I may examine the effects on the equilibria associated with changes in the parameters in the model. When both the entrepreneur and the moneylender are credit rationed (Case: IC_E and IC_M binds in Table 1 below), an increase in the entrepreneur's wealth, ω_E, positively affects the credit line, $\bar{L}_E$, both by raising the returns to investment and by strengthening the entrepreneur's outside option in the bargaining with the moneylender, thereby decreasing the repayment. As these two changes simultaneously make it less tempting to divert resources, the bank extends more funds to the entrepreneur. (The wealth of the moneylender, ω_M, has a similar effect on $\bar{L}_M$.)

Interestingly, the model predicts that a change in the moneylender's wealth, ω_M, has

[22] The empirical evidence further shows that entrepreneurs also borrow from the informal sector alone. In the present set-up, the linear lending technology implies that multiple lending always occurs for low levels of wealth. In Madestam (2004*a*), I introduce transaction costs and allow for market concentration in the formal sector, concluding that formal-informal credit market segmentation arises as an endogenous response of the formal monopolist.

[23] See Table 5 in Giné (2001).

[24] See for example, Bolton and Scharfstein (1990).

[25] A way to salvage the ex-post set-up would be to assume bank seniority over the (verifiable) project claims. Again, proper enforcement of seniority clauses assumes functioning creditor rights. The problem of dysfunctional bankruptcy law could be avoided by introducing the notion of reputation building to prevent the entrepreneur from defaulting on the bank loan. However, this assumes frequent interaction between the bank and her borrowers. This may be true of a credit constrained moneylender as she turns to the bank on a regular basis to lend money to entrepreneurs. However, for a single entrepreneur this is less likely. See Section 5 for a discussion on the effects of reputation building.

Table 1: Properties of Bank Credit.

	IC_E and IC_M binds.			IC_E binds - not IC_M.		
Parameters	I	$\bar{L}_E$	$\bar{L}_M$	I	$\bar{L}_E$	L_M
Wealth of entrepreneur, ω_E	+	+	−	0	+	−
Wealth of moneylender, ω_M	+	0	+	0	+	−
Creditor vulnerability, ϕ	−	−	±	0	−	+
Interest rate, r	−	−	±	−	−	±
Bargaining power of entrepreneur, α	0	0	0	0	+	−

Notes: I denotes aggregate investments; L_E and L_M bank credit extended to the entrepreneur and the moneylender. For proofs, see Appendix.

no effect on the entrepreneur's credit limit, $\bar{L}_E$. Increasing ω_M makes the entrepreneur's investment more profitable, but at the cost of strengthening the moneylender's outside option in the bargaining between the two. As the latter raises the entrepreneur's benefit from diverting, the bank will not forward any additional funds to the entrepreneur. Also, an increase in the entrepreneur's wealth, ω_E, decreases the amount extended to the moneylender ($\bar{L}_M$ decreases), by strengthening the entrepreneur's bargaining position, consequently making diversion more tempting for the moneylender. Hence, while increases in the entrepreneur's or the moneylender's assets both lead to higher investment, these increases do not improve the other borrower's credit limit.

A higher interest rate r lowers aggregate investment, with an indeterminate effect on the credit extended to the moneylender. The change in r has two effects on $\bar{L}_M$. The direct effect is the increase in the utility of diversion relative to investment, leading to less credit extended. The indirect effect is the strengthening in the bargaining that a higher r and subsequently a lower $\bar{L}_E$ produces. If the latter effect dominates (when $\bar{L}_E$ accounts for a substantial part of total investment), an increase in the cost of funds actually leads to more credit extended, not less. Finally, the bargaining power of the entrepreneur, α, has no effect on the credit lines or the investment made, implying that moneylender market power does not matter for low levels of wealth.

When the moneylender is wealthy enough to support first-best investment but needs bank funds to do so (Case: IC_E binds - not IC_M), the moneylender's wealth and the entrepreneur's wealth are substitutes in terms of the credit lines. An increase in the moneylender's wealth, ω_M, will in this instance have a twofold effect. It induces the moneylender to borrow less from the bank (decreasing L_M), as the first-best level of investment is attained. In addition, it makes the entire project less prone to opportunistic behavior, allowing extra bank credit to be extended to fund the venture. Since the entrepreneur prefers bank to moneylender funds, the additional increase in ω_M allows the entrepreneur to borrow more from the bank, explaining the increase in $\bar{L}_E$. Hence, by considering opportunistic behavior on part of the informal sector shows that

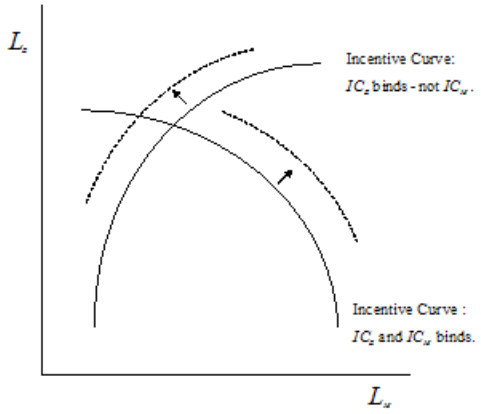

Figure 2: Equilibrium Credit Lines and Entrepreneurial Incentives.

entrepreneurial and informal assets are complements when both agents are poor, and substitutes when informal assets increase. The result is illustrated in Figure 2. The graph shows how changes in wealth and subsequently the credit lines affect entrepreneurial utility. When the entrepreneur and the moneylender are credit rationed, the entrepreneur equally enjoys increases in $\bar{L}_E$ and $\bar{L}_M$, while at higher levels of informal wealth, she prefers increases in $\bar{L}_E$. Another way to interpret this finding is that lenders complement each other in providing external finance for low levels of wealth, while acting as substitutes when the moneylender is wealthier. Intuitively this result can be understood in the following way. Although investment increases with the asset levels of both the entrepreneur and the moneylender, the entrepreneur's preference for bank funds implies that she will substitute away from moneylender funds as soon as first-best investment is attainable.

Finally, changes in the bargaining power of the entrepreneur, α, affect the credit limits in similar fashion to the changes in the wealth of the moneylender. As α increases, the entrepreneur's profits from making the investment goes up, enabling more bank lending, leading the entrepreneur to substitute formal for informal funds. Increased competition in the informal sector therefore diminishes its overall importance.[26]

4 Institutions and Informal Finance

The equilibrium outcomes established in the preceding section were derived under the assumption that legal protection of creditors was less than perfect. As argued in the Introduction, the reason for informal finance in the first place is the inability of the

[26] The comparative statics of the case IC_E binds - not IC_M are identical to the ones when the moneylender lends her own funds, except for the moneylender's wealth being irrelevant in terms of the entrepreneur's credit line.

formal sector to enforce its claims. I now show that informal finance is redundant for sufficiently low levels of creditor vulnerability.

Proposition 2 *There is a creditor vulnerability threshold, $\phi^*(\omega_E, r) > 0$, such that:*

(i) If $\phi \leq \phi^*$ and $\omega_E \in [0, I^*(r))$: Then the entrepreneur borrows from a bank exclusively.

(ii) If $\phi > \phi^*$ and $\hat{\omega}_E \leq \omega_E < I^*(r)$: Then the entrepreneur borrows from a bank exclusively.

(iii) If $\phi > \phi^*$ and $\omega_E < \hat{\omega}_E$: Then the entrepreneur borrows from both a bank and a moneylender.

Proof. See Appendix.

With $\phi \leq \phi^*$, entrepreneurs resort to exclusive bank lending for any level of wealth below first-best investments. In other words, as credit markets become more developed, informal finance looses its edge. The intuition is straightforward. The threshold level, ϕ^*, defines the level of creditor vulnerability for which a penniless entrepreneur can attain first-best by resorting exclusively to bank funds. As the entrepreneur prefers bank to moneylender funds, she will borrow solely from the formal sector when given the opportunity. The second and third part of Proposition 2 is simply a restatement of Proposition 1. Namely, that bank lending is preferable when this achieves first-best (part (ii)), but that the entrepreneur resorts to both lenders as long as less than first-best is attained when borrowing from the bank alone (part (iii)).

A related issue concerns how the share of informal to total intermediation varies in response to institutional change. Define the share of informal to total intermediation as

$$i = \frac{B}{B + \bar{L}_E}. \tag{11}$$

An increase in (11) corresponds to a larger relative share of moneylender funds.[27]

Proposition 3 *When the moneylender is not credit rationed by a bank, the share of moneylender funds to total intermediation, i, increases in creditor vulnerability, ϕ.*

In this instance the comparative static exercise referred to in Table 1 shows that higher creditor vulnerability lowers the entrepreneur's credit limit. Intuitively, the informal sector becomes the lender of choice when the formal sector's ability to prevent

[27] Note that B may include bank loans as well as the moneylender's own wealth. For simplicity I define the origin of intermediated funds to mean the lender from where the money was finally lent to the entrepreneur. This definition is also consistent with the empirical evidence referred to in the Introduction.

opportunistic behavior deteriorates. When the moneylender is credit rationed the result is more ambigous. Higher creditor vulnerability (ϕ increases) lowers aggregate investment, with an indeterminate effect on the credit extended to the moneylender. The change in ϕ has two effects on $\bar{L}_M$, similar to the ones described in relation to the interest rate. The direct effect is the increase in the utility of opportunistic behavior relative to investment leading to less credit extended. The indirect effect is the strengthening in the bargaining that a higher ϕ and subsequently a lower $\bar{L}_E$ results in. When the latter effect dominates (when $\omega_E + \bar{L}_E$ accounts for a substantial part of total investment), deteriorating institutions may in fact induce more credit being forwarded to the moneylender. When this is true, Proposition 3 holds globally.

Propositions 2 and 3 are novel predictions of the model that offer a striking yet simple explanation as to why informal lending is virtually non-existent in developed credit markets with well functioning legal protection of creditors, while much more prominent in developing markets.

5 Distribution of Wealth

Until now, I have assumed a given distribution of assets. Changing the concentration of wealth across lenders and entrepreneurs allows me to determine the distribution that yields the highest level of investment. Whereas previous work (Banerjee and Newman, 1993; Galor and Zeira, 1993) has emphasized the effects of formal sector credit rationing on entrepreneurs, the assets of the informal sector has not been considered. To allow for comparison with this literature I extend the model to a dynamic framework through two examples. However, I first consider the effects of a reallocation of wealth between the entrepreneur and the moneylender in the present set-up.

The comparative static exercise showed that marginal increases in wealth raised investment for low asset levels, although increases in either the entrepreneur or the moneylender's wealth did not improve the other borrower's credit limit. These findings tell us that a reallocation between the two does not seem to matter for subsequent investment. I now state this more formally.

Proposition 4 *There are wealth thresholds, $\hat{\omega}_E(r,\phi) > 0$ and $\hat{\omega}_M(\omega_E, r, \phi) > 0$, such that:*

(i) If $\omega_E < \hat{\omega}_E$ and $\omega_M < \hat{\omega}_M$; or

(ii) If $\omega_E < \hat{\omega}_E$, $\omega_M \geq \hat{\omega}_M$, and $\omega_E + \omega_M < I^*(r)$; or

(iii) If $\omega_E < \hat{\omega}_E$, $\omega_M \geq \hat{\omega}_M$, and $\omega_E + \omega_M < I^*(r)$ or $\omega_E + \omega_M \geq I^*(r)$;

then a reallocation of wealth from the entrepreneur to the moneylender has no effect on investment.

Proof. See Appendix.

This result, while quite powerful, is easy to understand in light of the discussion above. When the entrepreneur and the moneylender are credit rationed, case (i) in Proposition 4, a reallocation of wealth between them will not increase the investment level since they both invest (or lend) their entire wealth. When the moneylender becomes sufficiently wealthy such that first-best is reached, cases (ii)-(iii), the outcome is the same but for a different reason; the investment level will not increase any further and the assets of the entrepreneur and moneylender are perfect substitutes. If credit market transactions were to be characterized as one-shot interactions, the distribution of wealth would have no effect on productive efficiency when comparing the assets of the entrepreneur and the moneylender.

It is plausible to assume however that the moneylender lends to more than one entrepreneur, while the entrepreneur is engaged in one project only. In other words, while entrepreneurs' production technology applies to one project, lenders' enforcement technology is applicable to many entrepreneurs. This assumption allows me to extend the model dynamically to illustrate the importance of informal sector wealth. I proceed by way of two examples.

Example 1: In the first example I exploit the fact that wealth may be allocated across entrepreneurs and across time periods by introducing a second entrepreneur, extending the analysis to a two-period framework (the second period entrepreneur is identical to the entrepreneur in the first period). As in Proposition 4, a reallocation of wealth from the second entrepreneur to the moneylender leaves investment unchanged in period two.

A wealth reallocation therefore raises aggregate investment if reallocating the wealth from the first entrepreneur to the moneylender increases investment in the second period. This is indeed the case when less than first-best is invested in period two. In this instance a reallocation of wealth from the first entrepreneur to the moneylender increases investment for two reasons: first, there exists an unmet demand for funds; secondly, all funds available to any of the involved agents will be invested. Hence, as the moneylender becomes richer on account of the first entrepreneur, more is invested in period two. As soon as first-best is attained however, a reallocation again makes no difference.

Example 2: In the second example I focus on the frequency with which borrowers interact with the bank. In the current set-up, the interaction between the entrepreneur and the bank is identical to the interaction between the moneylender and the bank. Plausibly, the moneylender returns to the bank every period–if wealth constrained– while the entrepreneur only borrows once. If so, it is reasonable to assume that the moneylender has more to lose from a default, allowing the bank to extend funds more liberally to the moneylender than to the entrepreneur. Hence, a dollar of wealth with

the moneylender therefore generates more bank credit on the margin. Again, this only holds for low levels of wealth, as soon as first-best investment is attained the investment level will not increase any further and the assets of the entrepreneur and moneylender are substitutes.[28]

In sum, moneylender wealth matters more than entrepreneurs' wealth because it creates additional value through multiple interactions with entrepreneurs and/or banks, relative to the wealth of a specific entrepreneur.[29] These conclusions have some bearing on existing policy. For example, restrictions prohibiting lending for interest, or preventing too high interest rates, while beneficial to a particular entrepreneur create negative externalities on overall investments by leaving a smaller surplus to be transferred to the next project.

The two examples demonstrate that wealth concentration has to be accompanied by an ability to put the money to work, which is exactly what the moneylender's enforcement technology achieves. Also, the money has to be put to work where it is needed, i.e. when less than first-best is invested. Hence, asset inequality will not raise investment when firms and lenders are more affluent. These ideas are reminiscent of the work of Kaldor (1956), Kuznets (1955), and Lewis (1954). However, while Kuznets and Lewis saw inequality as inevitable in the development process I merely claim that it may improve investment.[30] According to Kaldor, the marginal propensity to save was higher among the rich than the poor. Hence, as GDP was assumed directly related to the proportion of national income saved, the economy would grow faster the more unequal the income distribution. Kaldor's capitalists somewhat resembles my moneylenders, but I do not assume that the propensity to save is higher for richer individuals, or that mobilization of domestic savings necessarily translates into more projects being undertaken, these differences are elaborated below.

Finally, I determine how an increase in the capital of the moneylender as supposed to the bank affects investment.

Proposition 5 *When the entrepreneur and the moneylender are credit rationed by the bank, investment increases in the share of moneylender funds to total intermediation.*

[28] A similar result is obtained when creditor vulnerability decreases in moneylender wealth, while being neutral with respect to the entrepreneur's wealth, i.e. $\phi'(\omega_M) < 0$ and $\phi'(\omega_E) = 0$.

[29] Some authors (Conning, 2001, Conning and Kevane, 2002, and Jain, 1999) have suggested that the informal sector "crowds-in" formal funds by allowing the formal sector to contract on the informal sector's dealings with the entrepreneurs. This is different from what the two examples above describe. In example 1, investment increases because the moneylender carries wealth with her from the previous period, not because the formal sector lends her more per-se. In addition, although the bank lends more to the moneylender in example 2, this is due to the assumption that the moneylender does not want to lose out on future bank funding, not because the bank contracts upon the moneylender's dealings with the entrepreneur.

[30] See Greenwood and Jovanovic (1990) for a more recent contribution along the lines of Kuznets and Lewis.

The result is straightforward once you take into account that neither the entrepreneur nor the moneylender's assets affect the other borrower's credit limit at low levels of wealth (Table 1, IC_E and IC_M binds). Increasing the moneylender's wealth, ω_M, improves the credit limit $\bar{L}_M$, the share of moneylender funds to total intermediation, and investment. Meanwhile the credit limit of the entrepreneur, $\bar{L}_E$, remains unchanged. Extending more bank funds in this case (increasing $\bar{L}_E$) is not possible as it induces opportunistic behavior. The model thus suggests that more liquidity in the financial system is not a good thing per-se. If the bottleneck is the scarce resources of the informal sector, a mobilization of domestic savings in the formal sector for example will not necessarily translate into more funds invested, contradicting Kaldor's claim.[31]

The predictions also complement recent empirical findings related to the theory of relationship banking.[32] Let the moneylender represent the small community bank and the bank correspond to its transaction-based counterpart. The model then predicts that a greater share of community bank lending leads to higher GDP growth at low levels of wealth since the community banks fill a lending-gap otherwise not met, a result empirically supported by Berger, Hasan and Klapper (forthcoming). Using cross-sectional data from 49 developed and developing countries, they conclude that a greater share of small, private, domestically-owned banks are associated with improved economic performance, with the effect being more pronounced in the developing context. Hence, in less developed economies, with high ϕ and low ω, increasing the assets of the community bank rather than its transaction-based counterpart increases overall investment.

6 Extensions and Concluding Remarks

I have assumed that the moneylender is able to costlessly ensure that investment takes place. Suppose instead that the lender incurs a fixed monitoring cost k when lending to the entrepreneur – will this alter the main insights of the paper?[33] Not really. In fact, as long as the cost is not too excessive, the lender constellations remain the same and the paper's current results continue to hold.[34] The difference is that the moneylender

[31] For higher levels of moneylender wealth such that first-best is obtained, the results are indeterminate. In this case, a higher level of moneylender assets, ω_M, induces a decrease in L_M, but also more bank funds extended towards the entrepreneur (an increase in $\bar{L}_E$), see Table 1, IC_E binds - not IC_M.

[32] Relationship banking implies that a lender develops a close relationship with a borrower over time; acquiring borrower-specific "soft" information facilitated through multiple interactions with the firm, the owner and the local community, as supposed to transaction-based lending based on "hard" information acquired at the time of the loan origination, see Berger and Udell (2002) and Boot (2000).

[33] The assumption of a fixed enforcement cost finds empirical support in Aleem (1993). In his study the informal lenders charge a fixed cost per borrower, independent of the amount lent out.

[34] The maximum cost consistent with the current equilibria varies depending on the values of the parameters in the model. For example, at low levels of wealth, $\omega_E < \hat{\omega}_E(r, \phi)$ and $\omega_M < \hat{\omega}_M(\omega_E, r, \phi)$, $k \leq Q\left(\omega_E + \bar{L}_E + \omega_M + \bar{L}_M\right) - Q\left(\omega_E + \bar{L}_E\right) - (1+r)\bar{L}_M + \alpha\phi\left(\omega_M + \bar{L}_M\right)/(1-\alpha)$. If not, the

is compensated in the bargaining for the additional expense that she incurs. At low levels of wealth, an increase in the cost, k, decreases investment through a lower bank credit limit, $\bar{L}_M$, extended to the moneylender, while the entrepreneur's credit limit, $\bar{L}_E$, remains unchanged. When first-best is attained through a wealthier moneylender (still borrowing bank funds), investment is insensitive to changes in k. Interestingly, increasing costs causes the entrepreneur's credit limit, $\bar{L}_E$, to decrease while the moneylender takes more credit (L_M increases). In other words, as the moneylender raises her price due to cost increases, she lends more money to the entrepreneur. The intuition for this substitution effect stems from the subsequent increase in the moneylender's outside option that the upward movement of k causes. This increase makes it more tempting to divert for the entrepreneur, necessitating a switch to moneylender funds (see Lemma 6 in Appendix).[35]

In addition, as the model stands, any entrepreneur willing to borrow from the moneylender may do so. Suppose, however, that the moneylender only lends money after some initial screening procedure, removing potentially opportunistic entrepreneurs from the borrower pool but supplying the remaining ones with funds in the same manner as before. Again the results basically remain the same. What changes is that some entrepreneurs will have to rely exclusively on bank funds, while others pass the test and qualify for moneylender funds. Finally, in the basic model the moneylender's occupational choice is restricted to lending money. In a more general setting she may have additional sources of income, e.g. holding land or trading. This will not weaken the results however. Complementary sources of income make it less tempting for the moneylender to behave opportunistically, enabling the bank to extend more funds. The case examined in the model thus provides the lower limit of bank funds flowing to the moneylender.

The current model may also be modified. In a companion paper (Madestam, 2004*b*), I explore the implications of a monopolistic formal sector, demonstrating that market concentration is particularly harmful in a setting where institutions are malfunctioning. The paper shows that the distortions are especially large for small, less capitalized, entrepreneurs. A related extension (Madestam, 2004*a*) further illustrates that bank market concentration may offer an important explanation as to why formal-informal credit markets are segmented. In the paper I demonstrate that the formal monopolist prefers lending exclusively to the informal sector rather than the entrepreneur when the wealth of the informal sector is large relative that of the entrepreneur.

entrepreneur only borrows from the bank.

[35] Similar results are found when the moneylender lends her own funds.

Appendix

The following result will be helpful in the analysis that follows.

Lemma 1 *(i)* $Q'\left(\omega_E+\bar{L}_E\right)-(1+r+\phi)<0$, *and (ii)* $Q'\left(\omega_E+\bar{L}_E+\omega_M+\bar{L}_M\right)-(1+r+\phi)<0$.

Proof. Part (i): When the entrepreneur borrows exclusively from the bank and the credit limit binds,

$$Q\left(\omega_E+\bar{L}_E\right)-(1+r)\,\bar{L}_E-\phi\left(\omega_E+\bar{L}_E\right)=0.$$

This constraint is only binding if $Q'\left(\omega_E+\bar{L}_E\right)-(1+r+\phi)<0$. Otherwise, $\bar{L}_E$ could be increased without violating the constraint. Part (ii): When the credit limits for the entrepreneur and the moneylender bind,

$$\begin{aligned}\alpha Q(I)+(1-\alpha)\,Q\left(\omega_E+\bar{L}_E\right)-(1+r)\,\bar{L}_E-\alpha(1+r)\,\bar{L}_M-\\ -\alpha\phi\left(\omega_M+\bar{L}_M\right)-\phi\left(\omega_E+\bar{L}_E\right)=0,\end{aligned}\tag{12}$$

and

$$(1-\alpha)\left(Q(I)-Q\left(\omega_E+\bar{L}_E\right)-(1+r)\,\bar{L}_M-\phi\left(\omega_M+\bar{L}_M\right)\right)=0,\tag{13}$$

with $I=\omega_E+\bar{L}_E+\omega_M+\bar{L}_M$. Adding the two expressions yields the maximum incentive compatible investment level:

$$Q(I)-(1+r)\,(I-\omega_E-\omega_M)-\phi I=0.\tag{14}$$

Given that it is maximal, the term must have a negative derivative, i.e. $Q'(I)-(1+r+\phi)<0$. ■

Proof of Proposition 1

I show the existence and uniqueness of $\hat{\omega}_E(r,\phi)$ and $\hat{\omega}_M(\omega_E,r,\phi)$ and proceed with the lender constellations that arise.

Lemma 2 *There exists unique thresholds,* $\hat{\omega}_E(r,\phi)$ *and* $\hat{\omega}_M(\omega_E,r,\phi)$, *such that:*

(i) $Q(I^*(r))-(1+r)\,\bar{L}_E-\phi\left(\omega_E+\bar{L}_E\right)=0$, *for* $\omega_E=\hat{\omega}_E(r,\phi)$, *and* $\omega_E+\bar{L}_E=I^*(r)$;

(ii) $\alpha Q(I^*(r))+(1-\alpha)\,Q\left(\omega_E+\bar{L}_E\right)-(1+r)\,\bar{L}_E-\alpha(1+r)\,\bar{L}_M-\alpha\phi\left(\omega_M+\bar{L}_M\right)-\phi\left(\omega_E+\bar{L}_E\right)=0$ *and* $Q(I^*(r))-Q\left(\omega_E+\bar{L}_E\right)-(1+r)\,\bar{L}_M-\phi\left(\omega_M+\bar{L}_M\right)=0$, *for* $\omega_M=\hat{\omega}_M(\omega_E,r,\phi)$, *and* $\omega_E+\bar{L}_E+\omega_M+\bar{L}_M=I^*(r)$.

Proof. Part (i) is analogous to Lemma A1 in Burkart and Ellingsen (2004) and hence omitted. Part (ii): The threshold $\hat{\omega}_M(\omega_E, r, \phi)$ is the smallest wealth level that yields $I = I^*(r)$ when the entrepreneur and the moneylender utilize bank funds. Given that (14) gives the maximum incentive compatible investment level for a given level of entrepreneurial wealth, ω_E, $\hat{\omega}_M(\omega_E, r, \phi)$ must satisfy

$$Q(I^*(r)) - (1+r)(I^*(r) - \omega_E - \hat{\omega}_M) - \phi I^*(r) = 0. \tag{15}$$

The threshold is unique if $\bar{L}_M$ is increasing in ω_M. Totally differentiating (12) and (13) using Cramer's rule yields

$$\frac{d\bar{L}_M}{d\omega_M} = \frac{(\phi - Q'(I))\left(Q'\left(\omega_E + \bar{L}_E\right) - (1+r+\phi)\right)}{\Delta} > 0,$$

where the determinant, $\Delta = \left(Q'\left(\omega_E + \bar{L}_E\right) - (1+r+\phi)\right)^2$, is positive by Lemma 1, and the two inequalities follow from Lemma 1, $Q'(I) \geq (1+r)$ and $\phi < 1$. Finally, $\hat{\omega}_M(\omega_E, r, \phi) > 0$ follows from the assumption $\phi > \underline{\phi}$. ■

Lemma 3 *If (i) $\omega_E < \hat{\omega}_E(r, \phi)$, $\omega_M < \hat{\omega}_M(\omega_E, r, \phi)$; or (ii) $\omega_E < \hat{\omega}_E(r, \phi)$, $\omega_M \geq \hat{\omega}_M(\omega_E, r, \phi)$, and $\omega_E + \omega_M < I^*(r)$: Then the entrepreneur borrows from both a bank and a moneylender, and this moneylender borrows from a bank. If (iii) $\omega_E < \hat{\omega}_E(r, \phi)$, $\omega_M \geq \hat{\omega}_M(\omega_E, r, \phi)$, and $\omega_E + \omega_M < I^*(r)$ or $\omega_E + \omega_M \geq I^*(r)$: Then the entrepreneur borrows from both a bank and a moneylender, and this moneylender does not borrow from a bank. Finally, if (iv) $\omega_E \geq \hat{\omega}_E(r, \phi)$: Then the entrepreneur borrows from a bank exclusively.*

Proof. Part (i): The entrepreneur may borrow from: (1) the bank exclusively; (2) both lenders with the moneylender lending bank funds; (3) the moneylender exclusively with the moneylender lending bank funds; (4) the moneylender exclusively with the moneylender lending her own funds; (5) both lenders with the moneylender lending her own funds.

Case (1) renders: $U_E^1 = Q\left(\omega_E + \bar{L}_E\right) - (1+r)\bar{L}_E$; $U_M^1 = 0$. Case (2) renders: $U_E^2 = \alpha Q\left(\omega_E + \bar{L}_E + \omega_M + \bar{L}_M\right) + (1-\alpha)Q\left(\omega_E + \bar{L}_E\right) - (1+r)\bar{L}_E - \alpha(1+r)\bar{L}_M - \alpha\phi\left(\omega_M + \bar{L}_M\right)$; $U_M^2 = (1-\alpha)Q\left(\omega_E + \bar{L}_E + \omega_M + \bar{L}_M\right) - (1-\alpha)Q\left(\omega_E + \bar{L}_E\right) - (1-\alpha)(1+r)\bar{L}_M + \alpha\phi\left(\omega_M + \bar{L}_M\right)$. Case (3) renders: $U_E^3 = \alpha Q\left(\omega_E + \omega_M + \bar{L}_M\right) + (1-\alpha)Q(\omega_E) - \alpha(1+r)\bar{L}_M - \alpha\phi\left(\omega_M + \bar{L}_M\right)$; $U_M^3 = (1-\alpha)Q\left(\omega_E + \omega_M + \bar{L}_M\right) - (1-\alpha)\left(Q(\omega_E) - (1+r)\bar{L}_M\right) + \alpha\phi\left(\omega_M + \bar{L}_M\right)$. Case (4) renders: $U_E^4 = \alpha Q(\omega_E + \omega_M) + (1-\alpha)Q(\omega_E) - \alpha(1+r)\omega_M$; $U_M^4 = (1-\alpha)\left(Q(\omega_E + \omega_M) - Q(\omega_E)\right) + \alpha(1+r)\omega_M$. Case (5) renders: $U_E^5 = \alpha Q\left(\omega_E + \bar{L}_E + \omega_M\right) + (1-\alpha)Q\left(\omega_E + \bar{L}_E\right) - \alpha(1+r)\omega_M - (1+r)\bar{L}_E$; $U_M^5 = (1-\alpha)\left(Q\left(\omega_E + \bar{L}_E + \omega_M\right) - Q\left(\omega_E + \bar{L}_E\right)\right) + \alpha(1+r)\omega_M$ (where U_E^i and U_M^i denote the entrepreneur's respectively the moneylender's utility). Starting with the entrepreneur, although $U_E^2 = U_E^1$, she prefers U_E^2 by the assumption that for the

same utility, the agent choses the outcome with the higher investment. Also, $U_E^2 - U_E^3 = U_E^1 - U_E^3 = Q(\omega_E) > 0$, while $U_E^2 \gtreqless U_E^4$. Finally, $U_E^4 - U_E^3 = Q(\omega_E + \omega_M) - Q(\omega_E) - (1+r)\omega_M > 0$, $U_E^5 - U_E^2 = Q\left(\omega_E + \bar{L}_E + \omega_M\right) - Q\left(\omega_E + \bar{L}_E\right) - (1+r)\omega_M > 0$, and $U_E^5 - U_E^4 = \alpha\left(Q\left(\omega_E + \bar{L}_E + \omega_M\right) - Q(\omega_E + \omega_M)\right) + (1-\alpha)\left(Q\left(\omega_E + \bar{L}_E\right) - Q(\omega_E)\right) - (1+r)\bar{L}_E > 0$ holds by concavity and $Q'(I) \geq (1+r)$. This renders: (i) $U_E^5 > U_E^2 > U_E^1 > U_E^4 > U_E^3$; or (ii) $U_E^5 > U_E^4 > U_E^2 > U_E^1 > U_E^3$. Similarly, $U_M^3 - U_M^2 = Q\left(\omega_E + \omega_M + \bar{L}_M\right) - Q\left(\omega_E + \bar{L}_E + \omega_M + \bar{L}_M\right) + Q\left(\omega_E + \bar{L}_E\right) - Q(\omega_E) > 0$, and $U_M^2 - U_M^5 = (1-\alpha)\left(Q\left(\omega_E + \bar{L}_E + \omega_M + \bar{L}_M\right) - Q\left(\omega_E + \bar{L}_E + \omega_M\right) - (1+r)\bar{L}_M\right) + \alpha\left(Q\left(\omega_E + \bar{L}_E + \omega_M + \bar{L}_M\right) - Q\left(\omega_E + \bar{L}_E\right) - (1+r)\left(\omega_M + \bar{L}_M\right)\right) > 0$ holds by concavity and $Q'(I) \geq (1+r)$. Also, $U_M^4 - U_M^5 = Q(\omega_E + \omega_M) - Q\left(\omega_E + \bar{L}_E + \omega_M\right) + Q\left(\omega_E + \bar{L}_E\right) - Q(\omega_E) > 0$ holds by concavity, while $U_M^4 \gtreqless U_M^3$, and $U_M^4 \gtreqless U_M^2$. This renders: (i) $U_M^3 > U_M^2 > U_M^4 > U_M^5 > U_M^1$; (ii) $U_M^3 > U_M^4 > U_M^2 > U_M^5 > U_M^1$; or (iii) $U_M^4 > U_M^3 > U_M^2 > U_M^5 > U_M^1$. It is straightforward to show that case (2) is the only possible outcome.

Parts (ii)-(iii): First, if $\omega_E + \omega_M < I^*(r)$, then $\omega_E + \omega_M$ accounts for the interval of credit lines such that $\omega_M < I^*(r) - \omega_E - \bar{L}_E$ for a given ω_E and ω_M. Second, if $\omega_E + \omega_M < I^*(r)$ or $\omega_E + \omega_M \geq I^*(r)$, then $\omega_E + \omega_M$ accounts for the interval of credit lines such that $\omega_M \geq I^*(r) - \omega_E - \bar{L}_E$ for a given ω_E and ω_M. The remaining Part (ii) is proved in a similar manner to Part (i) and hence omitted. Part (iii): Since, $\omega_M \geq I^*(r) - \omega_E - \bar{L}_E$, it is not credible for the moneylender to borrow from the bank and claim $\phi\left(\omega_M + \bar{L}_M\right)$ as an outside option when the entrepreneur also borrows from the bank (case (2)). When excluding case (2) it is easy to show that case (5) is the only possible outcome with $B \leq \omega_M$.

Part (iv): Since the entrepreneur prefers U_E^1 to U_E^2, U_E^3, U_E^4 and U_E^5, regardless of the moneylender's wealth, case (1) is the only possible outcome. ■

Proof of Properties in Table 1

I establish the properties of bank credit as reported in Table 1 when IC_E and IC_M binds, and when IC_E binds - not IC_M. The comparative statics of the case when $\omega_E < \hat{\omega}_E(r, \phi)$, $\omega_M \geq \hat{\omega}_M(\omega_E, r, \phi)$, and $\omega_E + \omega_M < I^*(r)$ or $\omega_E + \omega_M \geq I^*(r)$ are derived in a similar manner and hence omitted.

Proof. Table 1, IC_E and IC_M binds: When $\omega_E < \hat{\omega}_E(r, \phi)$ and $\omega_M < \hat{\omega}_M(\omega_E, r, \phi)$, the relevant constraints are given by

$$\alpha Q\left(\omega_E + \bar{L}_E + \omega_M + \bar{L}_M\right) + (1-\alpha)Q\left(\omega_E + \bar{L}_E\right) - (1+r)\bar{L}_E - \alpha(1+r)\bar{L}_M - \\ -\alpha\phi\left(\omega_M + \bar{L}_M\right) - \phi\left(\omega_E + \bar{L}_E\right) = 0, \tag{16}$$

$$Q\left(\omega_E + \bar{L}_E + \omega_M + \bar{L}_M\right) - Q\left(\omega_E + \bar{L}_E\right) - (1+r)\bar{L}_M - \phi\left(\omega_M + \bar{L}_M\right) = 0, \tag{17}$$

and

$$I - \omega_E - \bar{L}_E - \omega_M - \bar{L}_M = 0. \tag{18}$$

Differentiating equations (16)-(18) with respect to I, $\bar{L}_E$, $\bar{L}_M$, and ω_E using Cramer's rule I obtain

$$\begin{aligned}\frac{dI}{d\omega_E} &= \frac{(1+r)\left(1+r+\phi-Q'\left(\omega_E+\bar{L}_E\right)\right)}{\Delta} > 0,\\ \frac{d\bar{L}_E}{d\omega_E} &= \frac{\left(Q'\left(\omega_E+\bar{L}_E+\omega_M+\bar{L}_M\right)-(1+r+\phi)\right)\left(\phi-Q'\left(\omega_E+\bar{L}_E\right)\right)}{\Delta} > 0,\end{aligned}$$

and

$$\frac{d\bar{L}_M}{d\omega_E} = \frac{(1+r)\left(Q'\left(\omega_E+\bar{L}_E+\omega_M+\bar{L}_M\right)-Q'\left(\omega_E+\bar{L}_E\right)\right)}{\Delta} < 0,$$

where the determinant, Δ, is positive by Lemma 1. The inequalities follow from concavity, Lemma 1 and $\phi < 1$. Differentiating the equations with respect to I, $\bar{L}_E$, $\bar{L}_M$, and ω_M using Cramer's rule I obtain

$$\begin{aligned}\frac{dI}{d\omega_M} &= \frac{(1+r)\left(1+r+\phi-Q'\left(\omega_E+\bar{L}_E\right)\right)}{\Delta} > 0,\\ \frac{d\bar{L}_E}{d\omega_M} &= \frac{0}{\Delta} = 0,\end{aligned}$$

and

$$\frac{d\bar{L}_M}{d\omega_M} = \frac{\left(\phi-Q'\left(\omega_E+\bar{L}_E+\omega_M+\bar{L}_M\right)\right)\left(Q'\left(\omega_E+\bar{L}_E\right)-(1+r+\phi)\right)}{\Delta} > 0,$$

where the inequalities follow from Lemma 1 and $\phi < 1$. Differentiating the equations with respect to I, $\bar{L}_E$, $\bar{L}_M$, and ϕ using Cramer's rule I obtain

$$\begin{aligned}\frac{dI}{d\phi} &= \frac{\left(\omega_E+\bar{L}_E+\omega_M+\bar{L}_M\right)\left(Q'\left(\omega_E+\bar{L}_E\right)-(1+r+\phi)\right)}{\Delta} < 0,\\ \frac{d\bar{L}_E}{d\phi} &= \frac{\left(\omega_E+\bar{L}_E\right)\left(Q'\left(\omega_E+\bar{L}_E+\omega_M+\bar{L}_M\right)-(1+r+\phi)\right)}{\Delta} < 0,\end{aligned}$$

and

$$\begin{aligned}\frac{d\bar{L}_M}{d\phi} &= \frac{\left(\omega_M+\bar{L}_M\right)\left(Q'\left(\omega_E+\bar{L}_E\right)-(1+r+\phi)\right)}{\Delta} -\\ &\quad -\frac{\left(\omega_E+\bar{L}_E\right)\left(Q'\left(\omega_E+\bar{L}_E+\omega_M+\bar{L}_M\right)-Q'\left(\omega_E+\bar{L}_E\right)\right)}{\Delta},\end{aligned}$$

where the sign of $\frac{d\bar{L}_M}{d\phi}$ is indeterminate. The inequalities follow from concavity and Lemma 1. Differentiating the equations with respect to I, $\bar{L}_E$, $\bar{L}_M$, and r using Cramer's rule I obtain

$$\begin{aligned}\frac{dI}{dr} &= \frac{\left(\bar{L}_E+\bar{L}_M\right)\left(Q'\left(\omega_E+\bar{L}_E\right)-(1+r+\phi)\right)}{\Delta} < 0,\\ \frac{d\bar{L}_E}{dr} &= \frac{\bar{L}_M\left(Q'\left(\omega_E+\bar{L}_E+\omega_M+\bar{L}_M\right)-(1+r+\phi)\right)}{\Delta} < 0,\end{aligned}$$

and

$$\begin{aligned}\frac{d\bar{L}_M}{dr} &= \frac{\bar{L}_M\left(Q'\left(\omega_E+\bar{L}_E\right)-(1+r+\phi)\right)}{\Delta}- \\ &\quad -\frac{\bar{L}_E\left(Q'\left(\omega_E+\bar{L}_E+\omega_M+\bar{L}_M\right)-Q'\left(\omega_E+\bar{L}_E\right)\right)}{\Delta},\end{aligned}$$

where the sign of $\frac{d\bar{L}_M}{dr}$ is indeterminate. The inequalities follow from concavity and Lemma 1. Differentiating the equations with respect to I, $\bar{L}_E$, $\bar{L}_M$, and α using Cramer's rule I obtain

$$\begin{aligned}\frac{dI}{d\alpha} &= \frac{0}{\Delta}=0, \\ \frac{d\bar{L}_E}{d\alpha} &= \frac{0}{\Delta}=0,\end{aligned}$$

and

$$\frac{d\bar{L}_M}{d\alpha}=\frac{0}{\Delta}=0.$$

Table 1, IC_E binds - not IC_M: When $\omega_E<\hat{\omega}_E(r,\phi)$, $\omega_M\geq\hat{\omega}_M(\omega_E,r,\phi)$, and $\omega_E+\omega_M<I^*(r)$, the relevant constraints are given by

$$\begin{aligned}&\alpha Q\left(\omega_E+\bar{L}_E+\omega_M+L_M\right)+(1-\alpha)Q\left(\omega_E+\bar{L}_E\right)-(1+r)\bar{L}_E-\alpha(1+r)L_M- \\ &\qquad -\alpha\phi\left(\omega_M+\bar{L}_M\right)-\phi\left(\omega_E+\bar{L}_E\right)=0, \qquad (19) \\ &\qquad Q'\left(\omega_E+\bar{L}_E+\omega_M+L_M\right)-(1+r)=0, \qquad (20)\end{aligned}$$

and

$$I-\omega_E-\bar{L}_E-\omega_M-L_M=0. \qquad (21)$$

Define $\Theta=Q''\left(\omega_E+\bar{L}_E+\omega_M+L_M\right)\left[(1-\alpha)\left(Q'\left(\omega_E+\bar{L}_E\right)-(1+r)\right)-\phi\right]$. Differentiating equations (19)-(21) with respect to I, $\bar{L}_E$, L_M, and ω_E using Cramer's rule I obtain

$$\begin{aligned}\frac{dI}{d\omega_E} &= \frac{0}{\Theta}=0, \\ \frac{d\bar{L}_E}{d\omega_E} &= \frac{Q''\left(\omega_E+\bar{L}_E+\omega_M+L_M\right)\left(\phi-(1-\alpha)Q'\left(\omega_E+\bar{L}_E\right)-\alpha(1+r)\right)}{\Theta}>0,\end{aligned}$$

and

$$\frac{dL_M}{d\omega_E}=\frac{(1+r)Q''\left(\omega_E+\bar{L}_E+\omega_M+L_M\right)}{\Theta}<0,$$

where the determinant, Θ, is positive by concavity and Lemma 1. The inequalities follow from concavity, Lemma 1 and $\phi<1$. The remaining comparative-static results with respect to ω_M, ϕ, r, and α are derived in a similar manner and hence omitted. ■

Proof of Proposition 2

The first part establishes the existence and uniqueness of $\phi^*(\omega_E, r)$. The second part shows the lender constellations that arise.

Lemma 4 *There exists a unique threshold, $\phi^*(\omega_E, r)$, such that: $Q(I) - (1+r)\bar{L}_E - \phi\bar{L}_E = 0$ for $\phi = \phi^*(\omega_E, r)$ and $I = I^*(r)$.*

Proof. The threshold $\phi^*(\omega_E, r)$ is simply the highest level of creditor vulnerability that yields $I = I^*(r)$ when the entrepreneur utilizes bank funds and attains first-best with zero wealth. Hence, $\phi^*(\omega_E, r)$ must satisfy

$$\frac{Q(I^*(r)) - (1+r)I^*(r)}{I^*(r)} = \phi^*(\omega_E). \tag{22}$$

The threshold is unique if $\bar{L}_E$ is decreasing in ϕ. Totally differentiating (22) yields

$$\frac{d\bar{L}_E}{d\phi} = \frac{\bar{L}_E}{Q'(\bar{L}_E) - (1+r+\phi)} < 0,$$

where the inequality follows from Lemma 1, $Q'(I) \geq (1+r)$ and $\phi < 1$. Finally, $\phi^*(\omega_E, r) > 0$ follows from inspection of (22). ■

Lemma 5 *If (i) $\phi \leq \phi^*(\omega_E, r)$: Then the entrepreneur borrows from a bank exclusively for $\omega_E \in [0, I^*(r))$. If (ii) $\phi > \phi^*(\omega_E, r)$ and $\omega_E < \hat{\omega}_E(r, \phi)$: Then the entrepreneur borrows from both a bank and a moneylender. Finally, if $\phi > \phi^*(\omega_E, r)$ and $I^*(r) > \omega_E \geq \hat{\omega}_E(r, \phi)$: Then the entrepreneur borrows from a bank exclusively.*

Proof. Part (i): Follows from Lemma 4 and the the result of Proposition 1, i.e. that the entrepreneur prefers bank lending to moneylender funds. Parts (ii)-(iii): Follows from Proposition 1. ■

Proof of Proposition 4

Proof. There are three relevant cases: (i) $\omega_E < \hat{\omega}_E(r, \phi)$, $\omega_M < \hat{\omega}_M(\omega_E, r, \phi)$; (ii) $\omega_E < \hat{\omega}_E(r, \phi)$, $\omega_M \geq \hat{\omega}_M(\omega_E, r, \phi)$ and $\omega_E + \omega_M < I^*(r)$; and (iii) $\omega_E < \hat{\omega}_E(r, \phi)$, $\omega_M \geq \hat{\omega}_M(\omega_E, r, \phi)$ and $\omega_E + \omega_M < I^*(r)$ or $\omega_E + \omega_M \geq I^*(r)$. Part (i): The equilibrium is given by equations (16)-(18). Differentiation with respect to I, ω_M and ω_E, setting $d\omega_M = -d\omega_E$, and using Cramer's rule yields

$$\frac{dI}{d\omega_M} = \frac{0}{\Delta} = 0,$$

where the determinant, Δ, is positive by Lemma 1. Part (ii): The equilibrium is given by equations (19)-(21). Differentiating these equations with respect to I, ω_M and ω_E, setting $d\omega_M = -d\omega_E$, and using Cramer's rule yields

$$\frac{dI}{d\omega_M} = \frac{0}{\Theta} = 0,$$

where the determinant, Θ, is positive by concavity and Lemma 1. Part (iii): The equilibrium is given by

$$\begin{aligned} \alpha Q\left(\omega_E + \bar{L}_E + B\right) + (1-\alpha) Q\left(\omega_E + \bar{L}_E\right) - (1+r)\bar{L}_E - \\ -\alpha(1+r)B - \phi\left(\omega_E + \bar{L}_E\right) = 0, \end{aligned} \tag{23}$$

$$Q'(I) - (1+r) = 0, \tag{24}$$

and

$$I - \omega_E - \bar{L}_E - B = 0. \tag{25}$$

Define $\Lambda = Q''\left(\omega_E + \bar{L}_E + B\right)\left[(1-\alpha)\left(Q'\left(\omega_E + \bar{L}_E\right) - (1+r)\right) - \phi\right]$. Differentiating these equations with respect to I, ω_M and ω_E, setting $d\omega_M = -d\omega_E$, and using Cramer's rule yields

$$\frac{dI}{d\omega_M} = \frac{0}{\Lambda} = 0,$$

where the determinant, Λ, is positive by concavity and Lemma 1. ■

Properties of Monitoring Cost k

Lemma 6 *When $\omega_E < \hat{\omega}_E(r,\phi)$ and $\omega_M < \hat{\omega}_M(\omega_E, r, \phi)$: Then the entrepreneur's credit limit, $\bar{L}_E$, is independent of the monitoring cost k; the moneylender's credit limit, $\bar{L}_M$, is decreasing in k, as is investment, I. When $\omega_E < \hat{\omega}_E(r,\phi)$, $\omega_M \geq \hat{\omega}_M(\omega_E, r, \phi)$, and $\omega_E + \omega_M < I^*(r)$; or if $\omega_E < \hat{\omega}_E(r,\phi)$, $\omega_M \geq \hat{\omega}_M(\omega_E, r, \phi)$, and $\omega_E + \omega_M < I^*(r)$ or $\omega_E + \omega_M \geq I^*(r)$: Then the entrepreneur's credit limit, $\bar{L}_E$, is decreasing in k; the moneylender's credit limit, $\bar{L}_M$, is increasing in k; and the investment, I, is independent of k.*

Proof. When $\omega_E < \hat{\omega}_E(r,\phi)$ and $\omega_M < \hat{\omega}_M(\omega_E, r, \phi)$, the relevant constraints are given by

$$\begin{aligned} \alpha Q\left(\omega_E + \bar{L}_E + \omega_M + \bar{L}_M\right) + (1-\alpha) Q\left(\omega_E + \bar{L}_E\right) - (1+r)\bar{L}_E - \alpha(1+r)\bar{L}_M - \\ -\alpha\phi\left(\omega_M + \bar{L}_M\right) - \alpha k - \phi\left(\omega_E + \bar{L}_E\right) = 0, \end{aligned} \tag{26}$$

$$Q\left(\omega_E + \bar{L}_E + \omega_M + \bar{L}_M\right) - Q\left(\omega_E + \bar{L}_E\right) - (1+r)\bar{L}_M - k - \phi\left(\omega_M + \bar{L}_M\right) = 0, \tag{27}$$

and

$$I - \omega_E - \bar{L}_E - \omega_M - \bar{L}_M = 0. \tag{28}$$

Differentiating equations (26)-(28) with respect to I, $\bar{L}_E$, $\bar{L}_M$, and k using Cramer's rule I obtain

$$\begin{aligned} \frac{dI}{dk} &= \frac{Q'\left(\omega_E + \bar{L}_E\right) - (1 + r + \phi)}{\Delta} < 0, \\ \frac{d\bar{L}_E}{dk} &= \frac{0}{\Delta} = 0, \end{aligned}$$

and

$$\frac{d\bar{L}_M}{dk} = \frac{Q'\left(\omega_E + \bar{L}_E\right) - (1 + r + \phi)}{\Delta} < 0,$$

where determinant, Δ, is positive by Lemma 1. The remaining comparative-static results when $\omega_E < \hat{\omega}_E(r, \phi)$, $\omega_M \geq \hat{\omega}_M(\omega_E, r, \phi)$, and $\omega_E + \omega_M < I^*(r)$; or if $\omega_E < \hat{\omega}_E(r, \phi)$, $\omega_M \geq \hat{\omega}_M(\omega_E, r, \phi)$, and $\omega_E + \omega_M < I^*(r)$ or $\omega_E + \omega_M \geq I^*(r)$ are derived in a similar manner to the equilibrium outcomes above and hence omitted. ■

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